



# ENHANCING KEY ELEMENTS OF THE VALUE CHAIN FOR PLANTATION GROWN WOOD IN LAO PDR

## Log grading

- Part 1a** A review of the literature for small log grading
- Part 1b** An assessment of current practices and plantation teak log quality in Lao PDR
- Part 2** A manual for the Lao PDR sawmilling sector

C. Fitzgerald and G. Hopewell, DAFF  
2014



**VALTIP2**

# Contents

<b>Contents</b>	<b>2</b>
<b>Glossary</b>	<b>4</b>
<b>Introduction</b>	<b>6</b>
<b>About grading</b>	<b>6</b>
<b>Part 1a: A review of the small log grading literature</b>	<b>8</b>
General	8
Teak ( <i>Tectona grandis</i> )	9
Hardwood log grading systems	10
USA	10
Australia	12
Burma	13
Sri Lanka	16
South East Asia Lumber Producers Association (SEALPA)	17
Indonesia	18
Malaysia	18
Philippines	18
<b>Bibliography and additional reading, Part 1a</b>	<b>18</b>
<b>Appendices to Part 1a</b>	<b>21</b>
<b>Appendix 1- Teak log and squares- Myanmar Grading Rules</b>	<b>21</b>
<b>Appendix 2- Timber grading in Sri Lanka 2013</b>	<b>21</b>
<b>Appendix 3- Hardwood log classification guidelines Qld 1994</b>	<b>21</b>
<b>Part 1b: Assessment of current practices and plantation teak log quality in Lao PDR</b>	<b>22</b>
Introduction	22
Dimensions	22
Surface quality	22
Log pricing	22
Storage	23
<b>Bibliography for Part 1b</b>	<b>24</b>
<b>Part 2: A log grading system for Lao PDR</b>	<b>25</b>
Introduction	25
Documentation	25
Pricing	26
Square billets	26
Minimum length	26
Section sizing	26
Billet mensuration	26
Round logs	26
Minimum length	26

Log mensuration	26
Log storage and handling	26
Log segregation	27
Grade descriptions	27
A grade	27
B grade	29
C grade	30

## Glossary

<b>ACIAR</b>	Australian Centre for International Agricultural Research
<b>Burma</b>	Myanmar is the alternative name for Burma adopted by the military junta in 1989.  This report follows ACIAR's use of the English name Burma, except where referring to Myanmar Government.
<b>Butted</b>	Removal, usually by chainsaw, of a disc off the end of the log to exclude or reduce defect/s
<b>Butt log</b>	The log removed from the lower section of the tree, above the stump.
<b>Checks</b>	The separation of wood fibres, often due to shrinkage.
<b>Clear cuttings</b>	The yield of defect-free wood from the log.
<b>Dote, doyo</b>	The early stage of decay.
<b>Grading</b>	Grading separates logs into quality groups, providing a way in which buyers and sellers can agree on value.
<b>Grading system</b>	A system that allows: <ul style="list-style-type: none"> <li>the sawmiller to consider the end product, enabling them to purchase only the required quality for intended purpose;</li> <li>the seller to offer their material at a fair and competitive price.</li> </ul>
<b>Lao PDR</b>	Lao Peoples Democratic Republic (preferred by ACIAR, instead of Laos or Lao).
<b>Quality</b>	The combination of characteristics of a tree and its parts that permits the best use of the wood for the intended purpose; the intrinsic wood quality is defined in terms of the suitability of the wood for various products or end uses.
<b>Rot</b>	Decay.
<b>Scaling</b>	A mathematical calculation or estimation of log volume.
<b>SEDUB</b>	Small end diameter under bark.
<b>Shake</b>	A crack or cracks along the rays or growth rings; they can be caused by wind action on the standing tree or by the impact of hitting the ground when felled.
<b>Splits</b>	A wider separation of fibres along the grain.

<b>Sweep, bend</b>	The curvature along the axis of the log.
<b>Top log</b>	The logs cut from above the butt log.
<b>USDA</b>	United States Department of Agriculture.
<b>Wane</b>	The absence of wood due to the natural, external shape of the log.
<b>Want</b>	The absence of wood due to mechanical damage.

## Introduction

This user manual has been prepared using research into appropriate criteria for grading and segregating logs for optimum value recovery and efficiency when processing plantation teak logs in Lao PDR.

The research was undertaken as Activity 2.2 (Improve or implement log grading/segregation activities at the mill prior to processing) of Objective 2 (to increase returns to processors and smallholders through improved efficiencies of the primary processing sector) in the ACIAR co-funded aid project FST/2010/012 *Enhancing key elements of the value chains for plantation-grown wood in Lao PDR*.

Part 1a summaries a comprehensive review of the literature pertaining to grading systems for small logs, with an emphasis on plantation teak. Part 1b discusses the field trials carried out within the network of sawmilling companies involved in the project, which assessed current grading systems and typical log quality. The objective of these activities was to develop an appropriate log grading system using a combination of simple visual assessment and external log measurements, such as diameter, log length, taper, eccentricity, branch insertion, decay and discoloration. This grading system is discussed in Part 2. This will be used to develop operational practices for matching logs with particular a quality to products, while meeting demand expectations and taking the current sawmilling infrastructure into account. Part 2 is also available in Lao language.

## About grading

The purpose of grading logs is to provide a fair price for logs, establishing a clear understanding of what the buyer is paying for. It also enables resources to be used efficiently, by matching wood quality to end product requirements. A short, knotty, curved log with a high degree of taper and prominent end-splits won't provide boards suitable for high-value furniture and is theoretically of less value to a processor than a straight, cylindrical, pruned log with minimal end-splitting. Quality depends on the end-use requirements, where quality is defined by the end user. Quality should not be confused with quantity as it is not necessarily the largest tree that attains the highest value.

Factors affecting quality are attributed mostly to genetics, silviculture, growing conditions and tree health, including growth rate (slow and uniform generally equals more desirable quality), bole form, knots and limb-related defects (size and location), decay and insect damage.

Three main criteria are used to assign a value to a particular hardwood log viz. species, scale and grade. Some species are more prized than others due to their rarity, ultimate suitability for a particular end use, or reputation in the market. Scale is a measure of the amount of timber that can be recovered from a log in sawlogs, veneer or other timber commodities e.g. posts or poles. For a log to yield the maximum amount of timber it should be long and straight, have a round cross-section, a larger diameter and constitute mainly clear wood i.e. clear of certain, pre-determined defects that will ultimately reduce the grade of the log. Due to economies of scale, a large log is preferred over a small one because it will cost less to produce a unit of timber. Of course, a number of factors may affect this, not the least being the capacity of the available sawing and processing equipment.

In regions where there is a high volume of processing and manufacturing, there are many product options that cater for a wide range of log grades. In Queensland, foresters aim to

make the best use of the state's forest resources allocating timber efficiently and finding uses for all parts of the log while minimising waste. To accomplish this, they developed classification and grading systems that accurately measure characteristics of tree or log quality, and these have been refined over the past 100 years. For example, in well-managed plantations at the time of clear felling, the prime softwood trees are allocated to veneer processors, most thinnings and non-veneer logs go to sawmills for structural products such as house frames and roof trusses, and low quality 'top' logs and other trees not capable of making a sawlog (for example, too bendy) are diverted to particleboard and medium-density fibreboard manufacturers. The prime product from a well-managed hardwood forest is a bridge girder, then power poles, followed by sawlogs, fencing, landscaping timbers and pallets. The price paid to the grower by the processor therefore determines the perceived value of the potential end product. This alignment of price to product allows for profitable enterprises along the value chain, including low cost wood products.

Our experience in Lao PDR indicates that, currently, there are limited market options for growers due to the limited array of manufacturing options in country, that is, there are no veneering operations or panel manufacturers. The sawmills participating in the ACIAR project are primarily concerned with furniture, doors and windows, decking and flooring all of which are relatively high-value products.

## Part 1a: A review of the small log grading literature

### General

Grading a log entails an evaluation (often visual) of the quality of the log and hence (in part) of the timber that can be sawn from that log. Log grading, carried out with the assistance of log grading rules, is based on a visual assessment of specific log features that are set out for each grade classification (Petutschnigg and Katz 2005). Ideally, the grading rules should be simple to understand so they can be applied quickly and accurately.

Different grades may encompass sawlogs destined for the framing or furniture market, veneer for the plywood market or low grade timber for fence palings or pallets. Often the grade of the log will pre-determine the end-use for the timber that can be cut from it. This means that log grading achieves two important outcomes: it sets the limits of acceptability of the harvested material for a potential end-use; and within each particular end-use type it separates out different qualities of logs (James, 2001). The log grade assists buyers and sellers to settle on a fair price for a particular log by assigning a value to the log, based on a set of grading rules (Taylor, no date). The species of tree can also have a significant impact on the value of a log. Some species are more highly regarded for a particular end-use e.g. for premium furniture manufacture, boat building, musical instrument manufacture or bridge construction. Generally, a graded log will fetch a higher price than a similar ungraded log of the same species because the grading process has given the log a definable “value”. One advantage of a graded, high-quality log is that it can be used for lower value purposes (if this is necessary) but the reverse does not apply. Grading rules can be specific for a particular species e.g. teak (*Tectona grandis*) or for particular assemblages of trees e.g. softwoods or hardwoods (James, 2001).

Central to log grading are the dimensions of the log (scaling, diameter and length) and form of the log (the degree to which the log deviates from a true cylinder). Another critical factor in grading is identifying which defects (abnormalities) are present in a log. These defects are then quantified in conjunction with log dimensions and form so a grade can be assigned to the log. A defect is defined as any feature of a log that would prevent sawn timber of the lowest merchantable grade being recovered from it (James, 2001). Defects can include, but are not limited to knots, rot, holes, insect damage, ring shake and heart checks. Grading rules will nominate what level of defects, if any, is permissible within any particular grade. Defects are often considered as a cumulative figure and may incorporate a combination of size, number, position and severity of the defect.

A user-friendly set of grading rules will give a clear description of each defect type so even staff with limited experience are able to undertake log grading with a degree of confidence. A clear explanation of each defect will help mitigate disagreement between buyers and sellers as to what does or does not constitute a defect. Images of surface defects will help with identification. Some defects may be characteristic of a particular species and a defect present in one species may be absent from another. For example, kino veins (*Corymbia* spp.) or resin pockets (some *Pinus* spp.) and included bark (*Koompassia* spp.).

The difficulty with visual grading based on external features and form is that internal defects can only be identified, and therefore estimated, by the correlated surface defect indicators (Noble et al., 2000). Grade defects should not be confused with scaling defects. Scaling defects are those defects that reduce the volume of sound wood that can be obtained from a log; grading defects are those that take away from the appearance or limit the usefulness of the wood obtained from the log for the intended purpose (Wengert and Meyer, 1994).

Merchandising ('bucking' in north America) is the act of cross-cutting to minimise sweep and limit the effect of the location of a defect (or combination of defects). Merchandising is often necessary to increase the recovered value and to use wood resources efficiently. Each cross-cut creates a log of fixed scale and grade, which then determines the value of the log within a given market (Noble et al., 2000).

Many countries, or provincial regions within countries, have standard grading rules for logs and timber. These are often used as a basis for pricing where the forest resources are state-owned. The United States of America (USA) uses the University of Tennessee Hardwood Log Grading Handbook, Taylor, no date). Canada uses the Quebec Log Grading Rules (Myanmar timber, no date). In Australia log grading guidelines tend to be state-based and therefore implemented by the relevant Government forestry entities. In Malaysia logs are often graded according to local mill practices using the Sabah Log Grading Rules (Tze, 1999).

## **Teak (*Tectona grandis*)**

Teak timber is a prime high-value furniture wood grown in plantations around the world (Ladrach, 2009). Teak has long been valued for its durability, stability and workability (Sein Maung Wint, no date). Straight grained, richly coloured wood, clear of knots are also desirable qualities of teak logs. Teak is indigenous to only four countries i.e. India, Lao PDR, Myanmar and Thailand. But there are now limits being placed on the harvest of logs from native forests in these countries. The result is that teak plantations are now increasing and becoming more important as the global demand for teak remains high. Additionally, the governments of India, Thailand and Myanmar no longer allow the export of raw teak logs from their native forests, to help alleviate a marked decline in the native teak forest estate (Ibid). The increasing gap between supply and demand for teak means that even smallholder teak plantations can become an important source of logs for the overall teak market and they have the potential to generate valuable income for local families (Selvarajah, 2013). In Lao PDR, teak occurs naturally only in the north-west region of the country as a continuation of the teak forests in Burma and Thailand. The area of natural teak forest has gradually reduced over the years from 30,000 ha to around 16,000 ha in 1993 (U Sein Maung Wint, no date). To counter the on-going reduction in natural stands of teak in Lao PDR, plantations were established in 1942 and continue to expand, with many small holdings spread throughout the republic.

One of the major challenges for plantation teak growers is to produce quality teak that meets international market standard requirements for grade quality (Ladrach, 2009). Teak is now being harvested in short rotations (less than 20 years), resulting in a significant increase in the supply of small dimension logs of poor quality (Kollert and Cherubini, 2010). Previously, teak from native forests may have been managed in rotations from 80 to 100 years (Ladrach, 2009). One of the drawbacks with small plantation trees is that they have a high proportion of sapwood relative to a tree from a native forest. But market preference has traditionally been for the distinctive golden brown heartwood, which becomes darker over time. The rich brown colour is a very desirable feature in teak timber, especially for furniture use. This is in contrast to the creamy ivory colour of the sapwood. Grading rules for plantation teak logs will have to account for this higher proportion of sapwood for some appearance applications.

While smallholder teak plantation owners might not be selling their logs globally, they would still benefit from a standardised grading system for small diameter plantation teak logs and

timber. This would go a long way to assigning true value to their teak resource. Without access to a set of standard grading rules for small plantation teak, the sale price of a log can really only be determined by the size and volume. Often logs will be sold below their true value (Ladrach, 2009).

## Hardwood log grading systems

### USA

The USDA (United States Department of Agriculture) Forest Service utilises a hardwood log grading system based, in part, on the yield of 'clear cuttings' from the faces of the log (Rast et al, 1973). Although not a universal system, it has been widely adopted throughout the United States. Clear cuttings refer to the yield of defect free wood from the log. A similar method used by some graders is the 'clear face' system, where the number of defect-free faces on the log determines the grade (University of Tennessee, no date).

Defects are expressed as any feature that limits the quality or quantity of timber that can be sawn from the log. In addition, there are 'grade defects' that lessen the value of the timber sawn from the log. Common grade defects may include, but are not limited to, stem bulges, splits, rot, insect galleries or bird nesting holes. Abnormalities on the surface of the log must spread into the log by more than 15 % of the diameter to be assessed as a defect. Knots and bark distortions, where the tree has grown over old branch wounds, tend to be the most common defects and also the most significant in determining log grade. Knots are a major issue because they can extend right into the centre of the log. They appear on the sawn timber cut from the log which generally degrades the timber, depending on end product requirements.

Some defects will also be visible on the ends of the cut logs. With the USDA system any abnormality in the heart centre i.e. the innermost 1/5 of the diameter, is disregarded for grading purposes. End defects are classified into three categories:

- *unsound end defects* – include defects such as knots, decay and shake. Where the defect extends more than one half the distance from the heart centre to the bark it is considered that a clear cutting cannot be taken over it. The distance the defect extends along the log is estimated. A clear cutting can extend over one third of the estimated length of the defect.
- *sound end defects* – include defects such as blue stain and slight dot which is the beginning of rot. Sound end defects are restricted to Grade 1 (no more than ½ of either end) and Grade 2 logs (no more than 3/5 of either end).
- *specific end defects* – include defects such as bird peck, insect holes, spots and streaks which may be specific to a particular species or location. If these defects extend for more than ½ the distance from the heart centre to the bark under three or more faces at one end, or two faces at both ends, then Grades 1 and 2 are lowered one grade.

Scaling defects limit the amount or volume of useable timber that can be cut from a log. Extensive rot and large holes may result in no useable timber being sawn from the log. Scaling deductions can be made to account for these defects when scaling the log but these defects are also considered in log grading.

The USDA Forest Service log grading system segregates sawlogs into one of three grades.

- Grade 1 or F1 – highest grade and best quality
- Grade 2 or F2 – next best grade, medium quality
- Grade 3 or F3 – lowest grade

The grades separate logs of the same size by around 20% in value (Wengert and Meyer, 1994). The value separation gives the buyer reasonable confidence in paying a fair price for a log at a particular grade level. The system also calculates the yield of common and better grades of timber that can be sourced from the log. Once a USDA Forest Service log grade has been assigned, the volume yield and value can be quickly and accurately estimated. Each predictive log grade is initially based on whether the log is a butt or top log, and will give the log length and diameter and the number and location of defects in the log.

A butt log comes from the base of the tree and is favoured as a high grade timber source because of its larger diameter and the fact it usually contains more clear wood than other parts of the tree stem. Top logs are also acceptable for all three grades except for smaller Grade 1 logs (30 to 38 cm in diameter), which can be only be achieved by butt logs.

With the USDA Forest Service system, the log diameter for grading purposes is the diameter under bark at the small end (SEDUB). As very few logs are truly round, a number of measurements must be taken and the average calculated. The grading rules specify minimum acceptable diameters per grade because as the diameter increases there is a tendency to have a higher percentage of defect free wood – a desirable trait in high grade logs. The length of the log is measured, excluding the allowance for trim (100 mm to 200 mm for cross-cutting or squaring the end).

Clear cuttings represent the cornerstone of the USDA Forest Service log grading rules. The clear cuttings are determined on the grade face and the grade face is determined by dividing the surface of the log into four equal quadrants called faces. The face that contains the most number of defects is termed the 'worst' face. The next best face is termed the grade face. The remaining two faces should be equal to or superior to the grade face. The minimum length of a clear cutting is specified in the grading rules. By rule the cuttings must occupy the full width of the log face.

Grading a log using the USDA system involves four sequential steps:

- measure the diameter and length of the log and record whether it is a butt or top;
- determine the grade face – ignore the 'worst' face and grade the next worst or third best face;
- determine the size, number and yield of clear cuttings on the grade face;
- check that sweep and scale deductions are within allowable limits

These rules are independent of tree species, so any North American hardwood log can be graded using this system. As with most log grading systems the real advantage is being able to reliably predict how much high-grade timber can be produced from a log. USDA Forest Service developed the system after measuring and assessing more than 20,000 logs. Based on this sample they confidently predict the following timber yields are possible:

- Grade 1 (F1) logs – produce 60% plus of 1 common or better timber
- Grade 2 (F2) logs – produce 40-60% of 1 common or better timber
- Grade 3 (F3) logs – produce < 40% of 1 common or better timber

Some graders have a preference for clear face grading rules because they are perceived to be easier to apply – there is no requirement to calculate clear cutting yield. Clear face rule systems usually allow for more than three grades and hence more pricing levels for logs of different quality.

## Australia

The majority of natural hardwoods harvested in Australian forests (since access to the Wet Tropics rainforests was reduced in 1988) are representatives of the Myrtaceae family, particularly species of *Eucalyptus* and *Corymbia*. In New South Wales (NSW) and Queensland, the prime purpose of log grading is to segregate logs into 'fit for use' categories (James, 2001).

Typically in a high quality, well managed forest, a girder sale is the first exercise, selecting the prime trees for bridge timbers to achieve the highest value from the forest. Secondly a pole sale will be undertaken if the stand has a reasonable quantity of trees that will produce the minimum requirements for a power pole. Then trees are selected for sawlogs that would produce structural beams, bearers and joists and flooring, decking and furniture timber. In NSW these logs are termed 'quota logs' and in Queensland they are known as 'compulsory logs'. However, below-standard logs may also be purchased at a reduced rate and these are labelled 'salvage logs' (NSW), 'optional' (Queensland), 'Grade D logs' (Victoria), 'third grade' (Western Australia) and 'Category 8 logs' (Tasmania). Where a timber cutter is unable to produce a saleable log from a felled tree due to internal defects, it is labelled a 'dud' and left in the forest, although the timber cutter is still paid for his work. Within each product category there are grading rules that define the minimum requirements for the product (girder, pole, sawlog).

In 2004, in Victoria, changes were made to account for an E-grade log that would normally be part of the residual log resource, but for which a profitable sawmilling option was devised (Washusen and Waugh, 2004). Other changes to the existing log criteria included:

- 'mean end defect' rather than 'worst end defect' was chosen as an indicator of log quality; end defects include abnormalities such as pipe, decay and insect damage;
- 'mean minimum diameter' was reduced to 25 cm, with no small end restrictions;
- the definition of a 'clear quarter' was revised so that it needed to be truly defect free;
- logs that are > 40 cm mean diameter and have an end defect < 40% are now allowed to have four 'defective quarters'.

The minimum log length in Australia is 2.4 m, which is the standard height of the wall frame in a domestic dwelling (James, 2001).

A number of significant defects are common in many Australian hardwood logs:

- *sweep* – straightness is a desirable quality for a high-grade sawlog and the greater deviation from a straight line, the lower grade of log (it may be even unacceptable as a sawlog). In NSW, Victoria and Tasmania a deviation of up to 1/5 of the log diameter over a 2.4 m length is allowable. In Queensland (Appendix 4, pages 19-20) the thresholds for bends vary with diameter and log classification will drop from compulsory to optional if the bend is greater than:
  - 2.5° for logs 40 cm CDUB
  - 5° for logs 40-49 cm CDUB
  - 10° for logs >50 cm CDUB

- *pipe* – this is probably the most common and important defect found in logs from Australian native forests and is due mostly to internal rot or subterranean termite attack, resulting in the complete absence of wood from the centre of the log. Pipe can greatly reduce the quality and quantity of timber that can be sawn from the log. In Queensland, NSW, Victoria and Tasmania there are limits to the size of the pipe that will impact on a saleable log. These limits sit on a sliding scale i.e. the larger the log the larger the dimensions of the acceptable pipe. In the other states, the allowable size of the pipe also varies with the size of the log, but is based on the percentage of the log volume.
- *limbs and bumps* – large limbs such as a fork (or other major departure from the single stem in a tree) degrade the timber that comes from those logs, as limbs will transfer to large knots in sawn timber. If the limbs and associated swellings occupy more than 50% of the circumference of the log, the log is classed as optional. The specifications for limbs are prominent in NSW and Queensland, indicating that limbs have their greatest degrading effect in these two states. The specifications for limbs tend to be loosely specified in the other states (James, 2001).

Additional defects found in Australian hardwood logs include spiral grain, open ring shakes, loose or open gum veins, rot pockets and fire scars. These defects tend to be common in many hardwood log grading systems used worldwide.

Where there are many isolated defects and a substantial pipe to be considered, a ‘standout criterion’ may be applied to determine whether a log is acceptable or not for a particular end use. In Queensland, 50% of the remaining cross-sectional area must be defect free to be considered as a compulsory log (see Appendix 3 for Queensland Log Classification Guidelines). In NSW, the percentage tolerance varies with the diameter of the log, and in Victoria, the log is notionally divided into quarters similar to the clear cutting system used by the USDA Forest Service. While the systems vary, the ultimate aim is to quantify the accumulated effect of many small defects that occur close together.

Hardwood logs intended for peeled veneer production using traditional spindle-type lathes, require sound end surfaces so that the chucks on the lathe, which drive the peeling process, can grip the log. Some grades of logs intended for plywood can include knots but current veneer standards restrict the size and incidence of knots.

Girders and poles, which are both load bearing members, have very strictly defined specifications, and commonly, only a few species in each state are suitable. For girders, logs must be straight and with no pipe at the small end, and very little at the large end. No unsound knots are permitted and the number of sound knots is limited.

Poles have very tightly-defined specifications. Because poles are intended to support overhead loads, they must have high strength and good appearance. The poles must be 8.0 m or greater in length. Poles are graded in accordance with Australian Standard AS 2209-1994 Timber – Poles for overhead lines (Standards Australia, 1994).

## **Burma**

### ***Natural forest logs***

In Burma, which has traditionally been a major teak producer, there are a set of standard grading rules for teak logs sourced from native forests, but no rules specifically for plantation teak logs (Ladrach, 2009). Some plantation teak trees are now being harvested

as early as ten years after planting and there are currently no specific log grading rules to reflect the value and product potential of these small logs.

Log grading to value-add for teak began in Burma in the mid-1930s. This was a simple system based on the 'Logging Rules and Standard for Jungle Rejection of Teak Logs', with reference to a measuring system, a logging system and a system for rejecting low quality logs. The identification and calculation of certain prescribed defects meant the log could produce either obligatory or optional timber. There was no specific reference to grade (Myanmar Timber, no date).

In 1988 these rules were superseded by the 'Gallant Rules', a system developed by Mr M. Gallant, a forest economist from the Myanmar Forest Department. The classification encompasses five grades from high to low viz:

- Five star (5\*), also known as AY
- Four star (4\*)
- Three star (3\*)
- Two star (2\*)
- One star (1\*)

The star classes are graded based on a 'defect value' per 1.4 m<sup>3</sup> of log. There are also specifications for minimum length and diameter of log in each class. The Gallant Rules at the time did not distinguish between sawlogs and veneer logs, as historically, all the logs being harvested from native forests were acceptable for veneer production. However, as logging continued, an increasing number of inferior logs began to appear. Defects, previously not considered of any significance, began to be scrutinised more closely as market conditions commanded only the highest quality logs for veneer production. Subsequently in 1998, a new set of rules was formulated by the Myanmar Timber Enterprise (Myanmar Timber, no date) and these became known as the 'Grading Rules for Teak Veneer Logs'. Both grading systems are still used in Burma today. The 'Grading Rules for Teak Veneer Logs' framed some new terms to correspond with the earlier star classes:

- 5\* - special quality veneer
- 4\* - first quality veneer
- 3\* - second quality veneer
- 2\* - third quality veneer
- 1\* - fourth quality veneer

Below these equivalent star grades are six sawlog grades (SG1 – SG6) and two grades for local use viz. ER-1 and ER-2 (Appendix 1).

Both the Gallant Rules and the Veneer Log Rules are based on the recognition and quantification of log defects (Myanmar Timber, no date). There are greater restrictions for defects in veneer logs than for sawlogs, indicating the higher quality required for traditional veneer production. Allowable defects are rated according to their location and the magnitude of the defect. The defects are labelled as either mild (M) or serious (S). With this system two mild defects are equal to one serious defect and each grade has a limit of three serious and six mild defects (Myanmar Timber, no date). For sawlogs, log scaling, which estimates the net volume of the log (gross volume less the deduction for defects), is taken into account. However this does not occur with the Veneer Log Rules. Originally the Gallant Rules required all logs to be butted clean at both ends and the same applied once the Myanmar Timber Enterprise (MTE) Veneer Log Rules were introduced. But in time,

fewer and fewer veneer quality logs were available for harvest in comparison with saw logs. Teak logs are now marketed 'un-buttet' and 'as is' from the forest. There are eight major defect classes associated with saw logs: bee hole, curvature, end hole, doyo (incipient decay), included bark, sun crack, twist and decayed knots. As well, there are five minor defect classes: flute, double heart, spongy heart, heart hole and split.

The increasing prominence in the log market of lower quality teak logs that were considered inferior to 1 Star Class (fourth quality veneer log) meant an addition to the Gallant Rules was needed to accommodate sawlogs. The Sawlog Grade Rules calculate the defect value as with the Gallant Rules but log scaling is not taken into account (Myanmar Timber, no date). While there is a concise list of defects outlined for both Gallant Rules and Veneer Log Rules there is no glossary describing the defects. A search of the literature has been unable to locate any specific descriptions of defects as they pertain to teak. Some defects e.g. splits, knots, twist and shake are common to other hardwood log grading rules but others such as bear bites, doyo, snout and pig eyes appear specific to teak.

One aspect that is particularly relevant to teak log grading in Burma is the value placed on the area where the teak was grown (Myanmar Timber, no date). U Thein Aung (2003) claimed that teak logs from light rainfall areas is suited to veneer production due to the regular growth rings, higher density, appealing colour, black stripe feature and absence of bee holes

### ***Natural forest squares (part-processed)***

Square cross section billets are commonly supplied in Burma and other countries in Asia including Lao PDR, as they are easier to handle than irregular, round logs for transport and storage. To grade teak squares specifically, the Myanmar Forest Department, in conjunction with the Forest Research Institute in Dehra Dun (India) compiled the Seaman-Limaye Grading Rules for teak squares (Myanmar Timber, no date. See Appendix 1). The Department revised the rules in a format acceptable to the FAO and they became known as 'Rules for the Grading of Teak Squares' (Ibid.).

The rules judge the general quality of the wood and the probable loss of wood based on visible defects under normal sawing conditions. The rules help define the average quality of a parcel and the lowest quality individual piece allowed in any grade. There is a defect value that each teak square can carry as well as a parcel average. Defects are similar to those found in round logs, so defect values are calculated in the same manner with each grade having a maximum permissible defect value.

### ***Plantation logs***

The review of literature did not find any standard grading rules for plantation teak logs.

Keogh 2008 suggested that the quality of plantation teak logs should be determined by considering:

- dimensions of the log – diameter at both ends and length;
- cylindrical tendency – how closely does the log approach a true cylinder;
- the presence/absence of fluting;
- wood quality – the proportion of heartwood, its colour and homogeneity, growth ring width;
- defects – as per traditional log grading systems.

Keogh also recommended that grading rules be simple and user-friendly so that small holders, with limited grading experience, can readily interpret the rules for their own small

plantation lots. He proposed eight diameter classes from 15 cm up to 50+ cm, three log length classes from 1.0 m up to > 5.0 m and four quality classes A, B, C and D in diminishing quality). Keogh also argued that an international log grading scheme for plantation teak should consider the proportion of heartwood available in each class, as the contrasting sapwood depreciates the high value appearance for which teak is renowned. The literature search did not find a final version of Keogh's rules, nor evidence that they are in use.

## **Sri Lanka**

In Sri Lanka there are two systems used for grading hardwood logs, including teak:

- the yield system – the sound clear volume of the log is used to determine quality i.e. % of sound volume as compared to the total log volume;
- the defect system – this system is based on 'units of defects' to give a quantitative indication of the approximate degrade of utilisable material associated with each defect.

The combination of both systems formed the basis for the STC (State Timber Corporation) Log Grading System (Ruwanpathirana, 2013). The STC log grading system proposed grades ranging from Grade 1 to Grade 4, with two intermediate grades of 1/11 and 11/111, giving a total of six log grades (Appendix 2). As is the case with most log grading systems, there is a range of identifiable defects and the maximum number of each (penalties) allowable for each grade. The penalties are accumulated depending on the incidence of each defect along the log.

Sri Lanka uses a grade reduction process as part of its log grading system to visualise and quantify the portions of the log that are not suitable for timber production. As an adjunct to grade reduction, the rules require the grader to determine the quality of the products that could be obtained from the log, adding complexity to the system. In particular this necessitates an assessment of the frequency, size and occurrence of knots and any visible spiral grain or twist in the log. Other defects taken into account include rot, char, want, wane, shake, checks, splits, forks and lightning scars. Teak logs are graded into six categories of decreasing quality:

- super prime sawlog (SPS)
- prime sawlog
- standard sawlog
- economy sawlog
- saw-able log
- short log

Each grade is quantified by a range of form defects in association with length and mid-girth diameter:

- roundness
- condition
- trim (quality of end cut)
- bend
- grain

and a range of surface defects:

- knot

- borer holes
- checks/splits
- shake
- other surface defects

For both Super Prime and Prime sawlogs the defect limits are three 'STDs', which equate to three of the following- standard knot, standard borer holes, standard split or standard bend. Defect limits do not apply to the remaining four grades. The utilisable yield for a Super Prime teak sawlog is listed as solid, and for a Prime sawlog it is listed as 75% sound and over. With the lowest grade (short log) the utilisable yield is listed as 40% sound and over.

The list of defects covered by the Sri Lankan log grading system, while similar to those used by the Myanmar Timber Enterprise, is not as extensive.

### **South East Asia Lumber Producers Association (SEALPA)**

The SEALPA member countries are Malaysia, Indonesia, Papua New Guinea and the Philippines. In 1980 the group developed standardised grading rules for hardwood logs other than teak (SEALPA, 1981). Rules are given as to how log volume, length and diameter are calculated, as well as definitions for standard defects (knots, splits, bend and borer holes) and the equivalent units given to the defects for grading purposes. This approach is comparable to the Sri Lankan log grading scheme. At the high value level, grading separates the logs into three peeler log grades:

- special peeler grade (SSP)
- prime peeler grade (SP1)
- prime peeler grade (SP2)

A series of allowable dimension measurements and units for defects are set out for each grade of peeler log. For the special peeler grade, the diameter must be 60 cm or larger and at least 8 m long. For the remaining two peeler classes, the diameter must be 50 cm or greater and the length reduces to a minimum of 2.5 m.

Additionally, there are five sawlog grades and a wood chip class:

- prime sawlog grade (SS.1)
- standard sawlog grade (SS.2)
- low sawlog grade (SS.3)
- saw-able low grade (SS.4)
- short logs (SS.5)
- wood chip (SC)

The special and prime grade peeler logs are graded only on the value of the visible defects, whereas the remaining sawlog grades are graded on the value of the visible defects given as a percentage of the recoverable sound volume of timber (Oldeman et al. 1982).

Permissible dimension measurements and units of defect are set out for each sawlog grade. The grades are segregated sequentially by dimensions and the inability to meet the specifications of the grade immediately above it.

The lowest defined log grade is wood chip (SC) and this grade will select a log not covered by any of the grades above it. There are 15 defect classes listed with detailed descriptions

of each of the defects (SEALPA, 1981). As with the Sri Lankan STC log grading rules, defects are defined as either form defects and surface defects.

### **Indonesia**

The SEALPA rules are not specific to teak logs, so in Indonesia a separate set of rules were developed ('Indonesian Standard Grading Rules for Teak Logs') to provide criteria specifically for teak (Oldeman, 1982). Grading is based on estimated 'sound volume yield' of timber that will result from converting the log. The grading is governed by the form of the log, the abundance, the location and the relationship between the defects and the size of the logs.

The logs are segregated into three groups – poles, small round logs and large round logs. All are governed by the diameter at the small end. Poles are divided into four quality classes, small logs into six and large logs into nine classes.

### **Malaysia**

The 'Sabah Log Grading Rules' (Oldeman, 1982) were formulated in 1965 and define five grades of logs based on the value of visible defects in relation to the percentages of the sound volume of logs. As in other systems used in the region, logs are graded according to their dimensions, form, array of defects present and the limitations posed by these defects, expressed as units (the unit system for evaluating standard defects). These rules also pertain to Sarawak.

### **Philippines**

The 'Grading Rules for Philippine Logs' were formulated in 1964 and encompass four grades of veneer logs and three grades of sawlogs. Grading is based solely on the percentage yield of sound volume. The highest grade of veneer log will subsequently produce the highest percentage of sound volume of timber when compared to any of the other grades (Oldeman, 1982).

## **Bibliography and additional reading, Part 1a**

Cassens D.L and Fischer B.C. 1978. Hardwood log grades and lumber grades: is there a relationship? FNR 84. Purdue University, Department of Forestry and Natural Resources, 4 pp.

Hanks L.F. 1976. Hardwood tree grades for factory lumber. Res. Pap. NE-333. U.S. Department of Agriculture, Forest Service, North-eastern Forest Experiment Station, Broomall, PA, 81pp.

Hanks L.F.; Gammon G.L.; Brisbin R.L. and Rast, E.D. 1980. Hardwood log grades and lumber grade yields for factory lumber logs. Res. Pap. NE-468. U.S. Department of Agriculture, Forest Service, North-eastern Forest Experiment Station, Broomall, PA, 92 pp.

James R.N. 2001. Defining the product- log grades used in Australia. Rural Industries Research and Development Corporation Publication No.01/161, 30 pp.

Keogh R. 2008. International pricing mechanism for plantation teak: a proposal to bring transparency to log markets. International Tropical Timber Organisation (ITTO) Tropical Forest Update 18/2. 24–26.

Kollert W. and Cherubini L. (2012). Teak resources and market assessment 2010. Teaknet Bulletin 5(2), 1–4.

Ladrach W. 2009. Management of teak plantations for solid wood products. International Society of Tropical Foresters (ISTF) News. Reprinted from Proceedings of the Society of American Foresters National Convention, Orlando FL.

Myanmar Timber. no date. Teak log grading, veneer sawing, area-wise characteristics of Myanmar teak log < <http://myanmartimber.com/teaklog-grading.shtml>>, accessed 25<sup>th</sup> March 2014.

National Hardwood Lumber Association. 1982. Rules for the measurement and inspection of hardwood and cypress lumber. National Hardwood Association. Memphis, TN. 115 pp.

Northern Hardwood and Pine Manufacturers Association. 1976. Official grading rules for northern hardwood and softwood logs and tie cuts. Green Bay, WI, 17 pp.

Oldeman R.A.A. (ed). 1982. Tropical hardwood utilisation: practice and prospects. Martinus Nijhoff-Dr W Junk Publishers: The Hague.

Petutschnigg A. and Katz H. 2005. A loglinear model approach for evaluating and adopting log and lumber grading strategies. Forest Products Journal 55(7–8), 67–71.

Prestemon D.R. Dickinson. F.E. and Dost W.A. 1965. Chinkapin log grades and lumber yield. Forest Products Report No. 42, University of California School of Forestry, Forest Products Laboratory, 5pp.

Rast E.D. and Beaton J.A. 1985. Photographic guide to selected external defect indicators and associated internal defects in black cherry. Res. Pap. NE-560. U.S. Department of Agriculture, Forest Service, North-eastern Forest Experiment Station, Broomall, PA.

Rast E.D. 1982. Photographic guide of selected external defect indicators and associated internal defects in northern red oak. Res. Pap. NE-511. U.S. Department of Agriculture, Forest Service, North-eastern Forest Experiment Station, Broomall, PA, 20 pp.

Rast E.D., Sonderman D.L. and Gammon G.L. 1973. A guide to hardwood log grading. Gen. Tech. Rep. NE-1. U.S. Department of Agriculture, Forest Service, North-eastern Forest Experiment Station, Broomall, PA, 32 pp.

Rast E.D., Sonderman D.L. and Hilt D.E. 1987. Recognizing hardwood quality: Key to increased profits? Pp. 273–278 in Proceedings of the Symposium 'Multiple-Use Management of California's Hardwood Resources', San Luis Obispo, CA, November 12–14, 1986.

Rast E.D. 1975. Preliminary hardwood log veneer. Grades for yellow birch and sugar maple face veneer. Pp 84–89 in: Proceedings 3rd Annual Hardwood Symposium of the Hardwood Research Council, Cashiers, NC.

Ruwanpathirana N. 2013. Timber grading in Sri Lanka. Lecture delivered at the Capacity Building Workshop on Modern Technologies for Wood Based Industries, Department of Forestry and Environmental Science, University of Sri Jayewardenepura, Sri Lanka, September 2013. <<http://dl.sjp.ac.lk/dspace/handle/123456789/1338>> 25<sup>th</sup> March 2014

SEALPA (South East Asia Lumber Producers' Association). 1981. Log Grading Rules. 13<sup>th</sup> Meeting of the SEALPA Council, Port Moresby.

Selvarajah R. 2013. Boosting productivity and income from smallholding teak systems in Indonesia. *Agroforestry World*, 2013.

<<http://blog.worldagroforestry.org/index.php/2013/11/11/boosting-productivity-and-income-from-smallholding-tek-systems-in-indonesia>>, accessed 25th March 2014.

Shigo A.L. 1983. Tree defects: a photo guide. Gen. Tech. Rep. NE-82. U.S. Department of Agriculture, Forest Service, North-eastern Forest Experiment Station, Broomall, PA, 167 pp.

Sonderman D.L. 1979. Guide to the measurement of tree characteristics important to the quality classification system for young hardwood trees. Gen. Tech. Rep. NE-54. U.S. Department of Agriculture, Forest Service, North-eastern Forest Experiment Station, Broomall, PA.

Sonderman D.L. 1984a. Quality response of even-aged 80-year-old white oak trees after thinning. Res. Pap. NE-543. U.S. Department of Agriculture, Forest Service, North-eastern Forest Experiment Station, Broomall, PA, 6 pp.

Sonderman D.L. 1984b. Quality response of 29-year-old even-aged central hardwoods after thinning. Res. Pap. NE-546. U.S. Department of Agriculture, Forest Service, North-eastern Forest Experiment Station, Broomall, PA.

Sonderman D.L. and Brisbin, R.L. 1978. A quality classification system for young hardwood trees — the first step in predicting future products. Res. Pap. NE-419. U.S. Department of Agriculture, Forest Service, North-eastern Forest Experiment Station, Broomall, PA, 7 pp.

Standards Australia. 1994. Australian Standard AS 2209 Timber – Poles for overhead lines. Distributed by SAI Global. 22 pp.

Taylor A. (no date). A hardwood log grading handbook. The University of Tennessee Institute of Agriculture, 1–25.

Tze W.T.Y. 1999. Recovery and quality of lumber from mature teak (*Tectona grandis*) planted in Sabah Malaysia. *Journal of Tropical Forest Products* 5(2), 115–123.

U Sein Maung Wint. no date. Trade and marketing of teak wood and products <<http://www.fao.org/docrep/005/ac773e/ac773e09.htm>> accessed 23<sup>rd</sup> June 2014.

U Thein Aung. 2003. Variations in quality of Myanmar teak logs. TEAKNET Newsletter, Issue 28, 1–4.

USDA (United States Department of Agriculture). 2008. The role of quality in hardwood products and processing. NA-TP-01-08CD North-eastern Area State and Private Forestry. Newtown Square, PA.

USDA (U.S. Department of Agriculture, Forest Service). 1975. How profits are left in the woods. Information Leaflet, U.S. Department of Agriculture, Forest Service, Southeast Forest Experiment Station Atlanta, GA, 5 pp.

USDA (United States Department of Agriculture). 1973. Forest Service Hardwood Log Grading Handbook. Technical Report NE-1.

Washusen R. and Waugh G. 2004. Modification of log grading and log segregation strategies for low-quality logs from the East Gippsland FMA of Victoria. *Australian Forestry* 67(3), 204–211.

Wengert E. and Meyer D. 1994. Guidelines for grading hardwood logs. Forestry Facts No. 74. Department of Forest Ecology and Management, School of Natural Resources, University of Wisconsin.

Yaussy D.A. and Sonderman D.L. Multivariate regression model for partitioning tree volume of white oak into round-product classes. Res. Pap. NE-317. U.S. Department of Agriculture, Forest Service, North-eastern Forest Experiment Station, Broomall, PA.

Yaussy D.A. and Brisbin R.L. 1983. Multivariate regression model for predicting lumber grade volumes of northern red oak sawlogs. Res. Pap. NE-536. U.S. Department of Agriculture, Forest Service, North-eastern Forest Experiment Station, Broomall, PA, 11 pp.

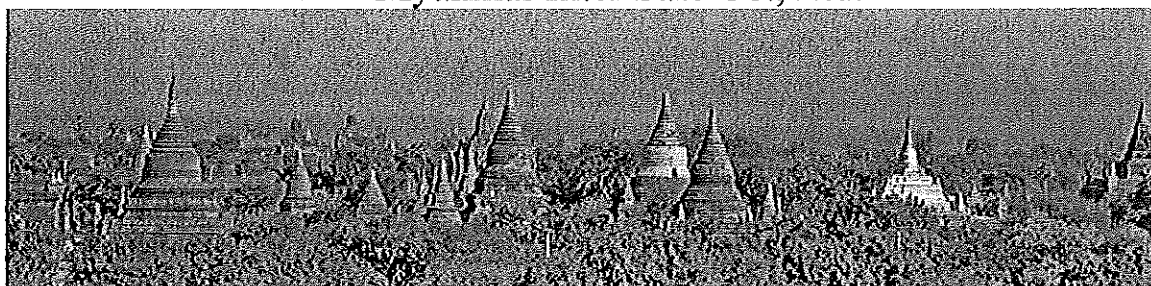
## Appendices to Part 1a

Appendix 1- Teak log and squares- Myanmar Grading Rules

Appendix 2- Timber grading in Sri Lanka 2013

Appendix 3- Hardwood log classification guidelines Qld 1994

## Appendix 1


 Myanmar Inter Safe Co., Ltd.

[Home](#) | [Our services](#) | [Forest management](#) | [Measurement](#) | [Other species](#)

Search this website

| [Teak Log Grading](#) |**Teak Log**

- Grading
- Area of origin
- Characteristics
- Teak Sawn Timber**
- Types
- MTE Grading
- FEQ

**Gallery of Logs**

- First Quality
- Second Quality
- Third Quality
- Fourth Quality
- Sawing Grade 1
- Sawing Grade 2
- Sawing Grade 3
- Sawing Grade 4
- Sawing Grade 5
- Sawing Grade 6
- Sawing Grade 7
- Sawing Grade 8

[Links](#)  
[Privacy policy](#)
**Teak Log Grading****Introduction**

Grading is a value adding process as "adding value" is an action that adds worth to something through a specific process. Properly graded timber gives a value of worthiness and satisfaction to the buyer and graded timber of any species enjoys higher prices than ungraded timber. In the early days not many items of timber were traded and grading was mainly by rule of thumb.

Most countries and regions have their own sets of grading rules with different rules for different species; for softwoods and hardwoods. For example, the National hardwood Lumber Association (NHLA) Rules from the United States, the British Columbia Lumber Grading and Quebec Grading Rules from Canada, the Finish Grading Rules and the Malayan Grading Rules (MGR) are some of the well-known rules, to name a few. As a major teak producer, Myanmar has its own sets of grading rules for teak and grading of teak logs and lumber in Myanmar is done according to these rules. Until now there appears to be no collaboration regarding grading among the teak producers in the Region. Teak, whether in the rough or processed is still a natural product, and growth conditions are mainly influenced by soil and climate. Until a wonder technique has been perfected to produce finer specimens of trees, grading rules will remain the arbiter of what a piece of timber is worth.

**Jungle Rejection Rules**

The origin of the first modern grading rules for teak logs in Myanmar can be traced back to 1936. The Forest Department established the "Logging Rules and Standard for Jungle Rejection of Teak Logs" and the rules mention the measuring system. Logging system and system of rejection in the jungle. In short, the rules specify the calculation of defects for obligatory and optional timber. Mention of Grades is not noted in these rules.

**Gallant Rules**

The "Standard for Jungle Rejection" was followed in April 1998 by "Classification of Teak Logs", popularly known as "Gallant Rules", as they were prepared by Mr. M.M. Gallant, Forest Economist of the Forest Department. This classification covers five grades; viz., five star (or AY), four star, three star, two star and one star. Like the standard for Jungle Rejection, and the Gallant Rules deduct five cubic feet per defect for scaling purposes. Star classes are graded according to the defect value and the limits determining the star class of a log are given in Table 1.

**Table 1: - Star Classes and defect values**

Star Class	Min. Length (Ft)	Min. Girth (Ft)	Min. Volume (Cu.Ft)	Defect
AY (5*)	15	6	-	0.5/50 Cu.Ft
4*	15	5	30	1.0/50 Cu.Ft
3*	12	5	30	2.0/50 Cu.Ft
2*	10	4	20	3.0/50 Cu.Ft

1*	10	4	20	5.0/50 Cu.Ft
----	----	---	----	-----------------

**Note** - Logs are graded by calculating the defects per 50 Cubic Feet.

#### Grading Rules for Teak Veneer Logs

The late 1950s saw the rise of the teak veneer market started much earlier. The quality of the logs harvested then was very good and therefore logs graded under the Gallant Rules were also acceptable as veneer logs, mainly because of the superior quality of the logs. Logs inferior in quality to those harvested earlier, increased in quantity as time passed. Market conditions also pinpointed defects previously not recognized. Aesthetic value is now being considered in addition to other quality defects. A new set of rules prepared by the Myanmar Timber Enterprise (MTE) came into being are called the "Grading Rules for Teak Veneer Logs", and are currently applied. Defects considered in the Gallant Rules and the Veneer Log Rules are shown below as comparisons:

#### Gallant Rules

Bear Bites; Bee Hole; Bend; Bird Holes; Buttress( no defcets); Doyo; Drag Hole; Ellipse; Flute; Holes (End); Knots; Shakes; Shatter; Snout(no defects); Sun Cracks, Inbark; Twist.

#### Veneer Log Rules

Bee Hole; Bump; Curvature; Elephant Skin; End Flute marks; Flutes; Green Band; Heart(Diagonal, Double, Spongy, Hole, End); Inbark; Knots(sound, Pin); Pig Eyes; Pitch Pockets; Shape(Elliptical, Triangular); Shake(Ring, Cup); Splits; Sun Cracks; Twist; Wavy Grain; Interlocked grain; Black Spots; sapwood pockets and Syphilis)

Permissible defects are scheduled according to the location and magnitude. These defects are then classified as either mild or serious. One serious defects (S) equals to mild(M) defects, and each grade limits 3(S) or 6(M). In the Veneer Log Rules, log scaling, i.e. estimating the net contents of a log, which equals the gross or full contents less deduction for defects, is not taken into account. This is one difference from the preceding rules but like its predecessors, each log has to be graded separately.

One of the disadvantages in the log trade is that one has to sell only what was extracted. Up to the mid-seventies, a larger percentage of First, Second and Third quality logs were available for export. What was not exported in log form was used in the local mills. The 1980s witnessed an entirely different scenario when fewer veneer logs were obtained and more sawing-quality logs become available.

The need for introducing rules for sawing quality teak logs that do not fit in the previous rules engendered a new set of rules for sawing quality logs that are inferior to the 1 Star Class. Gallant Rules require that logs are to be butted clean at both end. The same applies to veneer logs. But, the sawing quality logs sold today are unbutted and offered for sale as they come out of the forest. A comparison of dimensions is shown in Table (2).

**Table 2:** - Comparison Between Gallant Rules and Veneer Log Rule

Gallant Rules	Min Dimension Length x Girth	Veneer Log Rule	Min Dimension
AY	L15' x G6'	Special	L15' x G6'
4*	L15' x G5' - min.30Cft	First	L8' x G4'-2"
3*	L12' x G5' - min.30Cft	Second	L8' x G4'-2"
2*	L10' x G4' - min.20Cft	Third	L8' x G4'-2"
1*	L10' x G4' - min.20Cft	Fourth	L8' x G4'
-	-	Sawing Grade - 1	L8' x G5'
-	-	Sawing Grade - 2	L8' x G5'
-	-	Sawing Grade - 3	L8' x G3' to 4'-11"

-	-	Sawing Grade - 4	L8' x G4'
---	---	---------------------	-----------

Note - In veneer logs there is no minimum volume(vol) or cubic content specified provided that the length(L) and Girth(G) are met.

Relationship between Veneer Log Grading Rules and Defects

Sr.No.	Class	Special	First	Second	Third	Fourth	
1	2	3	4	5	6	7	8
	LENGTH		15"/24"	8'/24"	8'/24"	8'/24"	8' & UP
	GIRTH		6'-0" 7'-0" 4'-2" 5'-0" 6'-0" 7'-0"	4'-2" 5'-0" 6'-0" 7'-0"	4'-2" 5'-0" 6'-0" 7'-0"	4'-2" 5'-0" 6'-0" 7'-0"	4'-2" 5'-0" 6'-0" 7'-0"
			6'-11" & up	4'-11" 5'-11" 6'-11" & up	4'-11" 5'-11" 6'-11" & up	4'-11" 5'-11" 6'-11" & up	4'-11" 5'-11" 6'-11" & up
1	BEE HOLE	S	..	..	..	..	1 1
2	BUMP	M	..	..	..	3" 3" 4" 4"	2" 4" 6" 8"
3	CURVATURE	S	..	..	..	..	10'-1"
4	ELEPHANT SKIN	M	..	..	..	25%	50%
5	END FLUTE MARKS	M	..	..	..	6" 8" 10" 12"	8" 10" 12" 14"
6	FLUTE	M	..	..	..	4" 6" 8" 10"	6" 8" 10" 12"
7	GREEN BAND	S	..	..	..	..	3"
8	HEART	S	..	..	..	..	3" 4"
	a. DIAGONAL						
	b. DOUBLE	M	..	..	..	..	..
	c. SPONGY	M	..	..	..	DIA: (G-4)	DIA: (G-3) DIA: (G-2)
9	HOLE	M	..	..	..	DIA: (G-4)	DIA: (G-3) DIA: (G-2)
	a. HEART						
	b. END	S	..	..	..	DIA: (G-4)	DIA: (G-3) DIA: (G-2)
	c. DO YO	S	..	..	..	..	..
10	INBARK	S	..	..	..	2' x 3' 2' x 6'	2' x 9' 2' x 9'
11	KNOTS						
	a. SOUND	M	..	1 1/2" 1 1/2" 2" 2"	1 1/2" 1 1/2" 2" 2"	1" 2" 3" 4"	2" 4" 6" 8"
	b. PINK KNOTS PIG EYES	S	..	8' x 3 Nos.	8' x 4 Nos.	8' x 6 Nos.	8' x 8 Nos.
12	PITCHPOCKETS	S	..	..	..	2" 2" 4" 4"	2" 2" 4" 6"
13	SHAPE						
	a. RING	M	..	..	80%	70%	60%
	b. CUP	M	..	..	..	..	1/2 LENGTH
14	SHAPE						
	a. RING	S	..	..	..	(G-3)	(G-3) (G-2)
	b. CUP	M	..	..	..	..	4" 6" 3" 5" 7" 9"
15	SPLIT	M	6"	6"	6"	6" x 2 x 2 6" x 2 x 3	6" x 2 x 2 6" x 1 x 3
	b. CUP	M	..	..	..	..	4" 6" 3" 5" 7" 9"
16	SUN CRACKS (DEPTH)	M	2"	2" 3"	2" 3"	2" 3"	2" 3"
17	TWIST	S	..	..	..	..	20'-1'
18	INTERLOCKED	M	..	..	..	..	25%
	INTERLOCKED GRAIN	S	..	..	..	..	25%
19	BLACK SPOTS	S	..	..	..	..	5%

S = SERIOUS, M = MILD, .. = NOT ALLOWED

## Grading Rules for Teak Veneer Logs

Sr. No.	Class	Saving Quality Grade I	Saving Quality Grade II	Saving Quality Grade III	Saving Quality Grade IV
1	2	3	4	5	6
	LIGHT	8' & up		8' & up	8' & up
	GIRTH	5'-0" 6'-0" 7'-0"	5'-0" 6'-0" 7'-0"	3' 4'-11"	4'-0" 5'-0" 6'-0" 7'-0"
		5'-11" 6'-11" & up	5'-11" 6'-11" & up	3'-11" 4'-11"	4'-11" 5'-11" 6'-11" & up
1	BEE HOLE	S	1	1	1
2	CURVATURE	S	10'--2"	10'--3"	10'--3"
3	END HOLE	S	DIAMETER = 3"	DIAMETER = 4"	DIAMETER = 3"
4	DO YO	S	DIAMETER = 3"	DIAMETER = 4"	DIAMETER = 3"
5	In--BARK 3"	S	5' x 9"	6' x 9"	5' x 6"
6	SUN CRACK	S	DEPTH = 3"	DEPTH = 4"	DEPTH = 3"
7	TWIST	S	10'---6"	10'---7"	10'---6"
8	UN SOUND KNOT	S	DIAMETER = 6"	DIAMETER = 8"	6"
9	FLUTE 3"	S	5'---8"	6'---10"	5'-8"
10	DOUBLE HEART	S	4"	6"	4"
11	SPONG HEART	S	DIAMETER = 3"	DIAMETER = 4"	DIAMETER = 3"
12	HEART HOLE	S	DIAMETER = 3"	DIAMETER = 4"	DIAMETER = 4"
13	SPLIT	S	24"	36"	24"

S = SERIOUS DEFECT, M = MILD DEFECT

The sawing Grade Rules calculate the defect value as in Gallant Rules. But, there is no log scaling. Each Grade allows a fixed defect value. Grading is done according to the defect value considering the category of grade a log will fall into after the length and the girth are taken.

In addition, teak logs originating from different areas have different values. Area consciousness on the part of the buyers is very pronounced in this particular species. Teak logs from areas with heavy rainfall are less favored than logs from that of scanty rainfall. For instance, teak log from Yamethin, Pyinmana, Pyay, Minbu and Yaw are extremely popular. It has also been noticed that teak from Northern Shan State, and Momeik are also favoured. The reason for the partiality is that there are no typical defects in teak logs from these areas and the colour, stripe and conformation of the logs rate from Good to Very Good. Incidence of beeholes is markedly less in logs from the above mentioned area.

For the area-wise characteristics of Myanmar Teak logs please go to "Area of Origin of Teak"



## Teak squares

The next rule for consideration is the grading rules for teak squares. The Forest Department sought and obtained the co-operation of the Forest Research Institute, Dehra Dun, in bringing out the Seaman-Limaye Grading Rules for teak squares. Later the Department rearranged and rewrote the rules on the lines adopted by FAO.

Squares are not dimension stock and are mainly meant for re-conversion into smaller sizes. Undersized squares measure 10" & up x 10" & up x 10' (sometimes 7') & up. Full sized squares have sidings 12" & up x 12" & up. They are therefore judged by the general quality of the wood, and the probable loss chargeable to visible defects under normal sawing methods. These rules define the average quality of the whole parcel, and the poorest square which can be admitted in any grade. Graders, passing any square of the poorest allowable quality must offset it in the average by one or more squares of superior quality.

The condition of the logs available for sawing today produce only a small quantity of Selected First and up. Most squares are Market Quality. First and Second Quality are also available, but in a comparatively smaller quantity.

Grade names covered and value of defects permitted by these rules are shown in the Table 12. The Table shows the defect values (D.V.) each single square can carry and the parcel average as a whole.

**Table 12. Teak squares grade names and defect/square**

Grade	Previous name	D.V. per Parcel	D.V. per Square
Select Special (SA)	Europe 1st Class	0.25/10 cft	0.75/10 cft
Special (SB)	Europe Intermediate	0.5/10 cft	1.25/10 cft
Selected First (SC)	Europe 2nd Class	0.75/10 cft	2/10 cft
First (F)	Indian 1st Class	1.5/10 cft	4/10 cft
Second (II)	Indian 2nd Class	3/10 cft	6/10 cft
Market (M)	Indian 3rd Class	6/10 cft	9/10 cft

Definition of defects include; beeholes, curvature, end holes, equivalent defects not listed (e.g. bird holes rated as decayed knots, etc.), heart defects (crooked heart, diagonal heart cracks, side splits or exposed heart, ring heart cracks, star heart cracks or soft heart, inbarks and flutes, knots, rough grain, sapwood, seasoning checks, sun-cracks, taper and wane. Defect values are calculated as in logs, and each grade has its maximum permissible defects. The table of defects mention knots; beeholes; diagonal heart cracks; star heart cracks or soft heart; ring heart cracks; end holes; badly twisted or crooked heart; sun-cracks; and rough grain.

Five percent of the total quantity will be allowed for the personal judgement of different inspectors. If more than 5% is found to be defective in re-inspection, the balance of the parcel which comes up to specification will be accepted and the portion falling below grade may be disposed of as agreed between buyers and sellers.

## Teak conversions

All sawn teak fall in the category of teak conversions. Before the 2nd World War, millers and shippers used their traditional grades which were known and accepted at home and abroad. The State Timber Board (STB) was formed after the independence to take over extraction, milling and marketing of teak. The STB had to find a common ground among the traditional grades offered and prepared a fresh set of rules by setting out to find grades common to the traditionally offered grades. The rules for teak conversions now in use are being prepared by the Forest Department on FAO lines, based on the practices of the State Timber Board.

These rules divide the specifications into two: viz., the General Market Specifications (GMS), and the Special Market Specifications (SMS). GMS includes planks, boards, flitches, etc., that are intended for reconversion. SMS applies to decks, margin planks, and special sizes of scantlings that are to be used without further cutting.

Defects are mainly the same as in other products; but also includes those found after sawing. Bark pockets; beeholes; black streak or oil streak; blemish; chalk pockets and veins; checks; end splits; wavy, curly, rough, and cross grain; knots; sapwood; shake; spring; sun cracks; and wane comprise the list of defects.

Grades recognized in the rules are - Select Special; Special; Selected First; First; Second; Market. But in actual practice only Special & Better (S&B); Special (S); First (F); and Second (II) are usually sold. Specifications of teak conversions are shown in Table 13.

**Table 13. Specifications of teak conversions**

Specification	Measurement	Grades Available
Posts	6"/9" x 6"/9" x 6' & up	F, II, M
Planks	Avg. (3.5" x 8" x 8')	S&B
Boards	0.5"-2" x Avg. (8" x 8')	S&B
Flitches	3" & up x 7" & up x 6' & up	S&B
Decks	2"-3" x 4", 5" x 10' & up	S&B
Scantlings	0.5"-5" x 1"-6" x 1' & up	S, F, II

The above mentions only the general groupings. Quality names as well as specification names also differs with those of other rules. Some of the terms used in the softwood and hardwood trades like baulks, battens are not used here.

Conversions should be well-manufactured with cross sections rectangular throughout. They must be sawn full with 1/8" overcut full to the normal dimensions at the time of milling. The permissible defects of each grade for teak conversions are briefly explained in Table 14. The width (W), length (L) of the piece is usually considered in calculating permissible defects. In knots the diameter (dia.) of the knot is taken into account.

**Table 14. Teak conversions grades and permissible defect**

Defects	Special	First	Second
Knots (kn)	L<6'-one 3/4" L>6'-two 1/2"	one 1"+ one 1/2"	one 1.25"+ one 1/2" +one 3/4" (If knot unsound dia. is halved)
Beeholes (b.h.)	L<6'-one 3/8" L>6'-two 1/4" distance<30% of L	two 3/8" distance<30% of L	two 1/2" distance<20% of L
Knots + Beeholes	one kn 3/4'+ one b.h. 1/4"	one kn 3/4'+ one b.h. 3/8"	one kn 1.25"+ one b.h. 1/2"
Sap	W>4"- 1/2"x1/4" if 1 kn or 1bh W<4"-1/2"x1/4"	W>4"- 1/2"x1/4" if 1 kn or 1bh W<4"-1/2"x1/4"	<33% of width if free from other defects. if defects present same as FQ
Curly\Wavy Grain	<5% of pcs	<10% of pcs	allowed
Suncracks	not allowed	<1/8" on <30% of length <15% of pcs	<1/8" on <50% of length <15% of pcs
Pitch\Bark\Chalk Pockets	not allowed	three - small <3/8" dia. if oval;  <u>or</u> 1"x1/8" <15% of pcs	four <1/2" dia. if oval; <u>or</u> 1.5"x1/2"
Black\Oil Streaks		permitted	allowed

The Grading Rules for Teak Squares, when read in comparison with the Grading Rules for Teak Conversions, will show that the rules for squares give methods for calculating the defect value, and the permissible defect value is fixed for each grade. In the case of teak conversions, the rules indicate only the size, location and number of defects that are permitted, and the defect value system of defects per 10 cubic feet or per ton of 50 cubic feet is not mentioned.

Scantlings are exported today as Special, First, and Second Quality. Special and Better Quality is the export quality for Teak Boards, Planks, Decks and Fitches. There is no standardisation of quality names with other countries exporting teak. For example, Special Quality is, at present, more popularly traded by Singapore, Hong Kong and Thailand as First European Quality (FEQ), and not Europe Intermediate as was previously called in this country.

It should be mentioned that in the case of small-sized scantlings, it is not practical to examine each piece as the lumber comes out of the mill. It is too time consuming as well as costly. The time for inspection is very limited. The integrity and the experience of the grader is the sole criteria in such cases. The rules can also be deceptive if followed too slavishly. Being a natural product, going by the book may sometimes result in instances where a piece of first quality is graded as special and vice versa.

## **TEAK WOOD INDUSTRY PRODUCTS**

### **Teak veneer**

Only two grades of veneer are recognised, viz., Special and Fair. The grades are determined by the maximum permissible defects they can carry. The defects are: Bark Pockets; Beehole; Mineral Streak; Black Spot; Burr; Chalk Vein; Colour; Curve Natural Markings; Decay; Flame; Flash; Grain (Rough, Wavy); Green Band; Hole (Insect. Pin) Knots; Sapwood; Split; Stain. The rules explain the place and size of the imperfection that would constitute a defect and the extent that is permissible any grade.

### **Teak plywood**

Three grades viz., Special, Superior, and Fair are recognised. In addition to the defects stated in the teak veneer, defects for plywood also include: delamination; gap; and overlap that is to be expected in the overlaying process.

### **Teak mouldings**

There are only two grades: Grades "A", and rejection "B". The defects for mouldings include: Mechanical Defects; Grain (Wavy, Cross); Sound Knots; Inbark; Decay (not allowed in any grade); Stain; Sapwood; Split (not allowed in any grade); Beeholes; Chalk Pocket; Green Band; and Moisture Content. Permissible defects are determined according to the grades and to the length of the moulding.

### **Teak lam parquet**

Three grades viz., Grades "A", "B" and "C" are recognised. Defects are: Mechanical Defects (not allowed in any grade); Wavy Grain (allowed only for Grades "B" and "C"); Crossed Grain (allowed only for Grades "B" and "C"); Sound Knots; Decayed Knots (not allowed in any grade); Stains (allowed only for Grades "B" and "C"); Sapwood on Face (allowed only for Grade "C"); Sapwood on Back (allowed only for Grades "B" and "C"); Splits (not allowed in any grade); Hole on Face (not allowed in any grade); Hole on Back (allowed only for Grades "B" and "C"); and Green Band (allowed only for Grade "C").

## **FINDINGS AND CONCLUSIONS**

1. Grading is a visual process. Graders have differences of opinion. Sometimes the written rules are not adequate to meet the provisions of nature. Then it is for the experienced grader to use his discretion.
2. Whilst the rules for teak logs and lumber in Myanmar have evolved through years of experience, there is still room for further improvement. The rules for other wood industry products are still in the rudimentary stage, and need more polishing. Markets conditions, exchange of information with other producers, and more experience would help establish a more precise set of rules.
3. Defects for quality of the texture is given more emphasis than defects for condition. Discoloration or dark colour or stripes when present in a log or a piece of lumber are not considered a defect in the existing rules.
4. No common set of grading rules has been established for teak from the Region where it is the natural habitat. In order to preserve the good name of teak it is strongly recommended that clear lines be drawn between mature teak and young immature teak.
5. It is important, that sawyers, edgermen, trimmerman and tallymen should have a basic idea of the grading rules for the goods handled by them. Graders are required to be more proficient with the different sets of rules. Systematic training complemented by years of seeing, feeling, and smelling, would make these people pass a piece of timber without having to refer the manual for determining the species and the grade in normal circumstances.
6. Market conditions set prices; and prices influence grading. It would be advisable not to adjust the grading to the fluctuating prices. Graders tend to relax the rules a bit or apply them more strictly under such situations. Let the prices rise or fall as the markets sway, but grading should be constant.
7. It would be endless to comment on grading. But as a means of providing good service, the improvement of the rules should never end.

## **REFERENCES**

- Anon. Grading Rules For Teak Logs, Forest Department, Myanmar.
- Anon. Grading Rules For Teak Squares, Forest Department, Myanmar.
- Anon. Grading Rules For Teak Conversions, Forest Department, Myanmar.
- Anon. 1936. Logging Rules and Standards For Jungle Rejection, Forest Department, Myanmar.
- Anon. 1939. Classification of Teak Logs, Forest Department, Myanmar.
- Anon. 1965. Grading Rules for Teak Logs. State timber Board, Myanmar.
- Anon. 1965. Log Grading Rules - MTIB.
- Anon. 1969. The Movement of Timber, Forest Products Research Laboratory, Princes Risborough. Tech. Note No. 38.

- Anon. 1972. British Columbia Lumber Grading.
- Anon. 1984. Tropical Timbers of the World, USDA Agriculture Handbook No 607.
- Anon. 1994. Log Rules Northeastern Loggers Association.
- Bourdillon, T.F. 1895. The quality of quickly grown teak wood. Indian Forester.
- Chowdhury, K.A. 1953. Rate of growth and quality of tropical Wood. For. Abst. 14.
- Ferguson, J.H.A. Thickness of hardwood and sapwood of teak. Tectona 27.
- Gamble, T.S. A Manual of Indian Timbers.
- Keating, W.G., Bolza, E. 1982. Characteristics, Properties and uses of Timbers of S.E. Asia, Northern Australia and the Pacific.
- Kyi, Win. 1992. Design and Construction of Commercial Sized Solar Lumber Drier and Study on its application.
- Lushington, P.M. 1893. The quality of quickly grown teak wood. Indian Forester No 21.
- Mallinson, & Leich, J.H. 1965. Timber Trade Practice.
- Mya, U. 1966. Research on Seasoning of Burmese Timbers.
- Nair, K.R., Mukerjee, H.K. 1957. A Statistical Study of the Variability of Physical & Mechanical Properties of *Tectona grandis* (Teak) grown at different localities of India and Burma and the effects of the Variability on the Choice of Sampling.
- Pearson, R.S. 1911. Note on the Relative Strength of Natural and Plantation grown teak in Burma.
- Pearson, R.S. 1913. A Further Note on the Relative Strength of natural and Plantation Grown Teak in Burma.
- Pearson, R.S., Brown, H.P. 1932. Commercial Timbers of India.
- Rodger, A. 1963. A Handbook of the Forest Products of Burma.
- Rudman, P., Doeasta, E.W. 1959. Journal of the Institute of Wood Science.
- Ryan, A. Kloot, W.H. 1960. Some Notes on the mechanical properties of teak in natural teak and plantation teak.
- Seaman, L.N. 1930. plantation Grown Timber. Indian Forester 56(10).
- Sekhar, A.C., Bhartri, R.K. and Rawat, M.S. 1960. Comparative Studies on Natural and Plantation Teak.

Sekhar, A.C., Rawat, B.S. 1966. Physical and Mechanical Properties of teak from Different Localities in India and Neighboring Areas.

Sono. 1974. Mechanical Properties of Thailand Timbers. Forest Products Research Division, Royal Forest Department, Bangkok, Thailand.

Sono, P, Rativanigh, T. 1965. Comparative Study on the properties of plantation and natural grown teak in Thailand. Bulletin Royal Forest Department, For. Abst. 26(2).

Sono, P, Saengsakul, P. 1959. A Preliminary Study on the Physical and Mechanical Properties of teak in Thailand.

Weimann, M.C. 1979. A Comparison of Plantation grown and Natural grown Teak. Graduate Paper. SUNY, Syracuse, New York.

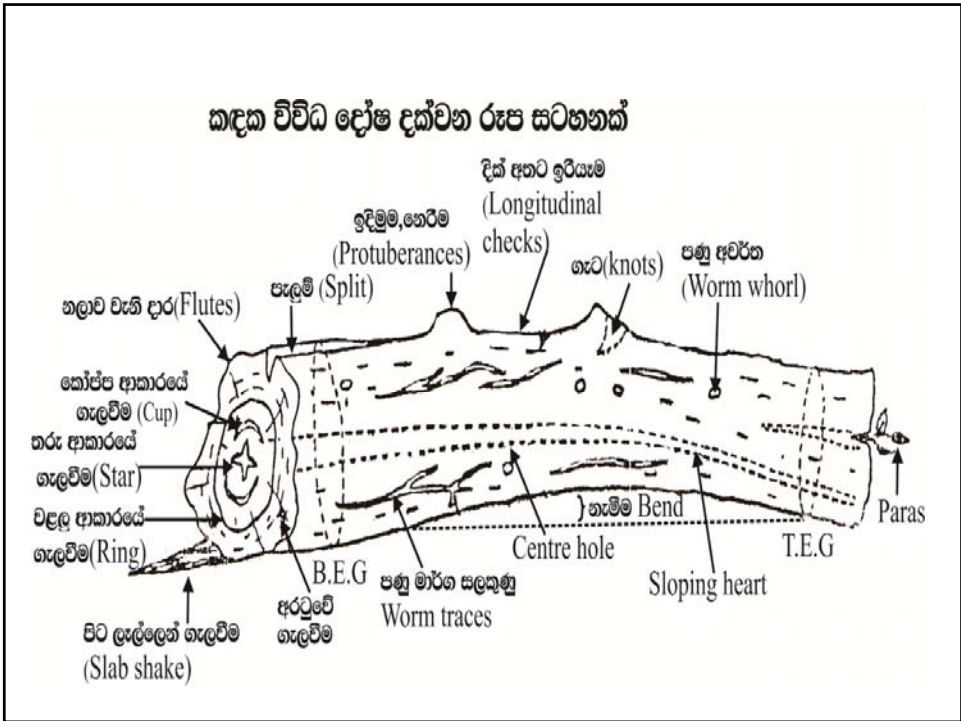
Wattanakal, Sadki. 1959. A Comparative Study on the Physical and Mechanical Properties of green felled and girdled teak timber.

# Timber grading in Sri Lanka

DR.Nimal Ruwanpathirana

Deputy General Manager (Research, Development and Training.

State Timber Corporation



# Timber

Timber is a natural product when extracted for utility purpose it comes out in

1. Various lengths
2. Sizes
3. Form
4. Taper
5. Fluting
6. Defects (split, check, borer holes and fungi)

Defect in timber

- 1. Natural defect
- 2. Seasoning defects
- 3. Defect caused by fungi
- 4. Defects caused by insect
- 5. Felling defects
- 6. Defects in preparation or manufacture of logs.
- *Attachment :*

# Timber grading

## • How much is a log worth ?

- Three main factors determine the value of a log
  - (i) **Grade** : quality of the log and the lumber
  - (ii) **Scale** : quantity of lumber within a log
  - (iii) **Species**.

Sale price of both logs and sawn timber ,where grading is not done is based on classification of species and sizes only.

## How log price varies with species and girth classes

### Teak log price (Rs/m<sup>3</sup>)

Mid Girth classes (meter)	Rs:per m <sup>3</sup>
1.50 above	88450.00
1.22 -1.48	62150.00
1.00 -1.20	43945.00
0.82 -0.98	31130.00
Below 0.8	18655.00

### Hora log price (Rs/m<sup>3</sup>)

Mid Girth classes (m)	Rs: per m <sup>3</sup>
1.50 above	17600.00
1.22 -1.48	17160.00
1.00 -1.20	11880.00
0.82 -0.98	96100.00
Below 0.8	6600.00

Prices paid for logs of different species and grade, all values are in rupees per cubic meters of 1m mid girth log in 2013

Grade	Teak	Hora	Lunumidella
High grade (prime:A/90)	65,620.00	22,572.00	6,555.00
Medium grade (B grade)	34,540.00	11,880.00	3,450.00
Low grade (C /50 grade)	17,270.00	5,940.00	1,725

## Timber grading

- **Classification for quality is known as grading in timber trade.**
- **There is a recognized set of standards needed to group logs and sawn timber into quality classes.**
- **Grading rules: inspection and assessment of anomalies with penalty points of log shape, defects, deterioration**

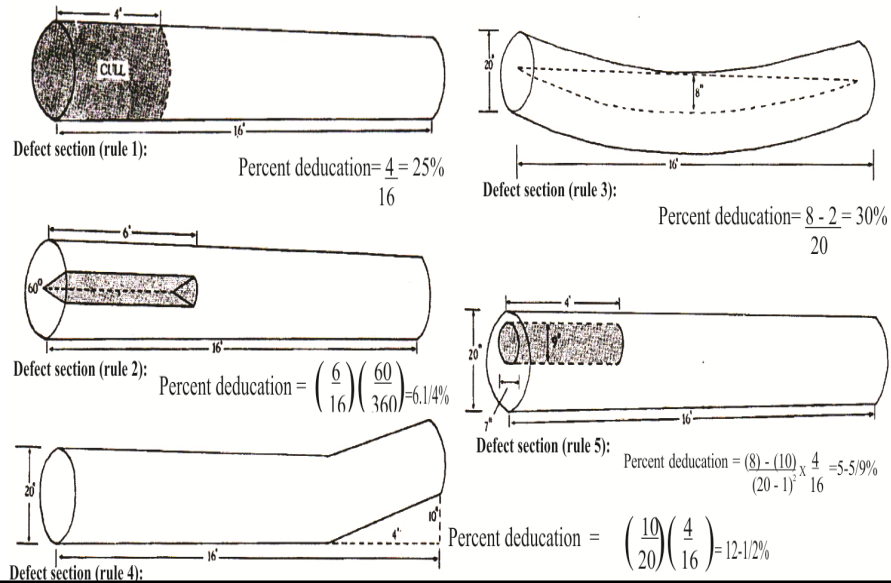
## System of grading

- 1.The Yield system**
- 2.The Cutting System**
- 3.The Defect System**
- 4.Combination System**
- 5.Stress Grading System.**

# 1.The Yield system:

- **Sound clear volume of a log as an indicator to determine the quality. ( % of sound volume from the log volume ).**

## Scaling deduction of 16 foot log with 20 inch scaling diameter



## 2.The cutting system

- **This system is applied for grading of sawn timber usually re-sawn to smaller sizes before use.**
- **The grade shall be determined from the worse face of the piece by determining the % of the total surface sound face cutting.**

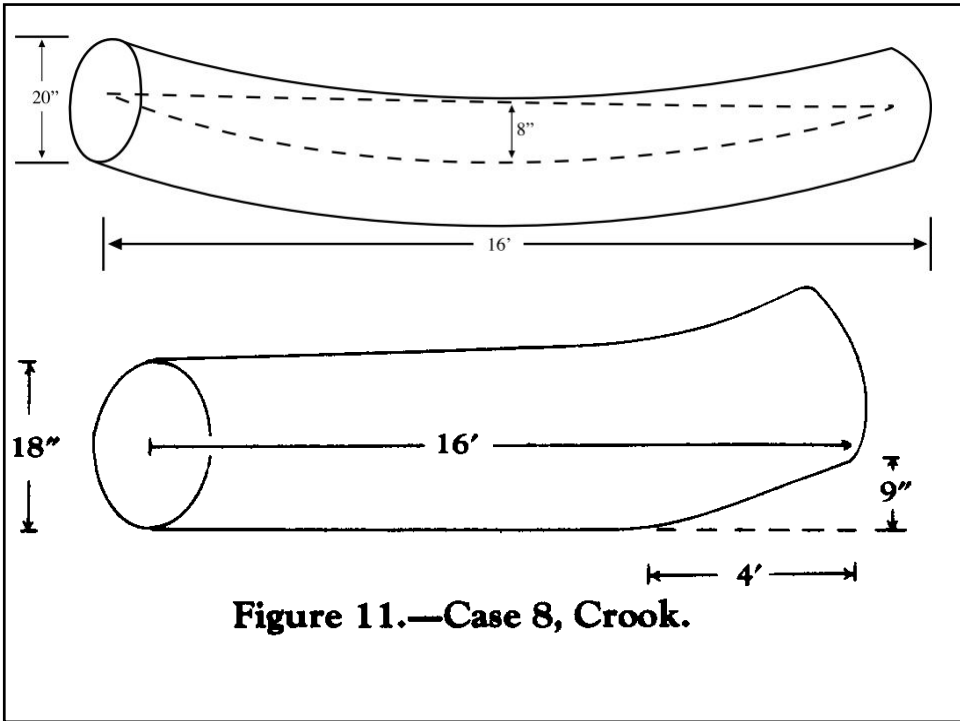
## 3.The Defect system

- **Quantitative valuation of defects is done by using units of defects which is a quantitative representation of the approximate degrade of the utilizable material for each defect. See example in table.**

Standard defects	Equivalent units
1. Two sound knots of 2-6 cm diameter for every 2 m log length with interval between knots not less than 1.5m	2 units
2. One or two splits with a total length of upto 10% of the log length	1 unit
3. One or two bends with a total deviation over 20% upto 30% shortest log end diameter.	3 units
4. Radial shakes not reaching the longitudinal surface of the log more than 10% of the diameter and 5% of the length of the log but not more than 8% of the length of the log for one shake	1 unit
Total units	7 units.

Bend fraction=Deviation or deflection of bend/the shortest diameter of top end of log

Bend Fraction Ratio	Defect Value in Percent	Defect Value in Units
One bend of 1/12 One bend of 1/10 One bend of 1/8	5 7 8	One unit
One bend of 1/6 One bend of 1/5 One bend of 1/4	12 14 17	Two unit
Two bents or one of 1/3 Two bents or one of 1/2	23 34	Three unit
One or Two bend of over 1/2	Reject or re- buck log into two (2) standard length logs with reduced bend defects.	



## 4. Combination System

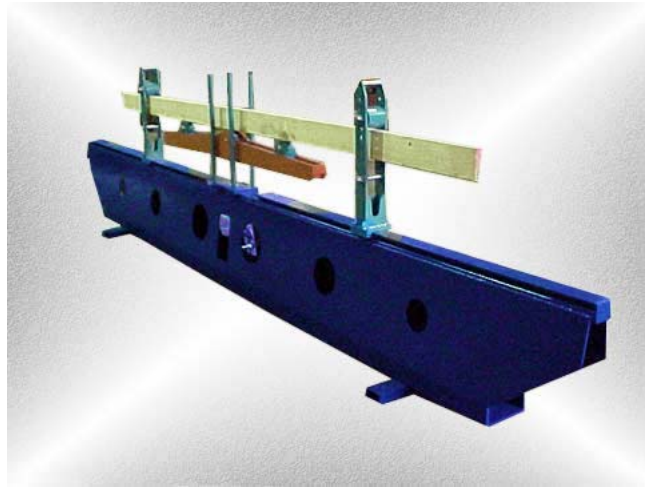
- Defect and cutting systems should be applied for grading of sawn timber
- Defect and Yield systems should be applied for grading of logs.
- Eg: Proposed STC grading System

## 5. Stress Grading System

this system designed by engineering calculations for timber construction (Scantlings)

- **Visual Stress Grading**  
A piece will satisfy the requirements of the grade if the defects do not exceed limits specified.
- **Machine Stress Grading**  
A piece will satisfy the machine requirements if it has been passed through an approved grading machine and the whole piece has been classified as complying with the grade

## Machine Stress Grading



- **Veneer log** : very high quality log with few if any visible defects. Color, growth rate and amount of sapwood versus heartwood.
- **Sawlog (factory log):** that are sawn into lumber.
- **Other log classes:** that are sawn into pallet (appearance is not important)

## Principles of timber grading

- Grade represent the size, quality, and quantity available for potential manufacture of specific end products (Lumber, veneer, or chip.)

### Eg. STC prime teak saw log (SPS)

Grading requirement	description
Size	Length 3m or above, mid girth 90cm or over
Quality	Fresh cut, cylindrical, well trimmed, bend (2 units), knots (2units), Borer hole (2 units), checks/splits (1 units) , shakes is not allowed, surface defect is not applicable, center hole is confined to pith, Heart displacement is not applicable, etc.
Quantity	75% sound wood or over.

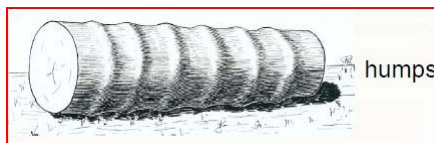
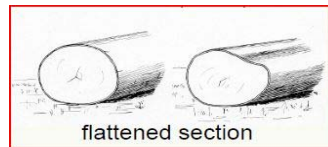
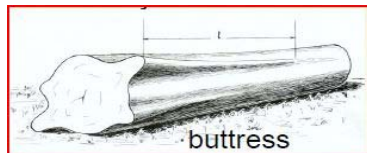
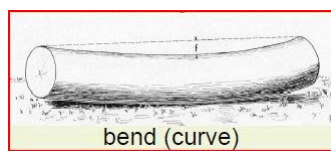
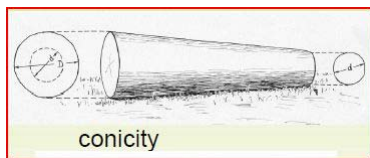
# Grading Rules

**Principle:** Inspection and assessment of anomalies with penalty points. (1) Shape (2) Defects (3) Deteriorations (4) Maximum global penalties allowed.

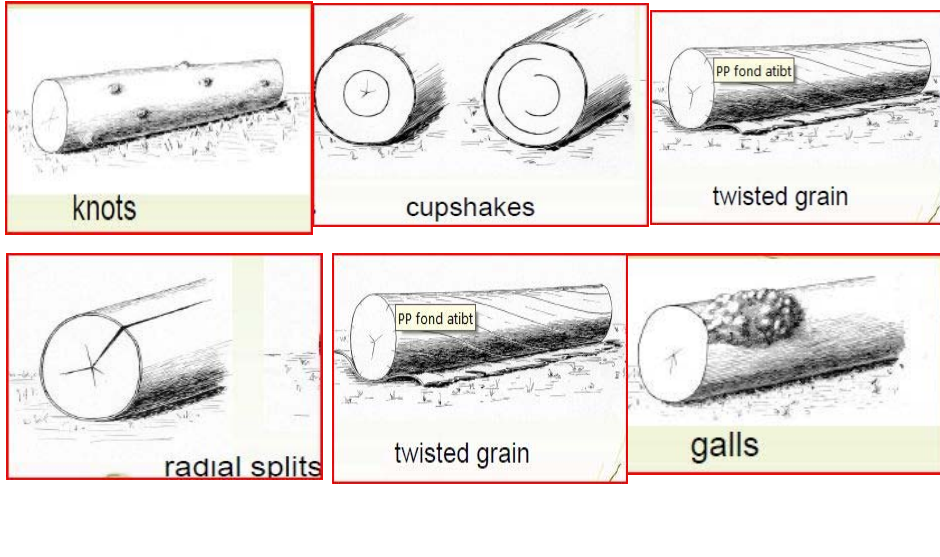
3 different kinds of rules

Logs	Sawn timber for joinery	Sawn timber for structure
<p>Pictures?</p> 		

# Logs shape




## Logs defects



## Log deterioration



Maximum number of penalties allowed in each grade for each type of defect for logs



Grade	Maximum number of penalties allowed in each grade for each type of defect					
	I	I/II	II	II/III	III	IV
<b>SHAPE</b>						
- Conicity	0	1	2	2	2	2
- Bend (curve)	1	1	2	2	3	3
- Flattened section	0	0	1	2	2	2
- Buttress	0	1	2	4	5	6
- Humps	0	0	2	4	5	6
<b>DEFAULTS</b>						
- Knots and knobs	2	2	4	6	8	9
- Inbarks, galls, blister grain, thorns, etc.	0	1	2	3	5	6
- Splits, cracks, breaks	2	4	6	8	10	14
- Cupshakes	0	2	3	4	5	5
- Abnormal heart	0	1	2	3	3	3
- Spiral grain, entangled grain, etc.	0	1	2	3	6	9
<b>DETERIORATIONS</b>						
- Pin holes, discoloration	1	2	4	6	10	15
- Grub holes, teredo holes	0	0	2	3	4	5
- Heart decay	0	1	2	4	6	6
- Off the heart rot	0	1	2	4	6	6
<b>MAXIMUM GLOBAL PENALTIES ALLOWED:</b>						
For logs up to 6 m	4	6	8	10	12	16

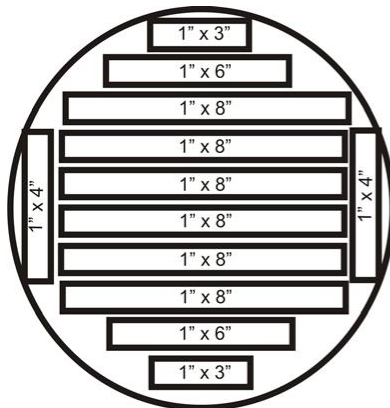
## Grade reduction

- The process of visualizing and quantifying the portions of the log not suitable for the production of lumber (or other product), is known as grade reduction.
- In addition to grade reduction, application of the grading rules requires the scaler to assess the quality of the products that could be produced from the log. This requires an assessment of the size, frequency and distribution of knots, and an assessment of any visible spiral grain or twist of the log.
- These defect include firmwood defects such as **rot, hole, char and missing wood** and non-firmwood defects such as shake, checks, frost cracks, shatter, splits, forks, catface, deadside, lighting scar, bark seams, sweep and crook).

## Grade deduction

- The volume of the log not available for the manufacture of lumber or the other products is the grade reduction volume.
  - In applying the grading rules, the scaler must deduct this volume from the gross log volume and express the remaining volume as a percentage of the gross volume. This percentage represents the percentage of the log that can be manufactured.
- **Gross Volume – Defect Volume x 100 = % Suitable for  
Manufacture  
Gross Volume**

## Methods of determining scaling deduction



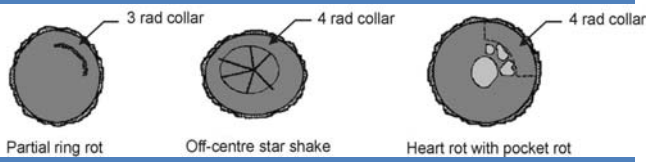
Lumber is a manufactured product derived from a log in a sawmill, or in a sawmill and planing mill, which when rough, shall have been sawed, edged and trimmed at least to the extent of showing saw marks or other marks made in the conversion of logs to lumber on the four longitudinal surfaces of each piece for its overall length, and which has not been further manufactured other than by cross-cutting, ripping, resawing, joining crosswise and/or endwise in a flat plane surfacing with or without end matching and working. (Source - the National Lumber Grades Authority)

## Defect Deduction method

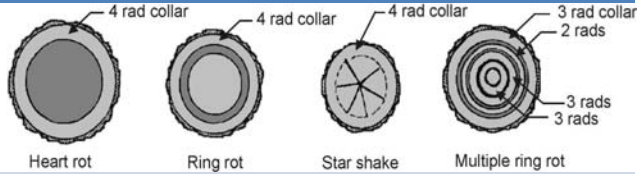
- 1. Squared defect method
- 2. Pie-cut method
- 3. Length-deduction method
- 4. Diameter-deducton method.

## Determining Grade Reduction for Collars (shells)

**Examples of Logs with a Portion of the Collar Too Thin to Produce Lumber.**



**Examples of Logs with Entire Collar Too Thin to Produce Lumber.**



**Examples of Logs with Sufficient Collar to Produce Lumber.**

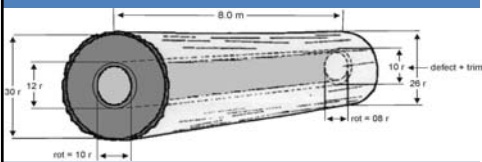


## Determining Grade Reduction for Sound Hearts (Residual cores)

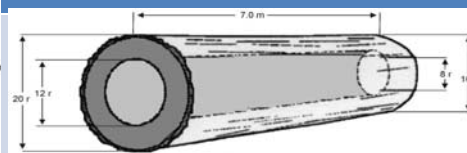
Sap Rot	Advanced Sap Rot	Residual Core is a Grade Reduction

## Determining of Trim Allowance

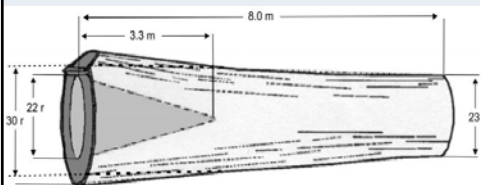
*The Application of Trim Allowance Around Heart Rot and Hole.*



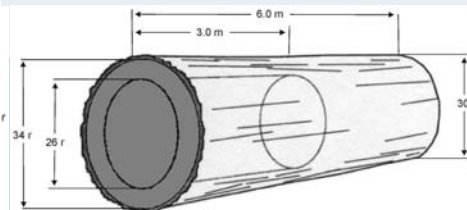
*Collar Too Thin to Cut Lumber*



*Application of Trim Allowance for Butt Rots*

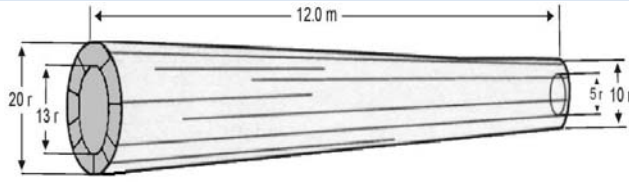


*Ring Shake and Only the Core is Thick Enough to Produce Lumber.*

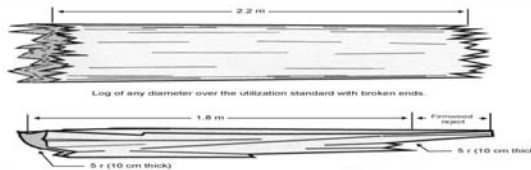


A log with simple butt rot estimated to penetrate 3.3 metres into the log (22 x 0.15 = 3.3m)

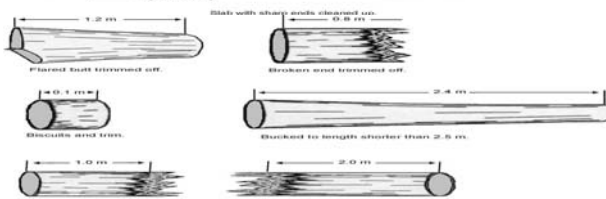
## Application of trim allowance to checks, shake and determining length for grading



**Short Breakage Pieces Contained in a Conventional Load.**

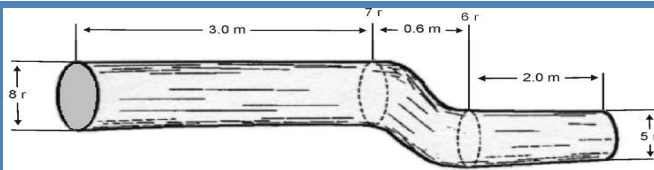


**Examples of Short Logs Left After Bucking at the Scale Site and Deemed to be 2.5 m Long (Interior) and 5.2 m Long**

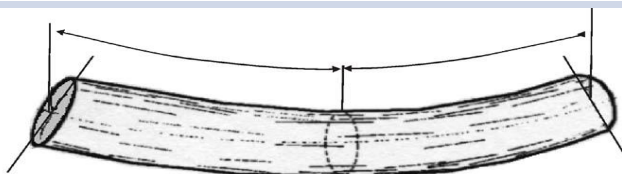


## Assessing Grade in Logs with Crook, Sweep and Pistol Grip

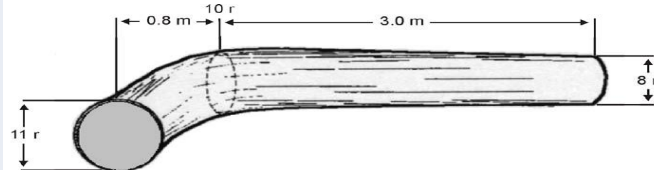
**Visually Bucking a Log with Crook to Assess Lumber Recovery.**



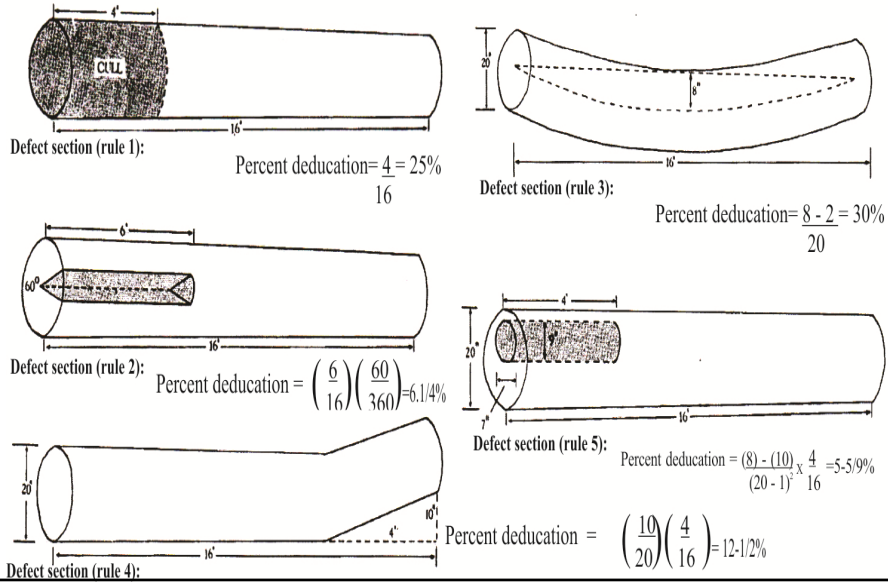
**Visually Bucking a Log with Sweep to Assess Lumber Recovery.**



**Visually Bucking a Log with Pistol Grip to Assess Lumber Recovery.**



## Scaling deduction of 16 foot log with 20 inch scaling diameter



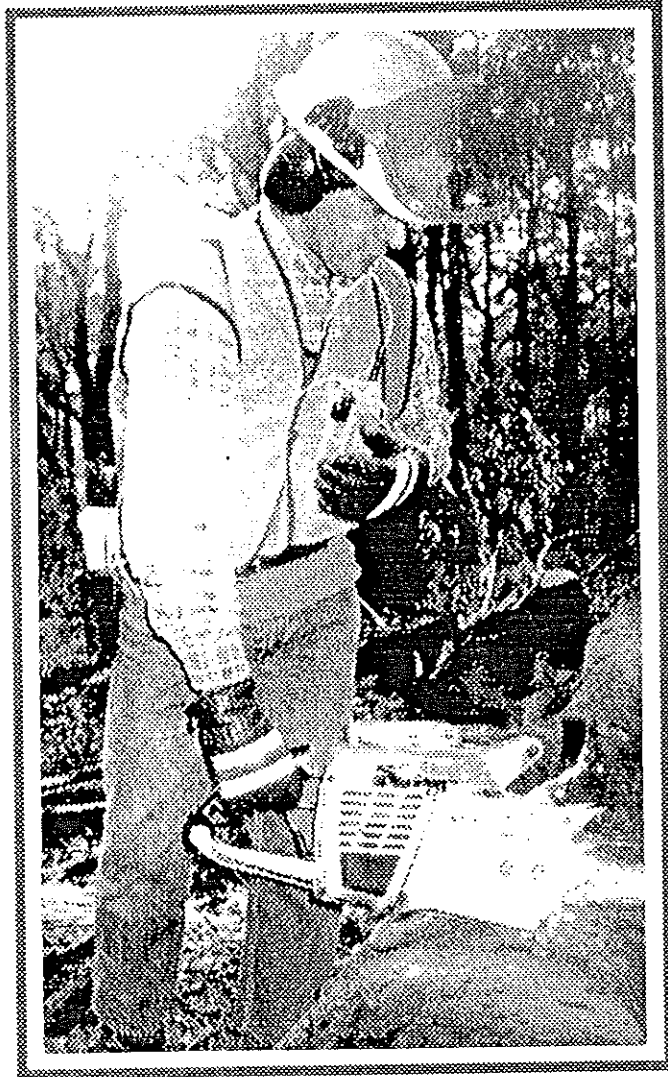
**Teak (Tectona grandis)**  
**කුඩි ලැලි කඳුන් සහ ඉටන කඳුන් සඳහා වර්ග දැරි සංස්ථාවේ දැව ලේඛන කිරීමේ නීති**

	Grading requirement	ඉටන කඳුන් ලේඛන					
		Supper prime saw log (SPS)	prime sawlog (PS)	standard sawlog (SS)	Economy sawlog (ES)	Sawlog grades (S1)	Short logs (S2)
1.	කඳේ දිග (length) මිටර	3.0m & over	3.0m & over	2m & over	2 m & over	2m & over	shorter than 2m
2.	කඳේ මැදටු Mid girth ( මැදමිමසා Diameter) සැමි	100(31.8) & Over	90( 28.6) & Up	80(25.5) & Up	60(19.1)& Up	45(14.3)& Up	45(14.3)& Up
3.	කඳේ තත්වය (Condition)	Fresh cut	Fresh cut	Not applicable	Not applicable	Not applicable	Not applicable
4.	කඳේ උල්ලි බව (Roundness)	Cylindrical (not less than 80%)	Nearly (not less than 80%)	Not applicable	Not applicable	Not applicable	Not applicable
5.	කඳේ කෙළවර කැපීම (Trim)	well trimmed	Nearly well trimmed	not applicable	not applicable	not applicable	not applicable
6.	කඳේ කැඹුම් (Bend)	1 Unit	2 Unit	Not applicable	Not applicable	Not applicable	Not applicable
7.	කඳේ මෙරටම (Grain)	Reasonably straight	Reasonably straight	Not applicable	Not applicable	Not applicable	Not applicable
8.	කඳේ ගට (Knot)	1 Unit	2 Unit	Not applicable	Not applicable	Not applicable	Not applicable
9.	කඳේ සිදුරු (Borer holes)	1 Unit	2Unit	Not applicable	Not applicable	Not applicable	Not applicable
10.	කඳේ ඉටුකැලීම් (checks/splits)	1 Unit	3Unit	Not applicable	Not applicable	Not applicable	Not applicable
11.	කඳේ ගුලුම් (shake)	Not admitted	Not admitted	Not applicable	Not applicable	Not applicable	Not applicable
12.	කඳේ මතුපිට දෝෂ (Surface defects)	Not admitted	Not admitted	Not applicable	Not applicable	Not applicable	Not applicable
13.	Center hole	Not admitted	Confined to pith	Not applicable	Not applicable	Not applicable	Not applicable
14.	කඳේ උස්වීමේ ස්ථානගතභව (Heart displacement -	1/4	not applicable	Not applicable	Not applicable	Not applicable	Not applicable
15.	කඳේ වළා (Sapwood)	Admitted discoloured but sound sapwood	-	-	-	-	-
16.	දෝෂ සීමාව (Defect limits)	3 STDS	3 STDS	-	-	-	-
17.	කඳේ ඉන්ද්‍රියානු යා යාමේ ඉන්ද්‍රියානු Utilizable yield	solid	75% sound and over	60% sound and over	50% sound and over	40% sound and over	40% sound and over

ABBREVIATIONS : NA = අදාළ නොවේ (not applicable)  
RSG = ප්‍රමාණවත් කැපුණු මෙරටම ( reasonably straight grained)

STD  
\* Standard knot  
\* Standard borer holes  
\* Standard split  
\* Standard bend

# Hardwood Log Classification Guidelines



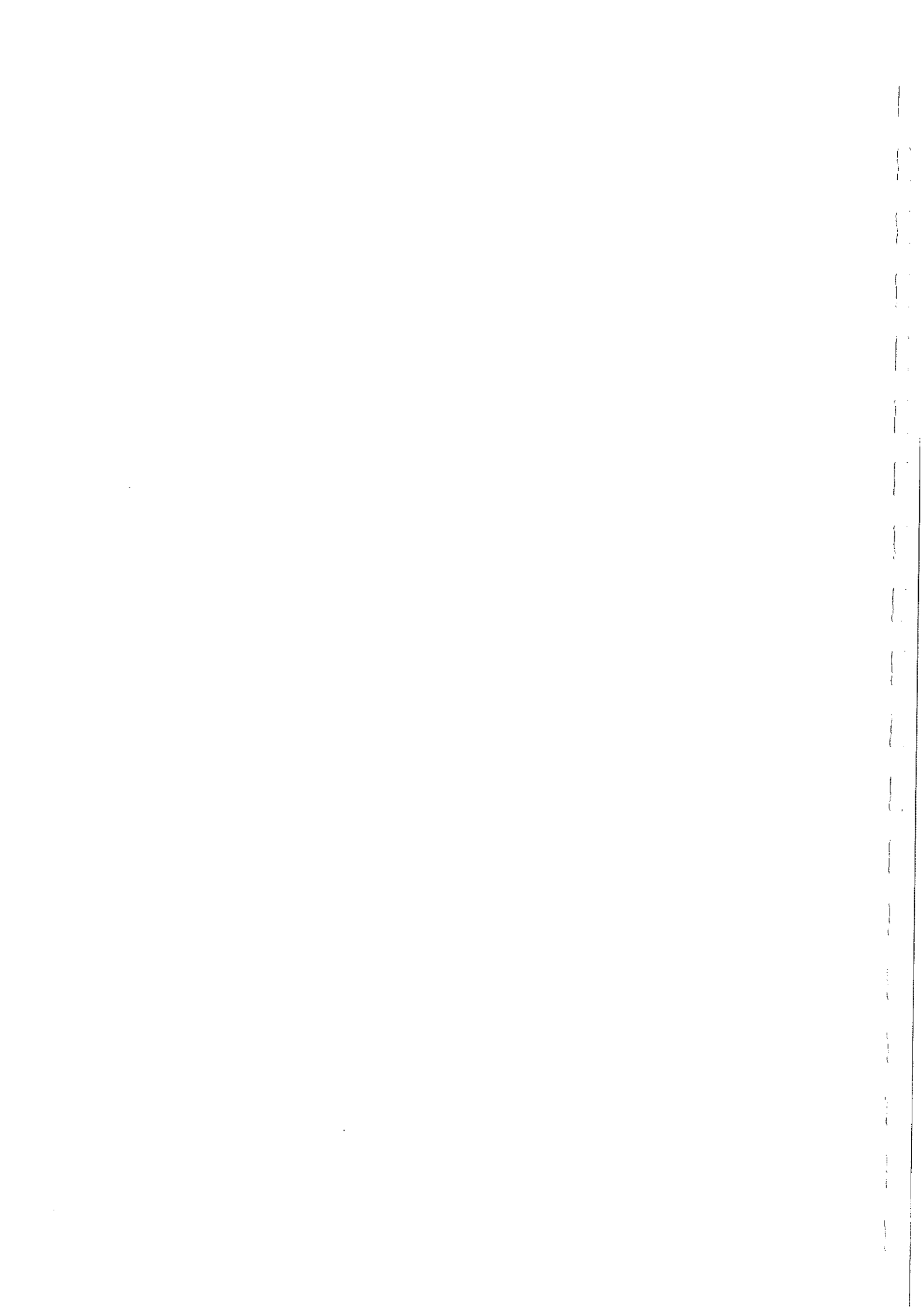
EDITION 2

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65  
66  
67  
68  
69  
70  
71  
72  
73  
74  
75  
76  
77  
78  
79  
80  
81  
82  
83  
84  
85  
86  
87  
88  
89  
90  
91  
92  
93  
94  
95  
96  
97  
98  
99  
100

*Printed by the D.P.I. Forest Service for use by Accredited Native Forest Sawlog Cutters, Cutters in Training, Sawmilling Industry and Harvesting and Marketing Officers.*

*This booklet is the result of a joint effort involving the Marketing Officers, Commercial Sales Branch Officers, and Print and Display Section staff.*

*October 1994*



# Contents

General (Cutting, Recording and Stencilling) .....	1
Length – Tolerance .....	2
Centre Diameter .....	3
Top Diameter .....	4
Butting .....	6
Heading .....	7
Defect Outside of Pipe .....	8
Pipe Defect (General) .....	9
Pipe Defect (Open Ring Shake – considered as pipe) .....	10
Pipe Defect (Open Ring Shake – considered as pipe) .....	11
Pipe Defect (Open Ring Shake – not considered as pipe) .....	12
Pipe Scale – Species Codes – XCPT (Exception) Codes .....	13
Cutters Docket Book .....	14
Pipe Defect, Single Logs .....	15
Pipe Defect, Multiple Logs .....	16
Compulsory Pipe – Bends .....	19
Irregular Shape .....	21
Wavy Grain – Spiral Grain .....	22
Limbs .....	23
Limbs – Bumps .....	24

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65  
66  
67  
68  
69  
70  
71  
72  
73  
74  
75  
76  
77  
78  
79  
80  
81  
82  
83  
84  
85  
86  
87  
88  
89  
90  
91  
92  
93  
94  
95  
96  
97  
98  
99  
100

# General

In a sawlog harvesting sale, the tree bole must be cut to maximise the volume of wood sold as sawlogs with due regard to efficient utilisation of the resource and the current sawlog classification rules.

The cutter must accurately record the following information in the order shown.

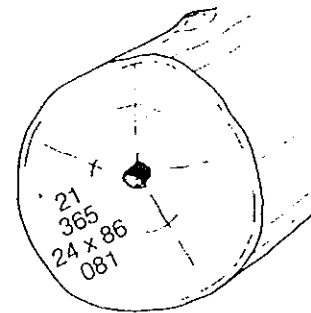
## On Stumps

- log number (where more than one log per tree, all numbers shall be recorded)
- cutter number

This information is to be placed on the stump prior to the removal of the log from the stump.

## On Logs

- sale area code
- log number (logs must be numbered sequentially)
- dimensions
- cutter number



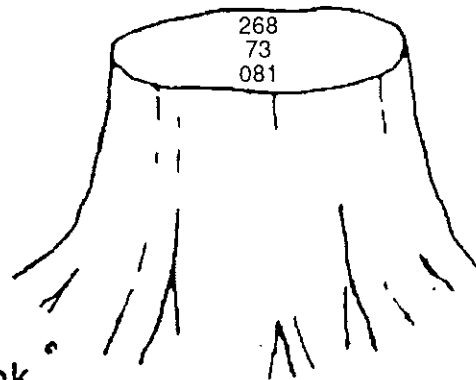
The log number is to be placed on the log prior to its removal from the stump.

## On Dud Logs

- log number

## On Dud Stumps

- log number
- stump diameter
- cutter number



## In the Docket Book

### For Combined Log Class Measure System

- Date of Cutting
- Purchaser (name in full i.e. Allen Taylor & Co Ltd)
- Timber Case (T.C.) or Sales Permit (S.P.) Number (can be supplied by the Forest Officer)
- Cutter's Name
- Area Code
- Cutter's Code (which is pre-fixed by 0. i.e. 008, 081 and not X i.e. XX8, X81)
- Log Number
- Log Length and Diameter
- Species
- XCPT Codes (full list of codes are shown on page 11)
- Compulsory Logs
- Optional Logs and Optional Sections of Logs
- Duds (to include species and diameter at stump height over bark)
- Hung Up Trees (with estimated dimensions)
- Girder Logs (show species)
- Missed Log Numbers (No log)

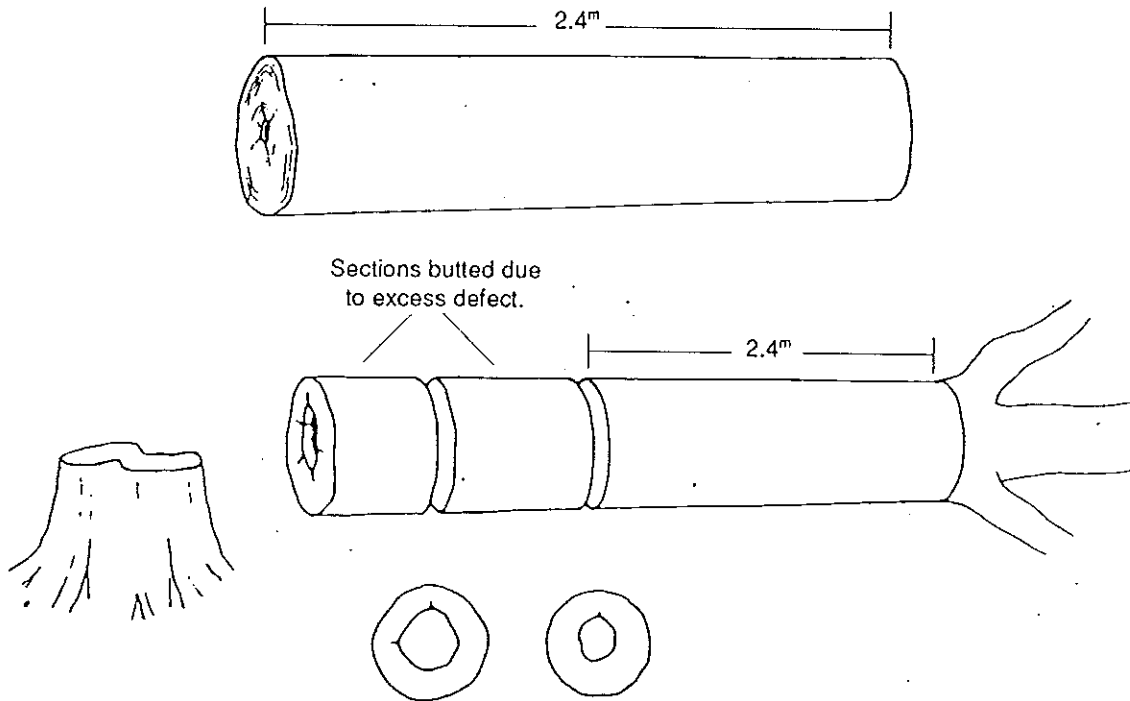
### For Hauler Docket, in Yard and At Stump Measure System

- Date of Cutting
- Timber Case (T.C.) or Sales Permit (S.P.) Number (can be supplied by the Forest Officer)
- Cutter's Name
- Area Code
- Cutter's Code (which is pre-fixed by 0. i.e. 008, 081 and not X i.e. XX8, X81)
- Log Number
- Log Length and Diameter
- Species
- Optional Logs and Optional Sections of Logs (if required)
- Duds (to include species and diameter at stump height over bark)
- Hung Up Trees (with estimated dimensions)
- Girder Logs (show species)
- Missed Log Numbers (No log)

# Length

The minimum single log length will be 2.4 metres and lengths will rise by 0.3 metre intervals. There is no maximum length.

## Minimum Compulsory Log Length



In all situations, the tree bole should be cut to produce the maximum length of compulsory wood.

# Tolerance

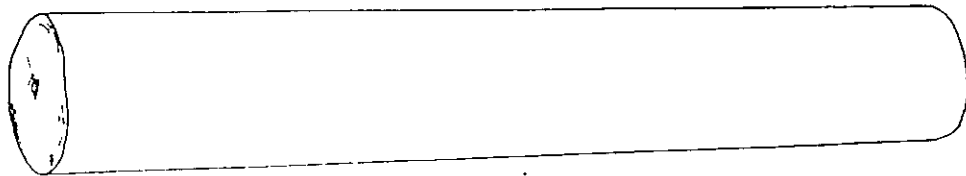
Provided logs are crosscut properly a maximum tolerance of 0.1 metres will be allowed on all straight logs up to 13.8 metres in length, while a maximum tolerance of 0.2 metres will be allowed for straight logs exceeding 13.8 metres.

An additional tolerance of up to 0.1 metres will be allowed for each sawcut deemed necessary to cut a log containing significant bends into straight sections 2.4 metres or longer.

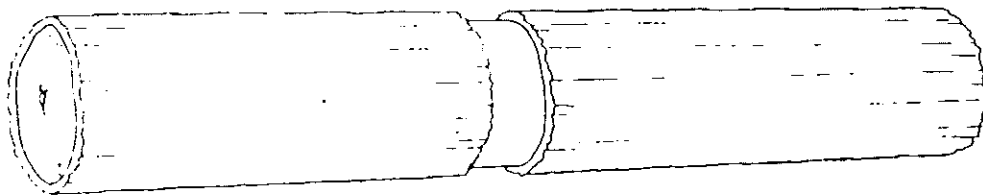
# Centre Diameter

Centre diameter will be measured in rounded down centimetre intervals. Measurement of centre diameter must be the underbark measurement determined at the centre of each log except for Spotted Gum (refer to bark thickness table for Spotted Gum).

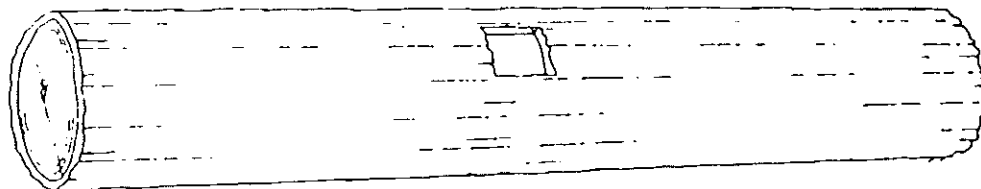
An underbark measurement may be obtained by any of the following methods:



by fully debarking the log; or



by removing a ring of bark at the centre point on the log; or



by removing a small square of bark at the centre point, measuring the bark's thickness, doubling this figure and then deducting this amount from the overbark measurement of centre diameter.

Measurement of centre diameter for Spotted Gum may be made in either overbark or underbark at the option of the purchaser. If measurement is to be made overbark the underbark diameter for Spotted Gum is to be determined from the deductions set out below:

Centre Diameter Overbark	Allowable Bark Thickness Deduction
Up to 40 cm	1 cm
41 to 70 cm	2 cm
71 to 90 cm	3 cm
91 to 120 cm	4 cm
121 cm and over	5 cm

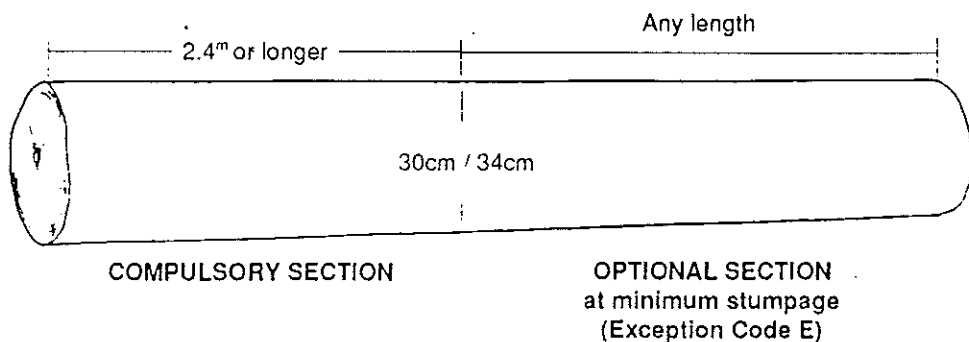
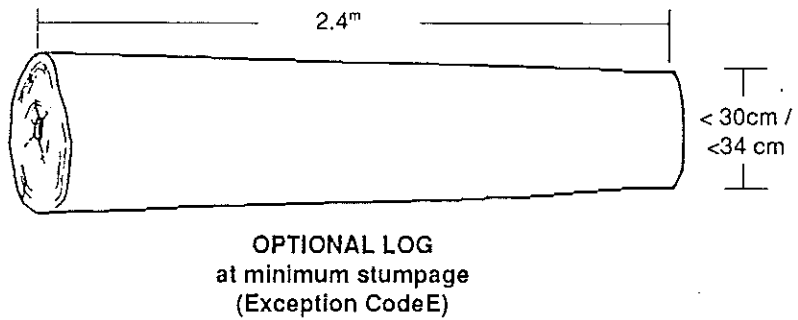
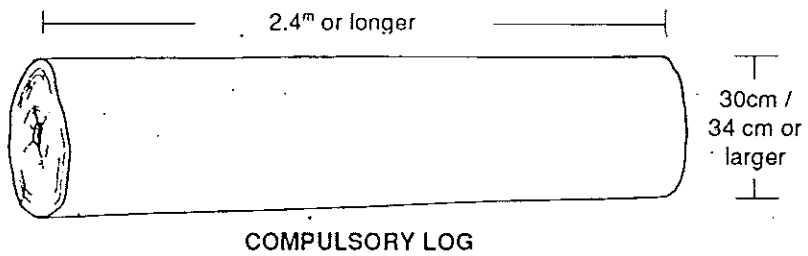
# Top Diameter

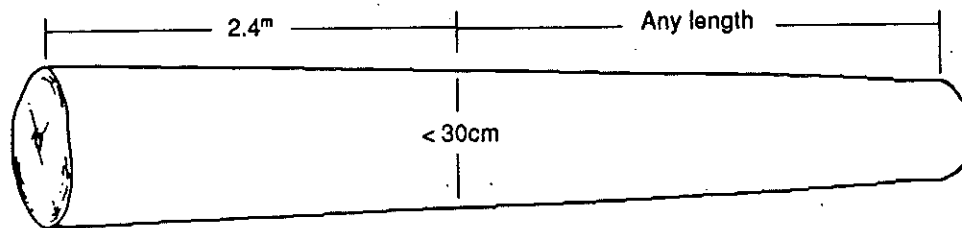
The minimum top end diameter underbark for a compulsory log or a compulsory section of a log is:

- 34 cm for species that attract a minimum compulsory pipe of 8 cms.
- 30 cms for all other species.

The "compulsory pipe" species are red mahogany, blackbutt, rose gum (flooded gum), killarney ash and brush box.

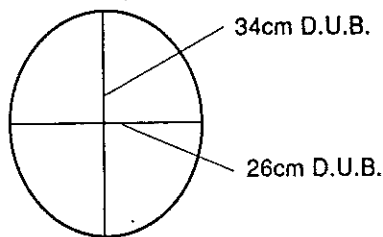
Logs or log sections smaller than the minimum top end diameter as listed above not containing defects which would render them optional (apart from size) will be charged for at minimum stumpage where they are taken by the purchaser. The Exception Code (XCPT) for such logs is E.





OPTIONAL LOG at minimum stumpage  
(recorded as one log)  
(Exception Code E)

Measurement of the top end diameter will normally be by diameter tape, but if the log is oval shaped, the log will be compulsory if the smallest diameter is not less than 26 centimetres inside bark to inside bark, and the average diameter is 30 centimetres for "non-compulsory pipe" species.



The corresponding dimensions for "compulsory pipe" species are 38 cm D.U.B. and 30 cm D.U.B.

# Butting

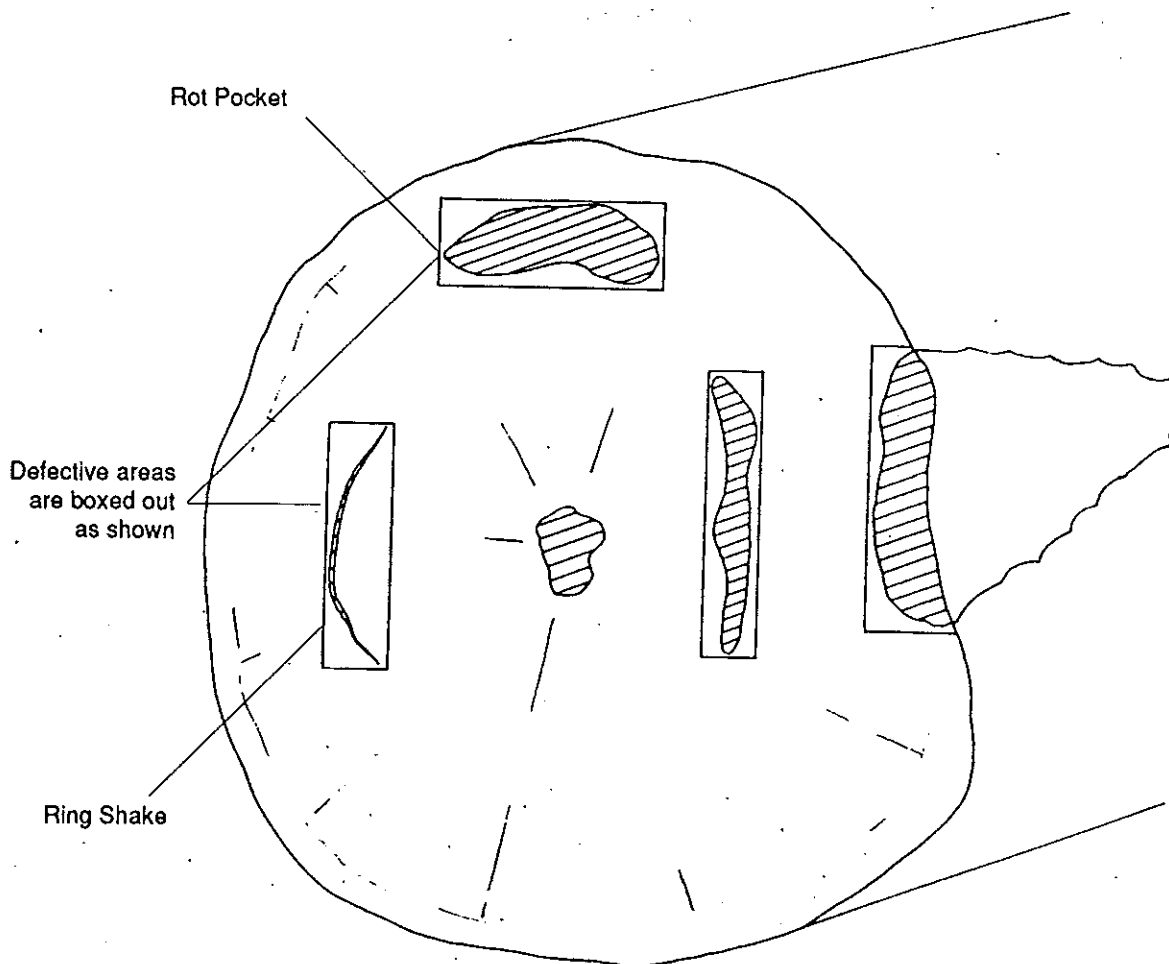
Logs should be butted to remove sections obviously useless for milling, for any particular reason or a combination of reasons.

In this connection, where extra to pipe defects render useless more than half the cross-section of the log outside the pipe, the log should be butted.

Butting within sections made optional for any other reason is allowable. However, excessive butting and heading within the compulsory log length, will not be permitted.

## End of Log Defect other than Pipe

Defects other than pipe such as star shakes, checks in dead timber, rot pockets, open gum veins or small ring shakes showing on the end of the log are to be considered when calculating end of log defect outside of pipe, unless they are so located as to be covered by pipe measurement.



If such defect amounts to more than 50% of nett area outside of pipe, then the log should be butted.

Where logs have not been properly butted, the measurer may, at his discretion, ocularly butt the log or alternatively require the cutter to properly present the log.

# Heading

Logs should be headed to remove sections obviously useless for milling, for any particular reason or a combination of reasons.

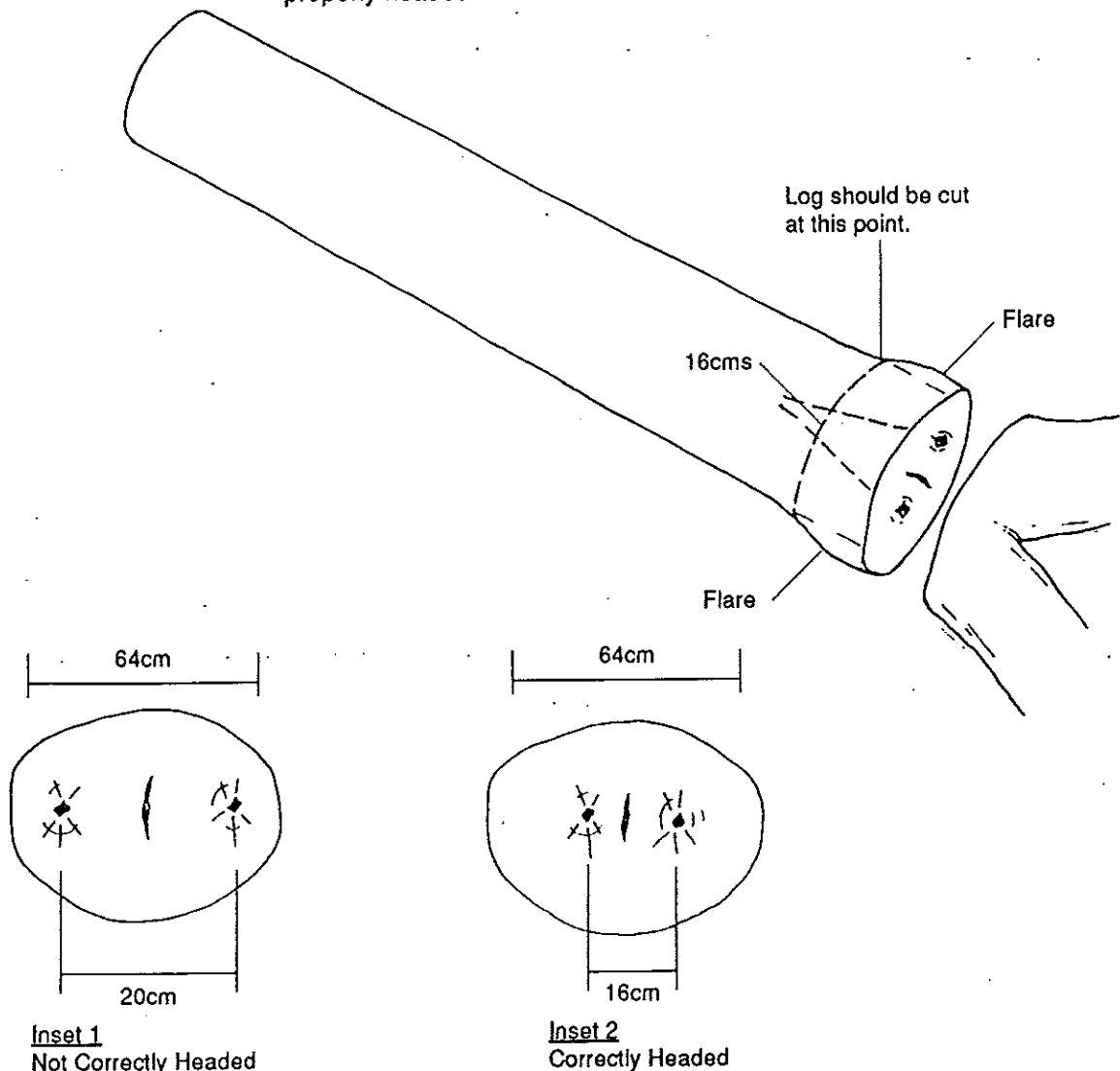
In this connection, where extra to pipe defects render useless more than half the cross-section of the log outside the pipe, the log should be headed.

If double heart occurs and the distance from centre to centre represents more than 25% of the top end diameter underbark, excluding flare, the log has not been properly headed. Flare must be apparent on both sides of the log before double heart is applicable.

Where logs have not been properly headed the measurer may, at his discretion, ocularly head the log, or alternatively, require the cutter to properly present the log. However ocular heading and butting will only be permitted on "at stump" sales. Ocular heading and butting will not be permitted once the log has been removed from the stump.

## Heading – Double Heart Defect

If double heart occurs and the distance from centre to centre represents more than 25% of the top end diameter, excluding flare, the log has not been properly headed.



# Defect Outside of Pipe

Dead timber showing deep radial checking affecting greater than 50% of the cross-sectional area of the log outside of pipe should be considered optional.

The following table can be used as a guide to assessing radial checking outside of pipe.

**Measures guide to assess when radial drying checks on logs from dead and dying trees.**

Centre Diameter of Log under bark	Max depth of checks before a solid log becomes optional (cm)	Pipe Diameter (intermediate) (cm)	Max Depth of check before log becomes optional (cm)	Max allowable pipe for a compulsory log (cm)	Max depth of check before log becomes optional (cm)
30 - 34	4	4	4	7	3
35 - 39	5	10	4	19	3
40 - 44	6	11	5	22	4
45 - 59	6	13	6	26	4
50 - 54	7	15	6	30	4
55 - 59	8	17	7	33	5
60 - 64	9	18	8	36	5
65 - 69	9	20	8	40	5
70 - 74	10	22	9	44	6
75 - 79	11	24	10	47	6
80 - 84	12	25	10	50	7
85 - 89	12	27	11	53	7
90 - 94	13	29	11	57	7
95 - 99	14	30	12	60	8
100 - 104	14	32	13	63	8
105 - 109	15	34	13	67	8
110 - 114	16	35	14	70	9
115 - 119	17	37	15	73	9
120 - 124	17	38	15	76	10
125 - 129	18	40	16	79	10
130 - 134	19	41	17	82	11
135 - 139	20	43	17	85	11
140 - 144	20	44	18	88	11
145 - 149	21	46	19	91	12
150 - 154	22	47	19	93	13
155 - 159	23	48	20	96	13
160 +	23	50	20	99	13

Note : The above table assumes no defects other than the pipe and the drying checks occur in the log. The impact of other defects will have to be allowed for.

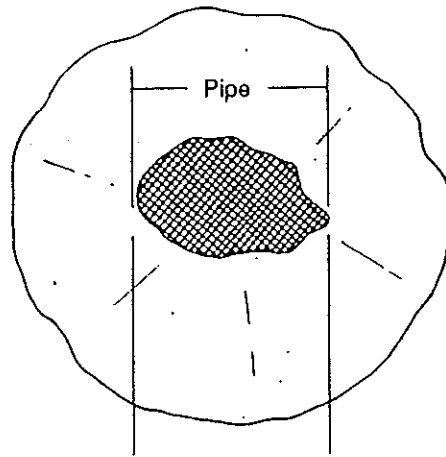
# Pipe Defect (General)

The measurement of pipe defect, in relation to the centre diameter underbark of the log, will classify a log as either compulsory or optional, or if butting or heading is required.

Pipe defect may be related to open ring shakes, or to heart breakdown caused by fungal attack, termites or borers resulting in wood disintegration or degeneration.

In measuring pipe the greatest diameter of the pipe should be measured to the nearest centimetre.

Blood rings which are not tight are regarded in the same way as open ring shakes.

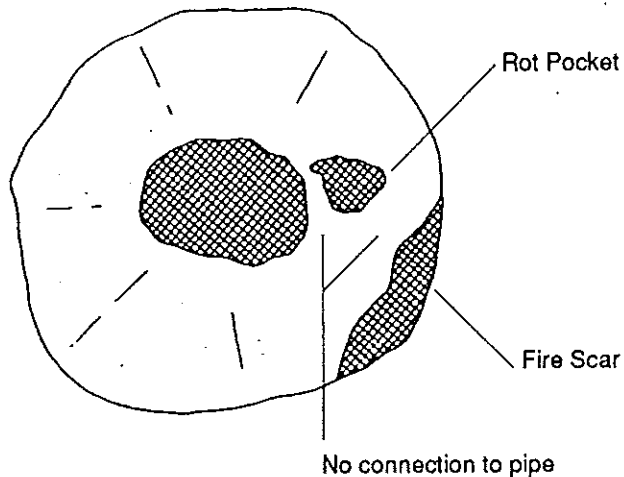


Pipe measurement is taken across the greatest diameter to the nearest centimetre.

**Example:**

Actual pipe measurement = 42.6 cm. Pipe dimension to the nearest whole centimetre is 43 cm.

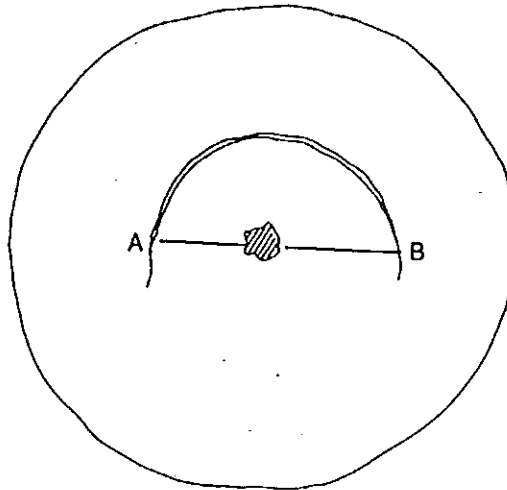
Actual pipe measurement = 42.3 cm. Pipe dimension to the nearest whole centimetre is 42 cm.



Rot pockets and fire scar are not included in the measurement of pipe, if not connected by defective wood to the main pipe.

# Pipe Defect (Open Ring Shake – considered as Pipe)

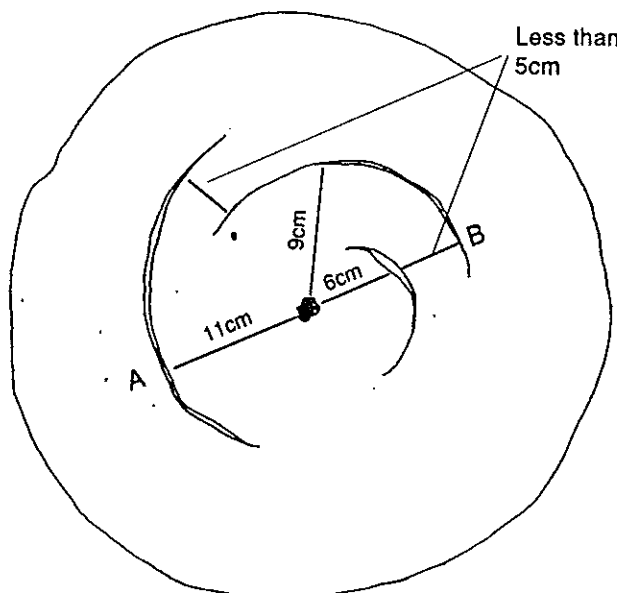
An open ring shake which is more than semi-circular is considered as pipe and allowed accordingly.



Diameter of pipe allowed will be actual measured distance A - B, i.e. if distance A - B = 30 cm, pipe allowed will be 30 cm.

A series of open ring shakes which collectively would amount to more than a half circle provided that:-

- (i) the radial distance of such ring shakes from the heart centre of the log does not vary by more than five (5) centimetres;
- (ii) the common sector of overlapping ring shakes is counted only once.



In the illustration above, as the distance between ring shakes is less than five (5) centimetres, pipe dimension will be A - B centimetres.

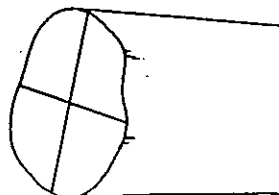
# Pipe Defect (Open Ring Shake – considered as Pipe)

A series of open ring shakes which would collectively amount to more than a half circle are to be considered pipe provided that:-

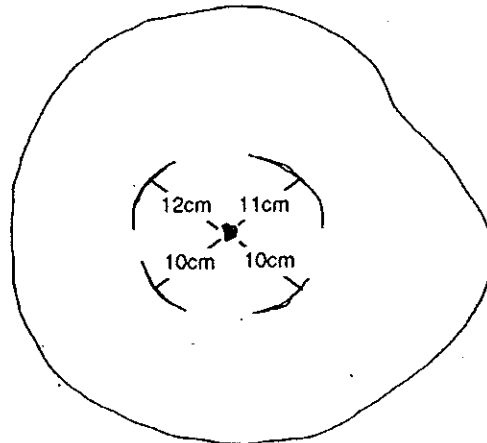
- The radial distance of such ring shakes from the heart centre of the log does not vary by more than five (5) centimetres.



Heart Centre



True Centre

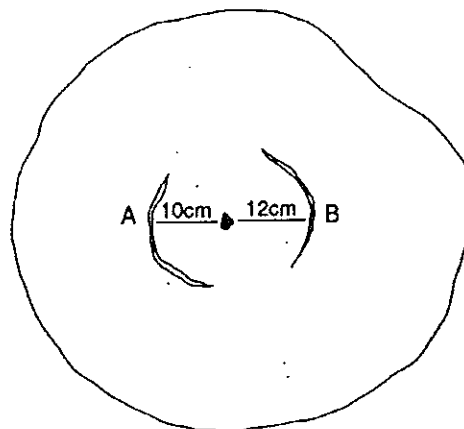


In the illustration above the radial distance of the four (4) ring shakes, from the heart centre of the log, does not vary by more than five (5) centimetres, and as the four ringshakes when added together amount to more than a half circle, pipe defect is allowable.

Actual pipe measurement in this case is the larger diameter, A – B cm.

A series of open ring shakes which would collectively amount to more than a half circle are to be considered pipe provided that:-

- The radial distance of such ring shakes from the heart centre of the log does not vary by more than five (5) centimetres.



In the illustration above, ring shake "A" is 10 cm radial distance from the heart centre, ring shake "B" is 12 cm.

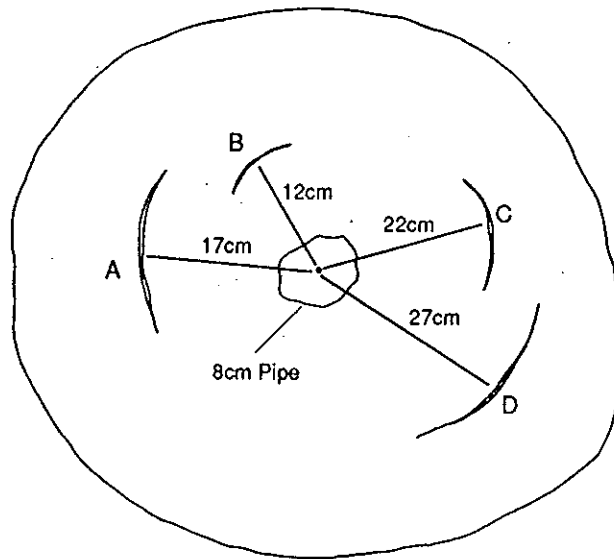
As radial distance of the two ring shakes varies by only two (2) centimetres, and as ring shakes "A" and "B", when added together amount to more than a half circle, pipe defect is applicable.

# Pipe Defect (Open Ring Shake – not considered as pipe)

"A" and "B" varying by five (5) centimetres or less in radial distance from the heart centre but are not semi-circular.

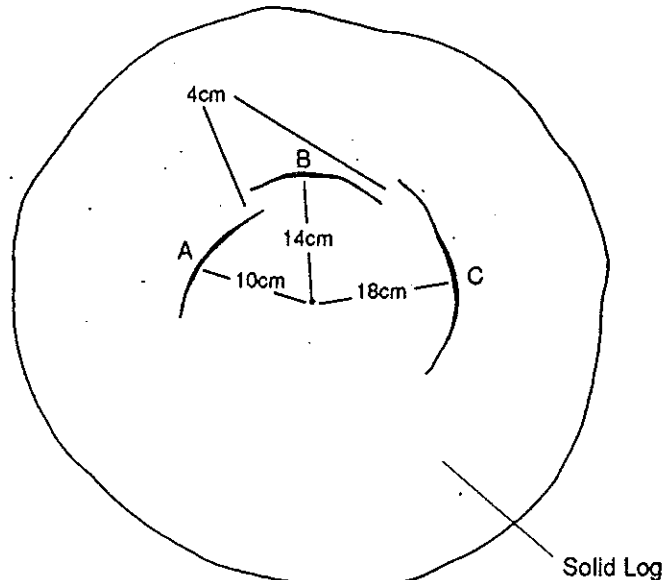
"A" and "C" and "C" and "D" likewise.

Pipe allowed in this log would be the 8 cm pipe.



"A" and "B" varying by less than five (5) centimetres in radial distance from the heart centre but not semi-circular.

"A" and "C" are not considered because they vary by more than five (5) centimetres from the heart centre of the log.



# Pipe Scale

The scale for classifying logs as compulsory or optional is shown in the table hereunder.

Centre Diameter of Log under bark (centimetres)	Removal Compulsory if if pipe is not greater than – (centimetres)
30-34 inclusive	5
35-39	17
40-44	20
45-49	24
50-54	28
55-59	31
60-64	34
65-69	38
70-74	42
75-79	45
80-84	48
85-89	51
90-94	55
95-99	58
100-104	61
105-109	65
110-114	68
115-119	71
120-124	74
125-129	77
130-134	80
135-139	83
140-144	86
145-149	89
150-154	91
155-159	94
160+	97

# Species Codes

The attached list sets out the standard codes for the most commonly logged species.

Blackbutt	BBT
Blackbutt New England	NEB
Bloodwood Brown	BBW
Bloodwood Yellow	BBW
Bloodwood Red	RBW
Box Brush	BBX
Box Grey	GBX
Box Gum topped	GBX
Box Sydney Blue	SBG
Gum Grey	GRG
Gum Spotted	SPG
Gum Lemon Scented	SPG
Gum Forest Red	FRG
Gum Rose	RSG
Ironbark Grey	GRI
Ironbark Broadleaved Red	BRI
Ironbark Narrowleaved Red	NRI
Mahogany Red	RMY
Mahogany White	WMY
Messmate Gympie	GMS
Peppermint Queensland	QPM
Stringybark White	WSK
Tallowood	TWD
Turpentine	TRP

### XCPT (Exception) Codes

- C = Compulsory
- L = Optional
- N = No Log
- H = Hung Up
- D = Dud
- G = Girder
- T = To Come
- S = Optional Log due to spiral grain at minimum stumpage
- E = Optional Log due to diameter at minimum stumpage.



# Native Forest Sawlog Accredited Cutters Docket Book

FS10734

Docket No.

①

Date of Cutting         ②

Purchaser ..... ③

T.C.S.P. No.       ⑤

Cutter's Name ..... ⑥

Area Code..... ⑦

Cutter's Code    ⑩

*QFS Use Only*

Measure Centre <input type="text"/> <input type="text"/> ③	Purchaser Code <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> ④
Sale Unit <input type="text"/> ⑥	Statistical Area <input type="text"/> <input type="text"/> ⑦
Tenure <input type="text"/> <input type="text"/> ⑧	Parish <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> ⑨
Reserve/portion <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> ⑩	E.C.L. <input type="text"/> <input type="text"/> ⑪
Logging Area <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> ⑫	Cpt. No. <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> ⑬
Sub-Cpt. No. <input type="text"/> <input type="text"/> ⑭	Planting <input type="text"/> <input type="text"/> <input type="text"/> ⑮
Special Action <input type="text"/> <input type="text"/> ⑯	Logging Type <input type="text"/> <input type="text"/> <input type="text"/> ⑰
Product <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> ⑱	Crown Hammer <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> ⑲
Number of Logs <input type="text"/> <input type="text"/> ⑳	Total of Diameters <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> ㉔

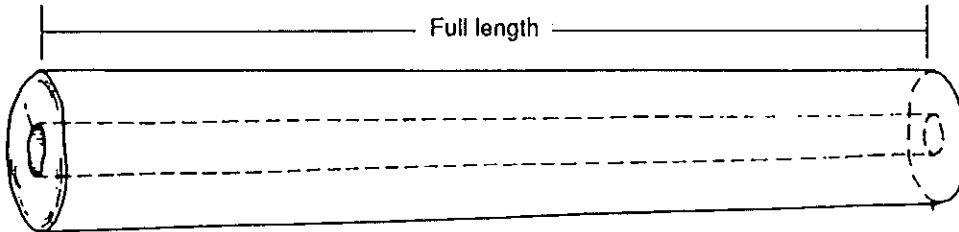
Ref. No.	Log No.	Lgth. (MX10)	Centre Diam.	Species Code			XCPT Code	Remarks	Ref. No.	Log No.	Lgth. (MX10)	Centre Diam.	Species Code			XCPT Code	Remarks
01	091	72	35	G	R	I			21	<del>109</del>	96	35	W	M	M		
02	092	51	44	R	S	G	L	Bends	22	109	96	35	W	M	Y		Not marked damaged by 108
03	093	90	39	W	M	Y			23	110	111	60	B	B	X		
04	094						N		24	111	30	31	B	B	X	L	Comp. Pipe
05	095	105	54	R	S	G			25	112	24	33	B	B	X	L	
06	096		53	R	S	G	D		26	113	138	39	G	B	X		
07	097	66	48	G	R	G			27	114	90	44	T	W	D		
08	098	81	65	W	M	Y			28	115		65	S	B	G	D	
09	099	51	61	W	M	Y			29	116	117	60	G	R	G		
10	100	69	79	T	W	D			30	117	123	51	G	R	I		
11	101	75	39	G	R	I	L	Pipe	31	118	105	35	G	R	I		
12	102	114	83	W	M	Y			32	<del>119</del>	<del>90</del>	<del>26</del>					
13	<del>103</del>	<del>27</del>							33	119	30	58	S	P	G		
14	103	72	85	F	R	G			34	<del>119</del>							
15	104	18	48	W	M	Y	L		35	120	24	27	S	B	G	E	
16	104	81	48	W	M	Y			36	121	33	29	S	B	G	L	
17	105	60	76	G	R	G	H	Hung Up	37	122	48	65	N	R	I	S	
18	106						N		38	123	24	48	N	R	I	L	Limbs
19	107	24	31	N	R	I	L	Bends	39	124			S	P	G	G	6.5 x 410
20	108	81	52	G	R	G			40	125		82	S	P	G	D	

I hereby declare that to the best of my knowledge the information set out above is true and correct. Cutter's Signature: \_\_\_\_\_

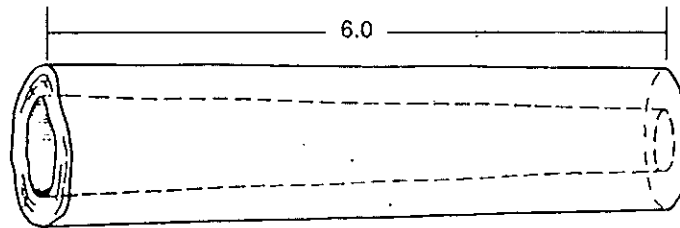
Date received by Measurer \_\_\_\_ / \_\_\_\_ / \_\_\_\_, checked \_\_\_\_ / \_\_\_\_ / \_\_\_\_. Measurer's Signature: \_\_\_\_\_

# Pipe Defect – Single Logs

A pipe so measured shall apply for the full length of a compulsory log, and for the full length of an optional log 6.0 metres or less in length.



## 1. Full Rate Compulsory Log



## 2. Optional Log

### Classification of Optional Logs

Logs presented as optional because of pipe defect must be classified in the following number of sections although they may be removed in longer lengths:

Log Length (m)	"Splitting" Restricted
2.4 to 6.0m	Nil splitting allowed
6.3 to 9.0m	1 split allowed
≥ 9.3m	Multiple splits allowed to the minimum log length of 2.4m

## Pipe Defect – Multiple Logs

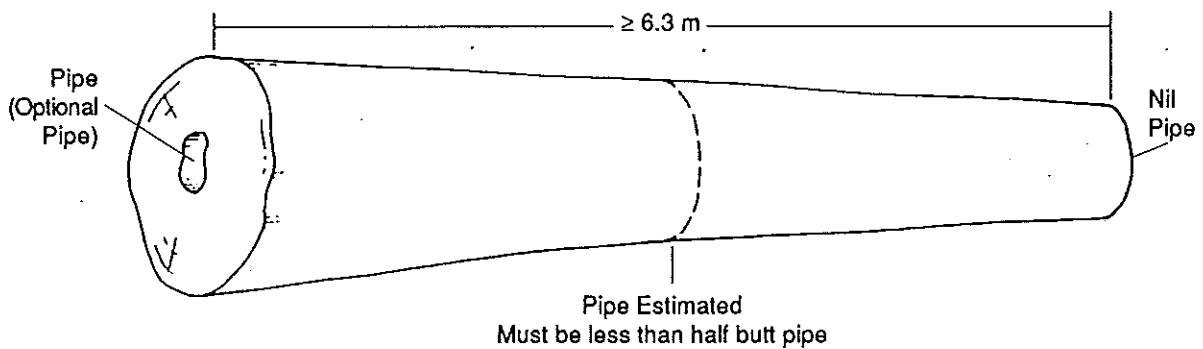
Where the butt log shows a pipe and the head shows no pipe, the pipe of the top log will be estimated but must be less than half that of the butt log.

If both logs when so measured are classed as compulsory the full length log should be recorded as one log with one length and centre diameter.

If both logs when so measured are classed as optional the log should be recorded as one log with one length and centre diameter classed as optional if acceptable to the purchaser.

If any dispute should arise over the estimation of pipe of a dual log the purchaser has the right to crosscut the log to enable actual measurement to be made.

If a log cut and properly presented falls into the optional class but is unacceptable to the purchaser as such, it should be re-examined. If any section 2.4 metres or more in length is estimated to be compulsory the original log will be remeasured and removal of such compulsory length will be required.



As a general principle it should be noted that while optional logs may be recorded in lengths in excess of 6.0 metres, optional logs 6.3 metres or longer in length must be measured and classified as two or more logs.

# Pipe Defect – Multiple Logs

For logs 6.3 metres or more in length when a pipe so measured indicates that all or part of the log may be optional the following procedure will apply:

The log is to be remeasured as two logs of approximately equal length.

The centre diameters of these logs can be obtained either by:

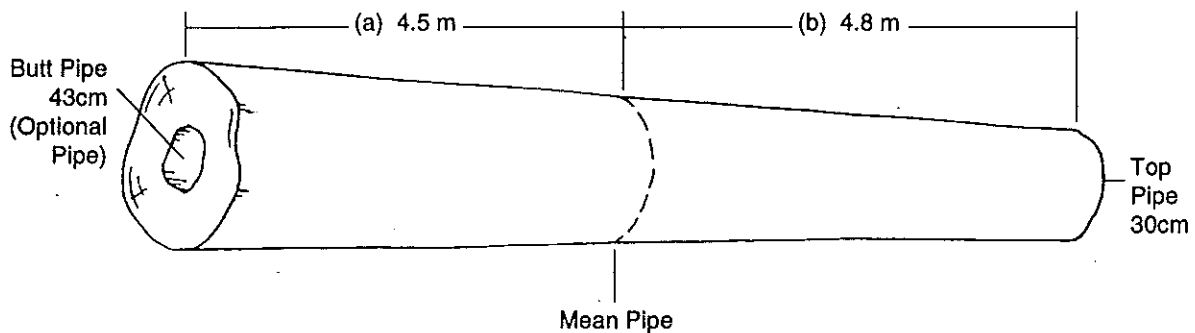
- (i) actual measurement, or
- (ii) by utilising the following taper differences from the original centre diameter measurement:
  - (a) log length 6.0 metres or less: 1 centimetres;
  - (b) log length 6.3 to 9.9 metres or less: 2 centimetres;
  - (c) log length 10.2 metres or more: 3 centimetres.

The purchaser has the option to physically measure these diameters.

The pipe measurement of the butt section will be considered with the centre diameter of the butt section as determined above.

The method of determining pipe measurement for the top log in all cases will depend on circumstances as follows:

Where the dual log shows pipe at each end and the defect is considered to carry through the dual log, the pipe of the top log will be the mean of the pipe at the butt and the pipe at the head.



Log (a) Pipe at butt = 43 cm

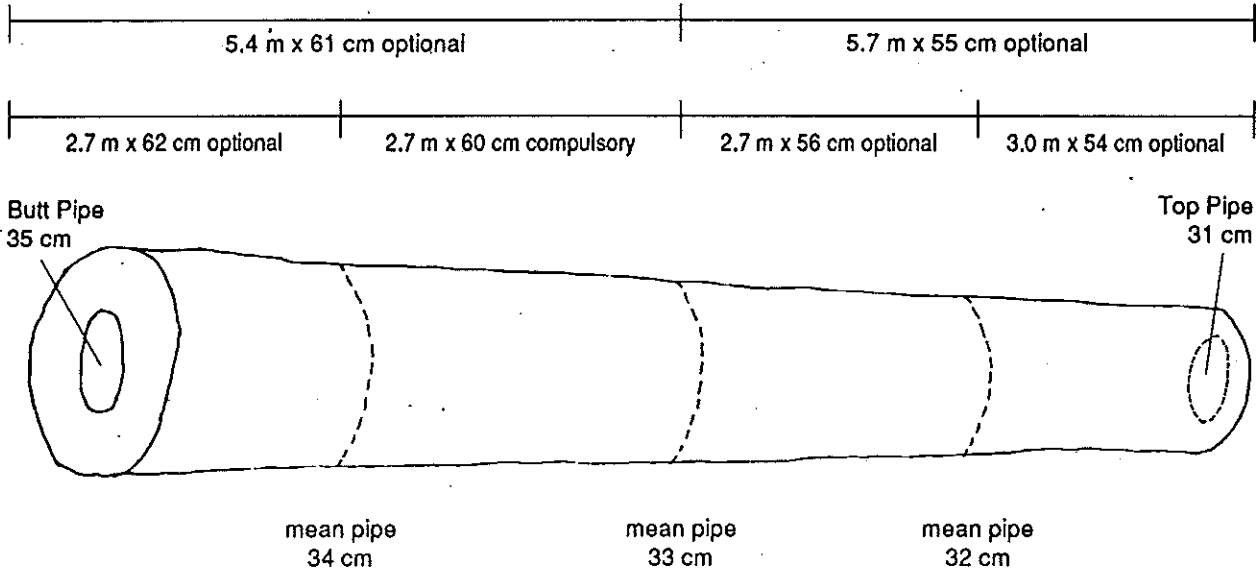
Log (b) Pipe at head = 30 cm

$$\text{Pipe allowance log (b)} = \frac{43 + 30}{2} = \frac{73}{2} = 36\frac{1}{2} \text{ cm} = 37 \text{ cm}$$

As pipes are not calculated in half centimetres, in all cases where this occurs it is taken up to the next whole centimetre. Therefore example above would be taken to 37 cm.

**Hardwood Cutter Guidelines**

Original Dimensions 11.1 m x 58 cm



**1. First Remeasure (Split)**

5.4 m x 61 cm optional

5.7 m x 55 cm optional

**2. Second Remeasure (Split)**

2.7 m x 62 cm optional

2.7 m x 60 cm compulsory

2.7 m x 56 cm optional

3.0 m x 54 cm optional

Therefore the bole should be recorded as three logs as follows:-

2.7 x 62 optional

2.7 x 60 compulsory

5.7 x 55 optional

# Compulsory Pipe

Logs of the following species attract a minimum pipe of 8 centimetres even if solid. Hence any log of these species less than 35 centimetres centre diameter will be classed as optional. Where a purchaser declines to accept this log, then an attempt is to be made to obtain a compulsory log out of the butt section.

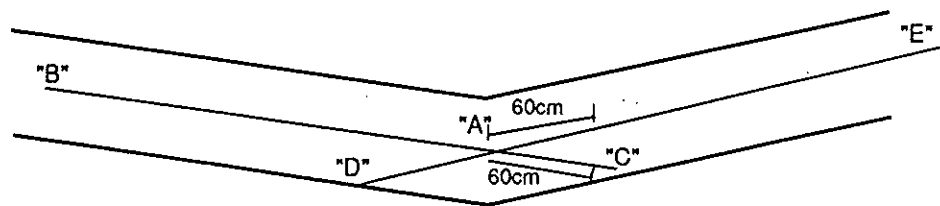
Red Mahogany  
 Blackbutt  
 Rose Gum (Flooded Gum)  
 Forest Red Gum (Fraser Island)  
 Killarney Ash  
 Brush Box

# Bends

Log sections containing a bend in excess of the following limits will be optional and charged at optional rates if removed provided that in all cases the tree bole is cut to best advantage to eliminate bends as far as possible.

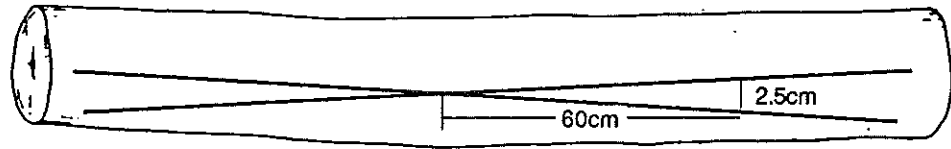
- Logs up to 40 centimetres centre diameter underbark - 2.5°
- Logs 40 centimetres - 49 centimetres centre diameter underbark - 5°
- Logs 50 centimetres and over centre diameter underbark - 10°

## Method of Measurement of a Bend

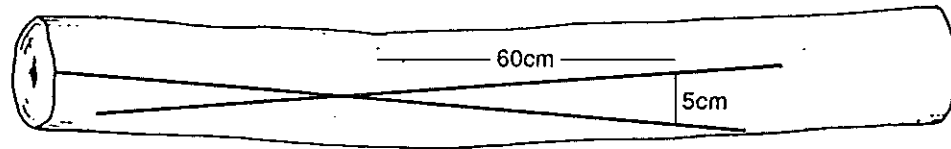


1. Select the centre of the bend ("A").
2. Determine the centre line of a straight section, extend through the centre of the bend and mark on the log ("B" to "C").
3. Determine the centre line of the other straight section, extend through the centre of the bend and mark on the log. ("D" to "E").
4. Measure a point 60 cm from the point of intersect "A", and measure the distance between the two lines.

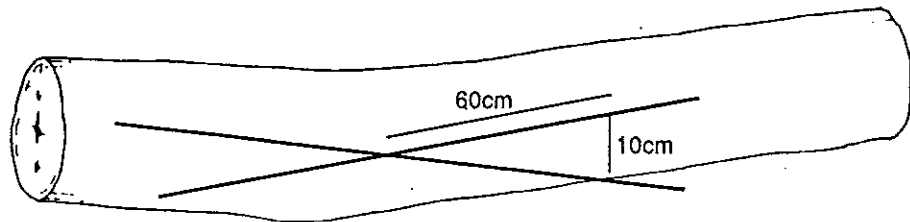
**Minimum Log Standards:** Maximum acceptable bend in logs less than 40 cm C.D.U.B. Log with a 2<sup>1</sup>/<sub>2</sub>° bend.



**Minimum Log Standards:** Maximum acceptable bend in logs 40 cm to 49 cm C.D.U.B. Log with a 5° bend.



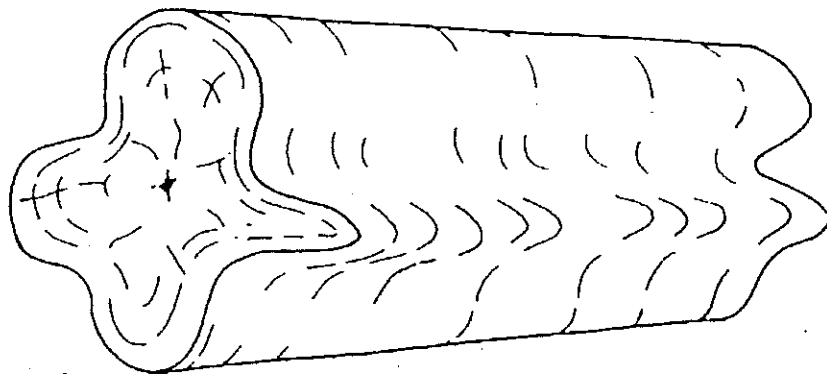
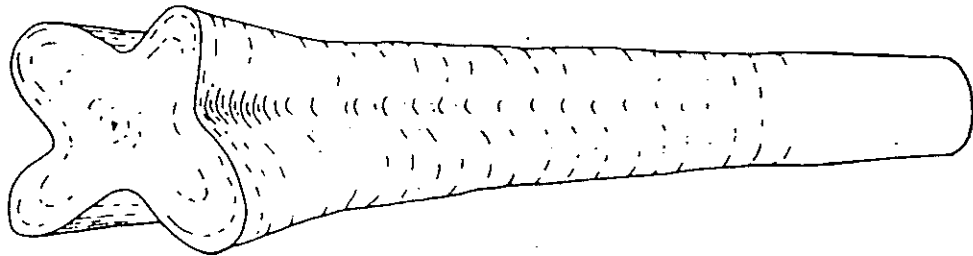
**Minimum Log Standards:** Maximum acceptable bend in logs 50 cm C.D.U.B. and over. Log with a 10° bend.



# Irregular Shape

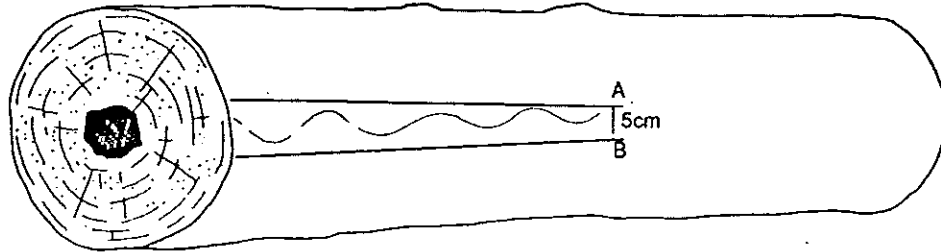
Where the amount of irregular shape is excessive, logs should be treated as optional.

Sections of Brush Box logs carrying fluting, bulbous butts or sharp taper should be regarded as optional.



## Wavy Grain

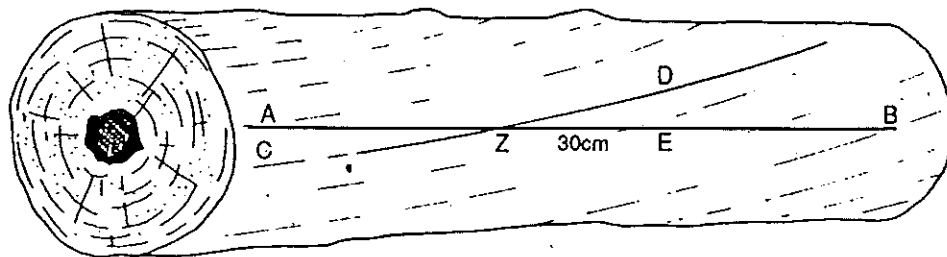
Where excessive coarse wavy grain occurs in Brush Box, logs should be treated as optional. It should be measured at centre diameter, on the wood and at right angles to the "wave's" longitudinal direction. As a guide, it would be considered excessive if the curl or wave in the grain is greater than 5 centimetres. Coarse wavy grain is not to be regarded as spiral grain.



If the distance AB is greater than 5 centimetres the log should be classed as optional.

## Spiral Grain

Spiral grain should be measured at centre diameter, and a log will be optional if the slope of the grain is worse than 1:6 on the wood. The degree of spirality should be measured from the longitudinal axis of the log.



Centre diameter = "Z"  
 Axis of the log = "A" to "B"  
 Slope in grain = "C" to "D"

Measure 30 cm from "Z" to "E"

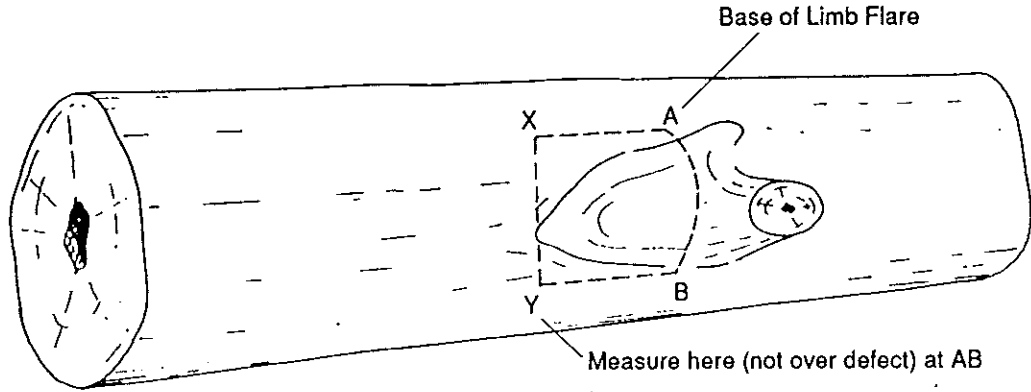
If "D" to "E" is greater than 5 cm the slope in grain is more than 1:6.

Where such spiral grain logs are taken by the purchaser they will be charged for at minimum stumpage. The Exception Code (XCPT) for such is S.

# Limbs

A limb should be taken into account when its underbark diameter measured at right angles to the axis of the log, and at the surface of the log is 10 centimetres or more.

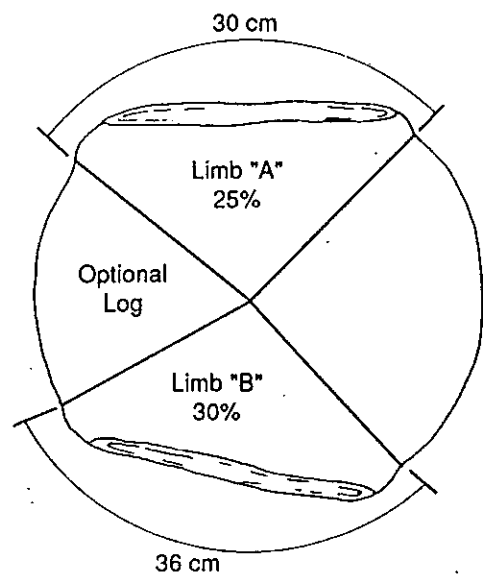
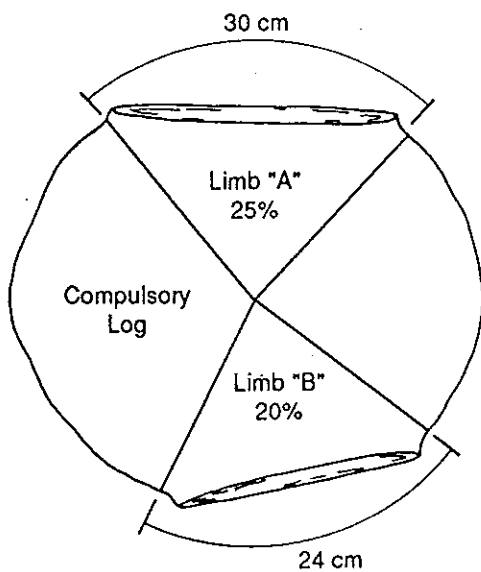
If more than one limb is to be considered, the overlapping section is to be counted only once.



Percentage of the round of the log affected will be the relationship between the distance XY and the circumference of the log at that point.

## Limbs at the Same Height

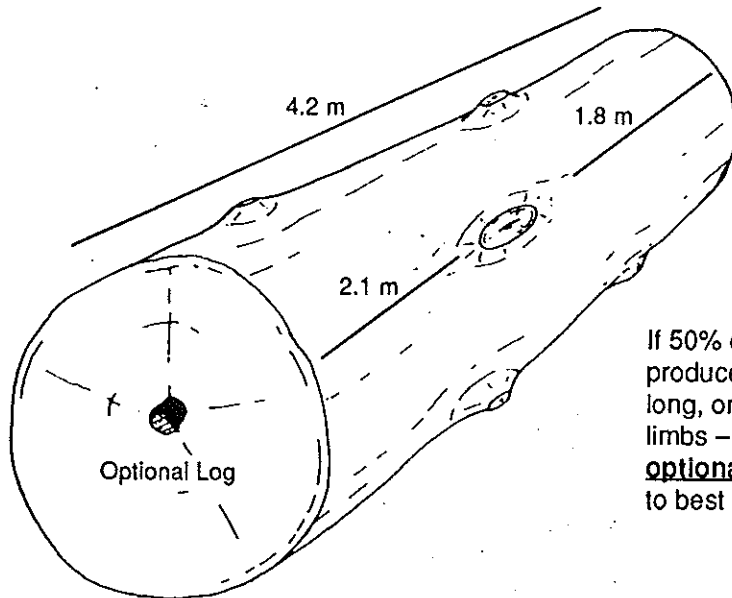
Limbs which affect less than 50% of the log individually may affect more than 50% of the log when added together.



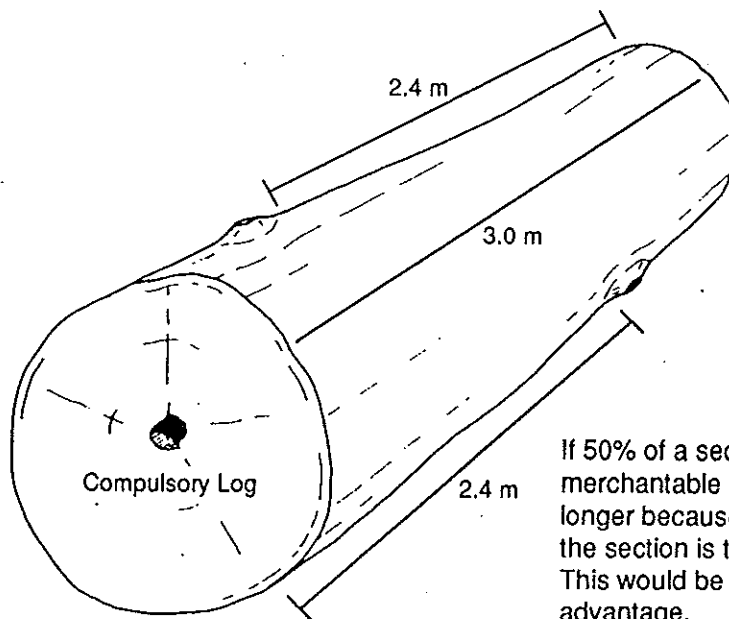
Where the log circumference is taken as 120 cm at this point.

# Limbs

## Position of Limbs



If 50% of a section of a tree bole will **not** produce merchantable sawn timber 2.4 m long, or longer because of the position of the limbs – the section is to be regarded as **optional**. This would be contingent on cutting to best advantage.



If 50% of a section of a tree bole will produce merchantable sawn timber 2.4 m long, or longer because of the position of the limbs – the section is to be regarded as **compulsory**. This would be contingent on cutting to best advantage.

# Bumps

A bump should be allowed according to the assessment of what the bump conceals and should be dealt with as for limbs if they are estimated to conceal a limb of 10 centimetres diameter or more.

Cutting into the round of the log to prove a defect is not to be carried out.

**TABLE 1**

Blackbutt	BBT
Blackbutt New England	NEB
Bloodwood Brown	BBW
Bloodwood Yellow	BBW
Bloodwood Red	RBW
Box Brush	BBX
Box Grey	GBX
Box Gum Topped	GBX
Gum Sydney Blue	SBG
Gum Grey	GRG
Gum Spotted	SPG
Gum Lemon Scented	SPG
Gum Forest Red	FRG
Gum Rose	RSG
Ironbark Grey	GRI
Ironbark Broadleaved Red	BRI
Ironbark Narrowleaved Red	NRI
Mahogany Red	RMY
Mahogany White	WMY
Messmate Gympie	GMS
Peppermint Queensland	QPM
Stringybark White	WSK
Tallowood	TWD
Turpentine	TRP

TABLE 2

Centre Diameter of log under bark  (centimetres)	Removal compulsory if pipe is not greater than (centimetres)
30-34 inclusive .....	5
35-39 " .....	17
40-44 " .....	20
45-49 " .....	24
50-54 " .....	28
55-59 " .....	31
60-64 " .....	34
65-69 " .....	38
70-74 " .....	42
75-79 " .....	45
80-84 " .....	48
85-89 " .....	51
90-94 " .....	55
95-99 " .....	58
100-104 " .....	61
105-109 " .....	65
110-114 " .....	68
115-119 " .....	71
120-124 " .....	74
125-129 " .....	77
130-134 " .....	80
135-139 " .....	83
140-144 " .....	86
145-149 " .....	89
150-154 " .....	91
155-159 " .....	94
160+ .....	97

## Part 1b: Assessment of current practices and plantation teak log quality in Lao PDR

### Introduction

From information gathered during an industry survey undertaken by the project team in late 2012 and early 2013, it was found that plantation teak logs are not currently graded, although native forest logs of other species are graded by the government.

Several companies were surveyed for log grading and sawing recovery studies during May 2014, and later re-visited. It was found that many of these companies purchase part-processed squared billets, rather than round logs, which makes handling and storage easier. In some cases, logs certified under the Forest Stewardship Council (FSC) system were available.

### Dimensions

The material supplied to partner sawmills ranges in section size from 10 x 10 cm to 20 x 20 cm for square billets and up to 30 cm diameter for the round log resource (Table 1).

**Table 1. Plantation teak resource data**

Company	Resource	Size (cm)	Length (m)	Products
Khamphai Sana	round logs	15+		furniture
Viengniyom Factory	square billets	13-20	2.1-2.2	furniture
TNK Furniture	square billets	10-20		furniture
Sone sawmill	round and square	10-25	2.2	boards, furniture
Somsakid	square	13-20	2.1-2.1	furniture
Changsavang	round			furniture, doors, windows
Phengmoungkhoun	round	30	2.0	furniture
Pongwan	round and square	10-20		boards, furniture, flooring
Changpheng	round and square	20+	2.2	boards, furniture

### Surface quality

Some of the squared billets are hewn with a chainsaw, leaving a rough and uneven surface that results in lower recoveries compared to sawn (circular or bandsaw) squares, which have comparatively flat surfaces.

### Log pricing

The current pricing system in Lao PDR for plantation teak is based on dimensions of the log or square billet. However, most grading specifications and systems discovered during the literature review are based on the presence or absence of defects, which align to the

suitability for products. The current system in Lao PDR is simple and appears to work well; the price agreed between seller and buyer is based on dimensions. For example a 10 x 10 cm billet costs half that of the same volume of a 20 x 20 cm billet (Table 2.).

**Table 2. Squared logs: indicative purchase cost, Lao PDR, 2012**

Dimension (cm)	Price per m <sup>3</sup> (LAK)
10 x 10	1.3 million
10 x 20	1.3 million
15 x 15	2.08 million
20 x 20	2.86 million

Source: Redman et al. 2014.

Some plantations in Lao PDR have achieved Forest Stewardship Council (FSC) certification. The logs from these plantations should attain a higher premium than logs from non-certified plantations. The premium suggested to reflect the added value is 10% more than the rate paid for non-certified logs irrespective of grade quality.

Butt logs cut from the lower section of the tree provide larger sections and are generally considered higher quality. However, log value based on dimension and higher quality is assumed, not assessed by the combined impact of defects, as is normal practice in many countries.

## Storage

Round logs are stockpiled in open log yards, and one company uses tarpaulins to provide some weather protection. Most sawmills store their squared billets under roof cover.



**Plate 1. Square billets stored under cover, ready for processing.**

## **Bibliography for Part 1b**

Redman A. Hopewell G. and Bouaphavong D. 2014. Current production practices and processing efficiency — industry survey results. Report to ACIAR FST/2010/012.

## Part 2: A log grading system for Lao PDR

### Introduction

The following log grading system has been developed as an activity within the ACIAR Project FST/2010/012 *Enhancing key elements of the value chains for plantation-grown wood in Lao PDR*. Within this project, Activity 2.2 is 'Improve or implement log grading/segregation activities at the mill prior to processing' with the required output being a user-friendly manual for log grading and segregation rules for SME sawmills in Lao PDR. This document is provided as that output.

The aims of this Manual are to provide a benchmarking system for log quality, to help growers achieve a fair value for their trees, and to enable sawmillers to specify and pay for logs of a known quality, ensuring that the wood and products will meet the requirements of their customers.

The guidelines are issued as a first edition and may be superseded or refined in the future if the needs of the stakeholders change, the nature of the resource changes (for example through improved silvicultural management resulting in higher quality logs), or if new products and markets are developed that require a different suite of grade descriptors than those provided here.

These guidelines were developed after a review of the literature and assessment of current practices and log qualities during factory visits in Lao PDR. The rules build on the current system, which is based on dimension only, by adding quality parameters relevant to the target end products (furniture, door and window joinery, flooring and decking).

### Documentation

It is recommended that a Wood Purchase Agreement is drawn up between the supplier and processor, listing the desired volume, minimum grade quality and dimensions. This order should specify if chainsaw-hewn squares are acceptable or only sawn squares with a higher quality surface such as produced by a bandsaw or circular saw. The order should also note if nails, screws, barbed wire or other metal fittings and foreign objects are to be removed prior to delivery.

The supplier should supply all relevant and necessary documents in accordance with Lao PDR legislation, where applicable, such as:

- *Plantation License* details
- *Cutting Permission*
- *Wood Moving Agreement* as issued by the District Forest Office and village if required;
- *Wood Moving Certificate* issued by Province or Prefecture Forest Office noting the total volume allowable for transport;
- *Loading Certificate*;
- *Bonded Transport Certificate*;
- *FSC certification* details if applicable;

Ideally the seller's representative and the purchaser should check the volume and grade quality together and agree on all aspects of the transaction at this time.

## **Pricing**

Fair prices are a matter of agreement between the grower and purchaser, although it is expected that rates might increase from chainsaw-hewn, to sawn squares, due to the higher surface quality and implied higher recovery in the latter.

A buyer's premium of 10% could apply to logs from certified plantations, for example forest Stewardship Council FSC Certification.

Transport costs will be negotiated between seller and the factory and should reflect the haulage distance from the supply region to the factory gate.

## **Square billets**

### **Minimum length**

Square billets and round logs will be cross-cut to maximise straight lengths in accordance with the buyer's written specification for length. In most cases this will be 2.0 to 2.2 m.

Shorter lengths may be supplied by agreement between both parties.

### **Section sizing**

Logs should be sawn to maximise face width, removing most of the bark. Sapwood is permitted as described in the heartwood minimum thresholds for each grade unless specified in writing to be excluded. The narrowest face should be no less than 10 cm.

### **Billet mensuration**

The length will be measured as the shortest length (if the end cut is sloping and not square to the long axis) or the end of a split where a severe end split is present.

Section sizes will be measured on the smallest face and rounded down to 10 cm (10 to 14.9 cm), 15 cm (15 to 19.9 cm), 20 (20 to 24.9 cm), etc.

## **Round logs**

### **Minimum length**

Square billets and round logs will be cross-cut to maximise the length in accordance with the buyer's written order specification.

### **Log mensuration**

The length will be measured as the shortest length if the end cut is sloping.

Where a severe end split that would affect sawn recovery is present, a reduction in length may be recorded as agreed by the seller and purchaser representatives so that the volume paid for is reduced accordingly.

## **Log storage and handling**

If logs are to be held in storage for prolonged periods before sawing, bark should be removed to prevent insect infestation and reduce the potential for damage to occur.

End-sealers should be used to retard development and severity of end checks.

Fungicides may be necessary to prevent against sapstain during the wet season where end products can't tolerate sapstained sapwood components.

### Log segregation

Logs and billets should be arranged on bearers to keep feedstock off the ground and avoid contamination with rocks and grit.

Logs and billets should be arranged in batches according to grade quality so they can be easily selected to match product orders.

Within graded batches, logs and billets should be arranged by diameter or section size, so that sawing patterns are the same for a batch.

### Grade descriptions

Classes are designated by alpha characters in preference to of numeric descriptors. This was adopted due to the inconsistent use of numeric systems in hardwood grading classifications between different countries, e.g. 1 is best in USA and SEALPA countries but 1\* is the lowest grade in Burma; whereas A grade always defines the best quality.

#### A grade

- best quality sawlog or square section billet
- suitable to produce feedstock for exposed components in high quality furniture, doors, windows, flooring and decking.

#### Heartwood

visual estimate of heartwood proportion on log or billet end:  
≥60%

#### Square section billets- minimum diameter heartwood for A grade

Section size (cm)	Minimum heartwood diameter (mm)
10 x 10	87
15 x 15	131
20 x 20	175
25 x 25	219

#### Round logs- minimum diameter heartwood for A grade

Log diameter (cm)	Minimum heartwood diameter (mm)
10	77
15	116
20	155
25	194
30	232

#### Decay

not permitted, check billet/log ends and knots

#### Knots

<5 cm Ø maximum of 3 knots per 2.0 m length  
>5 cm Ø not permitted

<b><i>Knot holes</i></b>	not permitted
<b><i>Insect holes/galleries</i></b>	not permitted, includes beetle, moth and termites
<b><i>Sweep</i></b>	maximum deviation 3% of length (e.g. 6 mm per 2.0 m length) double bends are not permitted
<b><i>Want/ wane</i></b>	visual estimate of face area: ≤5%
<b><i>Splits</i></b>	severe splits: reduce measured length to allow for effect of split
<b><i>Stain</i></b>	not permitted, unless within the want and wane tolerance
<b><i>Fluting</i></b>	diameter of rounds logs with excessive fluting shall be measured excluding the irregularity (diagram)

## **B grade**

- medium quality sawlog or square section billet
- suitable for feedstock for some exposed components and all hidden components in furniture, doors, windows, flooring and decking

### **Heartwood**

visual estimate of heartwood proportion on log or billet end:  
≥40%

#### **Square section billets- minimum diameter heartwood for B grade**

Section size (cm)	Minimum heartwood diameter (mm)
10 x 10	71
15 x 15	107
20 x 20	143
25 x 25	178

#### **Round logs- minimum diameter heartwood for B grade**

Log diameter (cm)	Minimum heartwood diameter (mm)
10	63
15	95
20	127
25	158
30	190

### **Decay**

not permitted, check billet/log ends and knots

### **Knots**

no limits if sound

### **Knot holes**

permitted if <5 cm Ø maximum of 3 knot holes per 2.0 m length  
holes >5 cm Ø not permitted

### **Insect holes/galleries**

permitted if within the surface area limits equivalent to knot hole limits

### **Sweep**

maximum deviation 5% of length (e.g. 10 mm/2.0 m)  
double bends are not permitted

### **Want/ wane**

visual estimate of face area: ≤20%

### **Splits**

severe splits- reduce measured length to allow for effect of split

### **Stain**

permitted

### **Fluting**

diameter of rounds logs with excessive fluting shall be measured excluding the irregularity (diagram)

## **C grade**

- lower quality
- utility sawlog

<b><i>Heartwood</i></b>	measure diameter of heartwood on log or billet end: $\geq 40$ mm
<b><i>Decay</i></b>	permitted
<b><i>Knots</i></b>	no limit
<b><i>Insect holes/galleries</i></b>	no limit
<b><i>Sweep</i></b>	no limit; double bends are not permitted
<b><i>Wane/ wane</i></b>	no limit
<b><i>Splits</i></b>	severe splits- reduce measured length to allow for effect of split, use reduced length for volume calculation
<b><i>Stain</i></b>	no limit
<b><i>Fluting</i></b>	diameter of rounds logs with excessive fluting shall be measured excluding the irregularity (diagram)