

# Making the Grade

A guide to appearance grading UK grown hardwood timber





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Unless otherwise stated, all photographs are by G R Brearley, Forest Research

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**Disclaimer**  
Appearance grading can only be a first approximation and it is always up to the customer to ensure that the characteristics of the timber selected will suit their envisaged use. In case of dispute, reference should be made to the relevant standards listed in the bibliography. While every effort has been made to ensure the accuracy of this publication, the authors, sponsors, and publishers cannot accept liability for any loss or damage arising from the information supplied.

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Clockwise from above

**This tabletop exploits the different appearance of several UK hardwood timbers.** *Woodschool Ltd*

**Where timber is to be steam bent the use of grade 1A timber is essential.**  
*C10 ash chair by David Colwell Design*

**This external cladding uses grade 2 oak with the sapwood removed.**  
*Earth Centre, Doncaster*

**The mixture of heartwood and sapwood in this grade 2 elm flooring gives a striking appearance.** *Out of Wood*

**Grade 2 oak used for decking at Harestanes visitor centre. Sapwood is removed and the grade excludes any large knots or other defects that would seriously weaken the timber in this semi-structural application.**



# Introduction

Photo: Leigh Simpson



**Wall-hung chest of drawers.**  
**Ebonised and natural English oak.**  
*Design by Wales & Wales*

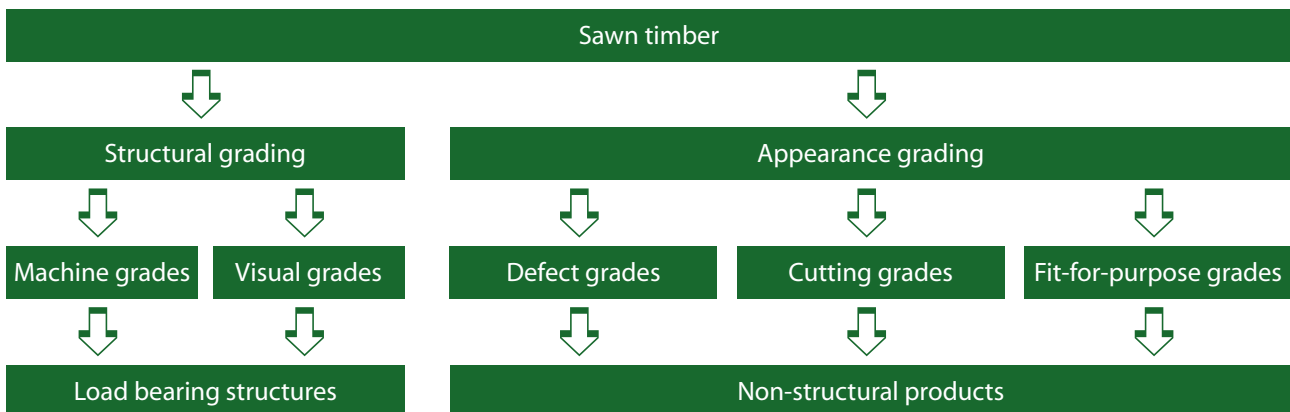
The aim of this guide is to encourage greater use of UK grown hardwoods. It provides information on the range of quality available from our sawn hardwood timber and highlights the special features of UK grown hardwoods that are often difficult to obtain from imports. The guide also gives information on timber measurement, the properties and uses of UK hardwoods, and an illustrated technical glossary.

Although not generally available in large volumes, UK hardwoods can be very decorative with a range of species and characteristics to choose from. The suppliers can add to this distinctiveness by being able to source timber from a local area or allowing the customer to select the specific boards required for a job. UK grown hardwoods can also be a sustainable choice – this results from the combination of high standards of woodland management and the short distances involved in transporting the timber from the forest to the customer.

The quality of sawn timber varies widely according to a range of factors including: the species, the growth conditions, the age of the tree when felled and the way it was converted into timber. In order that marketing can be rationalised and selection for a specific use simplified, this variety is usually sorted into similar groups – a process known as grading. The grades for sawn timber are divided into two categories – structural and non-structural. Grading for non-structural purposes is called appearance grading and this publication gives appearance grades applicable to hardwood planks and boards from trees grown in the UK.

Readers should note that appearance grading is not the same as visual grading, which is one of the methods used to assess the load-bearing characteristics of a piece of timber (see Fig. 1). Structural grading of UK grown hardwood timber is not dealt with in any depth in this guide because it is extensively covered elsewhere<sup>[1] [2]</sup>. The principles behind the main grading systems are described in the glossary.

**Figure 1. Summary of the different types of sawn timber grading**







In 1996 European Standard EN 975-1 introduced appearance grades for oak and beech [3]. Like all European standards, EN 975-1 has the status of a national standard in the UK - although not mandatory it is recommended as trade practice. The standard has, however, had a limited take-up amongst suppliers of UK grown hardwood, nor is widely understood by specifiers and end users. Many people feel that the lack of acceptance is due to the presentation of the standard being unnecessarily complex. It is also argued that the grades do not fully suit the characteristics of UK timber. Moreover the standard does not deal with other commercially important species such as ash and sycamore.

In response to these issues this guide has been published as a national commentary on EN 975-1. It was developed during 2003-04 through a combination of: desk research, testing in sawmills, consultation with representatives of the timber trade, specifiers and timber users, as well as research and governmental organisations throughout the UK.



As far as possible this guide follows the grading criteria in EN 975-1 and, in most respects, the grades given below are interchangeable with those in the standard. It has, however, been necessary to make some changes to accommodate the timber availability, species, characteristics, and resultant production methods found in the UK. Full details of these modifications are given in Appendix 1.

Many UK sawmills and timber merchants already use an appearance grading system of some kind and it is not the intention of this guide to explain every appearance grading option at every mill or to try to impose a one-size-fits-all scheme on the whole UK grown hardwood industry. Both of these would in any case be impossible. Instead, it is hoped that this guide will be useful, both to hardwood producers who are seeking to further develop their grading practices, and to specifiers and end users who want to learn more about the characteristics of UK hardwoods and how to obtain timber to meet their needs.



Top and centre  
**Solid wood furniture.** *Woodschool Ltd*

Above  
**Some large sawmills are beginning to use laser scanners to appearance grade their timber. To date this technique is mostly used with softwoods.**

Right  
**This stack of hardwood timber has just been removed from a drying kiln and is now being graded. Most appearance grading of UK hardwoods is done like this.**



# The appearance grading system used in this guide

The appearance grading system in this guide has been made as simple and logical as is possible given the range of species, timber qualities and trading practices found in the UK. The grades cover all hardwood species grown in the UK and apply to both square- and waney-edged timber. The grades are primarily determined by the presence, size or frequency of knots and splits on the best face of the plank or board. The characteristics of the worst face are only considered if they affect the performance of the timber in its intended use. A summary of the grading system used in this guide is given in Table 1.

## Grades

Three grades are used to describe the main features of a piece of timber:

- **Grade 1** describes planks and boards having a uniform appearance with few if any knots, splits or other features that would limit their use in applications where little variation in appearance is permitted. Equivalent to what is often called a 'clear' or 'prime' grade.
- **Grade 2** has some knots, splits or other features that limit use where uniformity of appearance is important. Nevertheless the piece will yield areas clear of unacceptable features along with timber suitable for applications where some variation is acceptable.
- **Grade 3** timber will include all manner of knots, splits, colour variation, and other features.

In most cases a simple assessment of the knots and splits will be sufficient to determine the grade. Occasionally, however, other timber characteristics may affect the grade and the piece may have to be downgraded even though the knot and split characteristics are acceptable, for example, discolouration may be an important limitation in light coloured species.

## Sub-Grades

Some mills or timber users may wish to make fine distinctions within a grade; to enable this, each grade can be split into two optional sub-grades. Though mainly intended for oak, these sub-divisions may occasionally be useful in other species, particularly sycamore and ash.

- 1A or 1B enables timber to be sorted into clear pieces and those with small knots.
- 2A or 2B permits planks and boards to be sorted according to knot size.
- 3A or 3B allows highly variable timber to be sorted. This is particularly useful for flooring.

**Table 1. The appearance grading system used in this guide**

<b>Species</b>	All UK hardwood species		
<b>Grades</b>	1	2	3
<b>Sub-grades (optional)</b>	A or B	A or B	A or B
<b>Type of edge</b>	Square- or waney-edged		
<b>Special features (optional)</b>	e.g. pippy, rippled, quarter sawn, spalted.		

### Type of Edge

The grading system in this guide allows both square and waney-edged timber to be graded using the same categories. Nonetheless the type of edge needs to be stated in all cases as this will affect the value of the timber. Pieces with one square- and one waney-edge are classed as waney-edged. Sapwood is not normally considered a defect. It can, however, be excluded on square-edged oak and sweet chestnut if these species are used out of doors (for the natural durability of their heartwood) or where a very uniform appearance is required with these two timbers. Sapwood cannot be excluded in other species.

### Special features

Hardwood timber grown in the UK tends to be more variable in appearance than European and North American imports. Thus, while it is usually possible to find UK grown hardwoods that are as uniform as imports, domestic suppliers can sometimes offer timber with decorative features or special sawing techniques that are difficult to source from abroad (Table 2). Where a feature is particularly pronounced, a supplier can highlight this in the grade description.

Table 2. The main special features of UK grown hardwood timber	
<b>Knots</b>	Pip, burr, character (chiefly in oak and elm)
<b>Colour</b>	Coloured ash, beech and sycamore
<b>Grain</b>	Rippled ash and sycamore
<b>Decorative stains</b>	Spalted beech, brown and Tiger oak, Tiger sweet chestnut.
<b>Sawing</b>	Quarter-sawn

The Scottish Parliament reception desk by David Colwell uses Scottish sycamore and English oak





## Grade descriptions

Grade descriptions should follow the standard format shown below. The essential components (grade/subgrade, edge, species) are always included, with any special features being given before the species name, for example:

- Grade 3 waney-edged ash
- Grade 1A square-edged sycamore
- Grade 2 square-edged spalted beech
- Grade 1B waney-edged quarter-sawn pippy oak

## Measuring-out

Measuring-out is a practice whereby planks and boards are measured in a way that excludes wane and some large defects from the volume of timber that is valued for sale. In effect the final dimensions of the piece are quoted as if the area containing any defects had already been removed before measurement. The area to be excluded around a defect is normally determined by how the piece of timber will be resawn - bearing in mind that all sawing has to be in straight lines (see Fig. 2). When measuring-out a defect it is normal practice to mark the piece to identify the area that is excluded. This grading system permits measuring-out of both waney- and square-edged timber.

Figure 2. Measuring-out

The features in these areas are graded as being acceptable



This grade 2 oak board has been measured to exclude the area of bark on the right - the area measured-out has been marked on the board using a vertical line.

These features are not acceptable and have been measured-out of the volume of merchantable timber

# Detailed grading criteria

The criteria for appearance grading planks and boards from UK grown hardwoods are given in Table 3. The numbers in the table refer to the footnotes on the opposite page.

<b>Table 3. Appearance grades for hardwood timber from the UK</b>						
Maximum size or extent of feature on the best face of the piece per specified length <sup>(1) (2)</sup>						
Features	The main grades					
	1	2	3			
<b>Fully and partly inter-grown knots</b> <sup>(3)</sup>	One ≤20mm diameter or several smaller up to a combined diameter of 20mm	Three ≤40mm diameter or several smaller up to a combined diameter of 120mm <sup>(4) (5)</sup>	No restrictions providing the appearance and mechanical properties are suitable for its intended use.  More detailed criteria may be set in the supply agreement <sup>(10)</sup>			
<b>Non inter-grown knots and rotten knots</b> <sup>(3)</sup>	Occasional if measured-out	Occasional				
<b>Checks</b>	Occasional surface <sup>(6)</sup>	Limits may be set <sup>(6) (7)</sup>				
<b>Shake</b>	No	Occasional if measured-out				
<b>Colour</b>	Limits may be set <sup>(7) (9)</sup>	No restrictions				
<b>Grain</b>	Straight or nearly straight <sup>(8)</sup>	Course grain and minor sloping grain permitted <sup>(8)</sup>				
<b>Bark</b>	One surface pocket if measured-out	One surface pocket if measured-out				
<b>Rot and insect attack</b>	No	One small area if measured-out				
<b>Warp</b>	Limits may be set <sup>(7)</sup>	Limits may be set <sup>(7)</sup>				
<b>Wane</b> (square-edged pieces only)	Limits may be set <sup>(7)</sup>	Limits may be set <sup>(7)</sup>				
<b>Sapwood</b> (oak and sweet chestnut only)	Limits may be set <sup>(7)</sup>	Limits may be set <sup>(7)</sup>				
The optional sub-grades						
	1a	1b	2a	2b	3a	3b
<b>Fully and partly inter-grown knots</b> <sup>(3)</sup>	No	As grade 1 above	Three ≤25 mm or several up to a combined diameter of 75 mm <sup>(4) (5)</sup>	As grade 2 above	One ≤80 mm or several up to a combined diameter of 80 mm <sup>(5)</sup>	As grade 3 above
<b>Non inter-grown knots and rotten knots</b> <sup>(3)</sup>	No		No			
<b>Checks</b>	No		As grade 2 above			
<b>Shake</b>	No					
<b>Colour</b>	Limits may be set <sup>(7) (9)</sup>					
<b>Grain</b>	Straight <sup>(8)</sup>					
<b>Bark</b>	No					
<b>Rot and insect attack</b>	As grade 1 above					
<b>Warp</b>						
<b>Wane</b> (square-edged pieces only)						
<b>Sapwood</b> (oak and sweet chestnut only)						

### Notes on Table 3

1.	The table gives the maximum size or extent of features permitted per: <ul style="list-style-type: none"> <li>■ one metre length in the case of square-edged pieces</li> <li>■ two metre length in the case of waney-edged pieces.</li> </ul>
2.	For the worst face, all listed characteristics are allowed, providing that they do not interfere with the mechanical properties of the piece, or otherwise limit its performance in use. Where it is essential that both faces are the same grade, this must be specified by the purchaser in the supply agreement. Knots are considered on the edges.
3.	Knot sizes are given as the diameter or, for oval knots, the average of the largest and smallest width. Occasional pin knots below 5mm diameter are not considered.
4.	Larger knots are allowed on 25% of boards in a batch if they are measured-out.
5.	Maximum knot diameter to be less than 1/3 the width of the piece.
6.	Occasional splits in sound knots are permitted.
7.	In these cases limits may be set by the customer in the supply agreement, for example colour variation may be excluded in light coloured species such as ash or beech.
8.	Wavy-grain is accepted providing that it can be regarded as a special decorative feature that will not limit the performance of the piece in its intended use.
9.	Surface stains are not generally regarded as a defect providing that they do not penetrate into the timber. Sticker-marks and other penetrating stains are not permitted in grade 1 pieces and may be excluded in grade 2.
10.	Where the grade is specific to a customer's intended use it is always the buyers responsibility to identify the appropriate appearance and mechanical properties for that end use.

**The following pages illustrate the different grades and sub-grades, for the most commercially important hardwood species grown in the UK:**

<b>Ash</b>	<b>Lime</b>
<b>Beech</b>	<b>Oak</b>
<b>Cherry</b>	<b>Sweet chestnut</b>
<b>Elm</b>	<b>Sycamore</b>

Although only eight species are illustrated, the same grades can also be used with less commonly encountered hardwoods such as alder, birch, or walnut providing it is accepted that not all of the grades will be readily available in these minor timbers.

The photographs are designed to show the full range of features that are acceptable within a particular grade and, for clarity, the timber has been finished before it was photographed. In practice however pieces of hardwood timber are usually sold before they have been finished and may therefore have surface stains which will subsequently be removed.

# Ash

See Table 3 on page 8 for detailed information on the grading criteria

	Permitted	Not permitted
Grade 1	One inter-grown knot up to 20mm diameter or several up to 20mm combined diameter. One small bark pocket	Non inter-grown and rotten knots, shake, sloping grain, rot, insect attack. Limits may be set on colour and warp
	Further limits may apply if the grade is split into sub-grades – see Table 3	



## Grade 2



### Coloured Ash

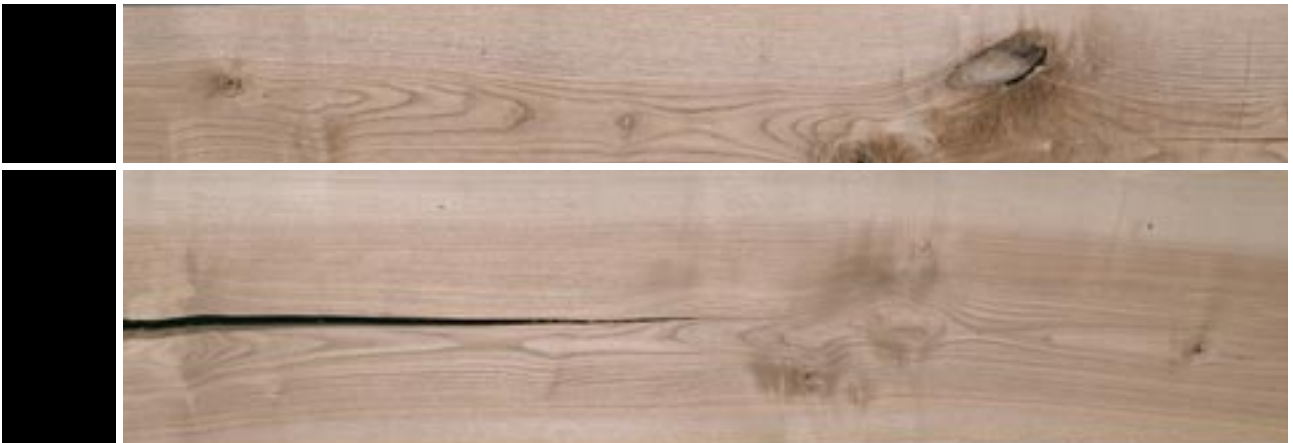




# Ash

## Grade 3

No restrictions providing the appearance and mechanical properties of the piece are suitable for its intended purpose



## Colour

While normally being white, the heartwood of ash can have a range of attractive colour – heavy colour is sometimes called olive ash



## Ripple

Very occasionally, rippled ash is available. The appearance is similar to rippled sycamore.



# Beech

See Table 3 on page 8 for detailed information on the grading criteria

Grade 1	Permitted	Not permitted
	One inter-grown knot up to 20mm diameter or several up to 20mm combined diameter. One small bark pocket	Non inter-grown and rotten knots, shake, colour variation, sloping grain, rot, insect attack. Limits may be set on colour and warp
	Further limits may apply if the grade is split into sub-grades – see Table 3	



## Grade 2



# Beech

## Grade 3



## Spalted

Irregular dark lines resulting from individual fungi forming boundary zones to separate themselves from other decay organisms. If arrested in the early stages of decay, spalting can be a decorative feature in beech



## Coloured

Beech sometimes displays a range of dark red or brown streaks and patches running with the grain. These have various names including: red heart, kern or flamey beech.



# Oak

See Table 3 on page 8 for detailed information on the grading criteria

Grade 1	Permitted	Not permitted
	One inter-grown knot up to 20mm diameter or several up to 20mm combined diameter. One small bark pocket	Non inter-grown and rotten knots, shake, colour variation, sloping grain, rot, insect attack. Limits may be set on colour, warp and sapwood
	Further limits may apply if the grade is split into sub-grades – see Table 3	



**This oak board includes an area of sapwood in the bottom left corner. Sapwood needs to be excluded if oak is to be used as external cladding or other joinery product where the timber will get wet for extended periods. Sapwood should also be excluded in sweet chestnut if it is to be used out-of-doors.**





# Oak

Grade 2	<b>Permitted</b>	<b>Not permitted</b>
	Three inter-grown knots up to 40mm diameter or several to a combined diameter of 120mm. Most other defects are permitted if small, occasional or measured-out	Large or frequent splits, bark pockets, and areas of rot and insect attack. Limits may be set on warp and sapwood
	Further limits may apply if the grade is split into sub-grades – see Table 3	



Grade 3	No restrictions providing the appearance and mechanical properties of the piece are suitable for its intended purpose
	Further limits may apply if the grade is split into sub-grades – see Table 3



# Oak special features

## Pippy

A very popular feature resulting from the presence of frequent pin knots. Some mills may split this category into light, medium and heavy pip.



## Character

Some mills sell oak with a mix of inter-grown knots, pin knots, heart shake, and colour variation as a separate grade called 'character'. If pin knots predominate it may be called 'pippy character'.



# Oak special features

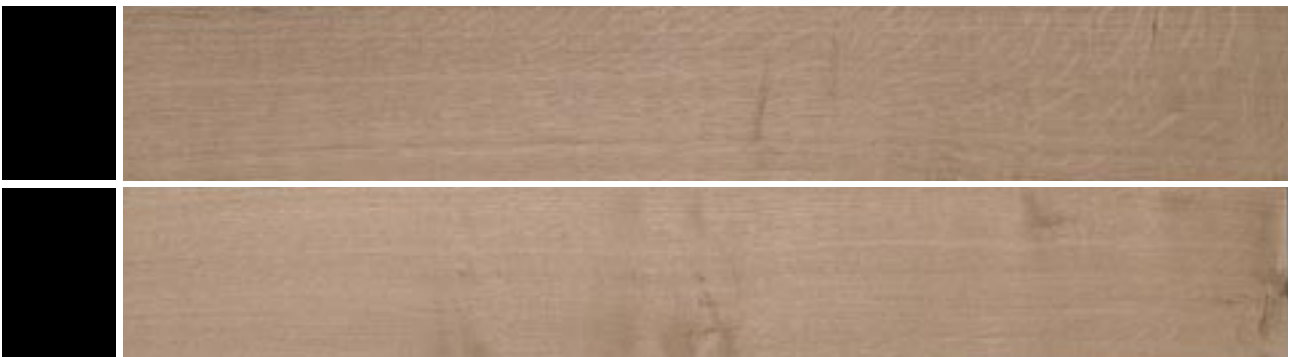
## Tiger oak and brown oak

An attractive colouration caused by the beef steak fungus *Fistulina hepatica*. Usually it occurs in streaks, known as Tiger oak, though occasionally the whole cross section of the heartwood is affected, in which case it is known as brown oak



## Quarter-sawn

These boards are sawn on a radial plane that reveals a very decorative figuring and also results in the timber being particularly stable in use. Quarter sawing is slow and expensive, and so few mills undertake it as a matter of course. Most suppliers will however be able to select some quarter-sawn material from their normal production of plain-sawn or rift-sawn timber



## Burr

Burr oak is available. The appearance is similar to elm burr.



# Sycamore

See Table 3 on page 8 for detailed information on the grading criteria

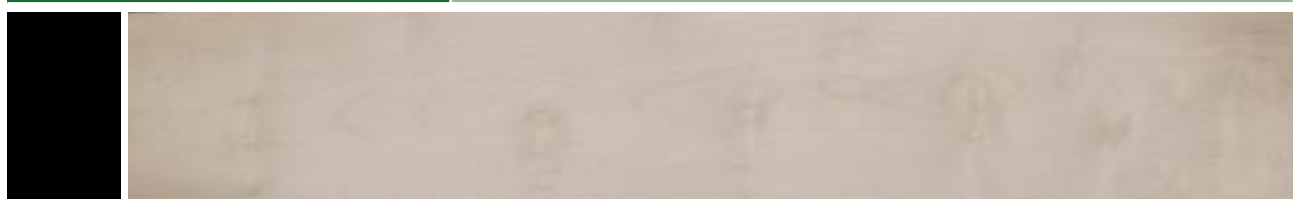
Grade 1	Permitted	Not permitted
	One inter-grown knot up to 20mm diameter or several up to 20mm combined diameter. One small bark pocket	Non inter-grown and rotten knots, shake, colour variation, sloping grain, rot, insect attack. Limits may be set on colour and warp
Further limits may apply if the grade is split into sub-grades – see Table 3		



## Grade 2



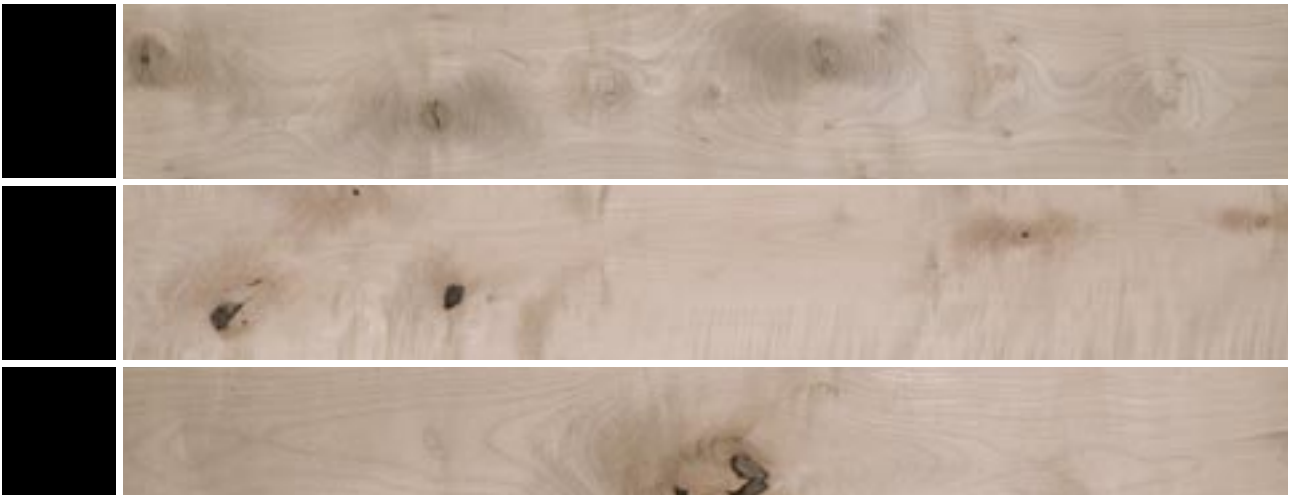
Pippy	Sycamore may exhibit a mixture of grain deviations with occasional pin knots. This is known as pippy sycamore
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# Sycamore

## Grade 3



## Ripple

Also known as fiddleback this feature results from wavy grain. It is very decorative particularly when the timber is quarter-sawn



## Coloured

Sycamore is sometimes coloured. Light brown is the most common although dark brown is also seen – this may be called marbled. Another possible colouration is a grey-blue stain which may appear during drying.



# Sweet chestnut

See Table 3 on page 8 for detailed information on the grading criteria

## Grade 1



## Grade 2



# Sweet chestnut

## Grade 3

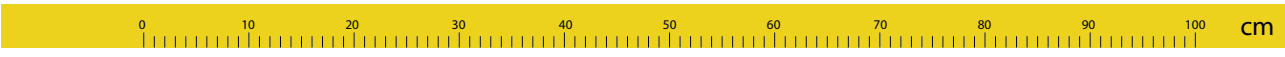


## Tiger

Sweet chestnut can, like oak, sometimes be affected by the beef steak fungus *Fistulina hepatica*, which results in a highly decorative stain usually in streaks



Grade 3 waney-edge Tiger sweet chestnut



# Cherry

See Table 3 on page 8 for detailed information on the grading criteria

## Grade 1



## Grade 2

Splits in timber need to be measured out.



## Grade 3



# Lime

See Table 3 on page 8 for detailed information on the grading criteria

## Grade 1



## Grade 2



## Grade 3





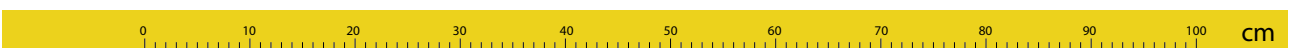
# Elm

See Table 3 on page 8 for detailed information on the grading criteria

## Grade 1



## Grade 2



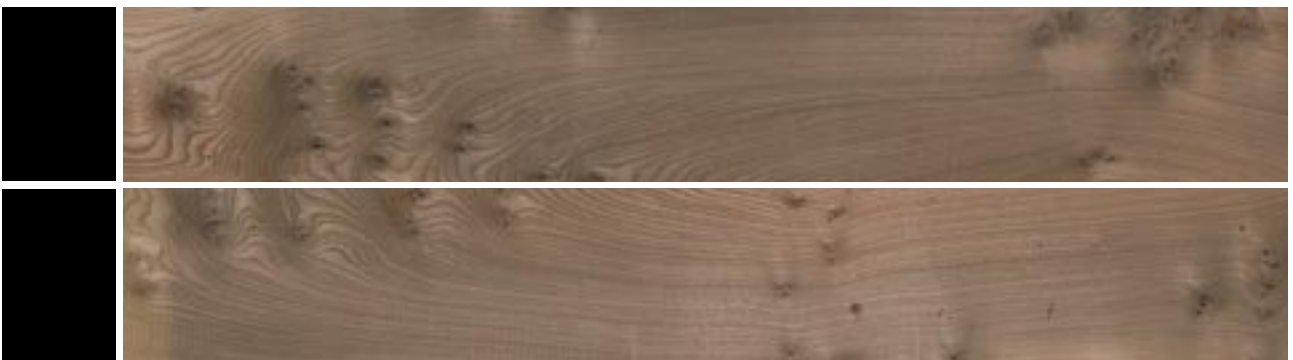
# Elm

## Grade 3



## Pippy

A very decorative feature resulting from the presence of frequent pin knots. Some mills may split this category into light, medium and heavy pip



## Burr

A spectacular feature caused by irregular grain around groups of epicormic buds. Burr is difficult to dry and is highly variable in appearance. Consequently, customers should always inspect each piece before purchase. It is normally only sold waney-edged



“Burr” elm



# Appendix 1

## A comparison between this system and the European and British standards

### EN 975-1

Timber graded using this system will be broadly equivalent to the oak grades in EN 975-1 <sup>[3]</sup> – see Table 4. There are, however, a number of differences, which have been adopted to reflect trade practice in the UK, particularly amongst medium and small sawmills (Table 5). The beech grades in EN 975-1 have not been followed because they are rarely used.

### EN 942 and BS 1186-3

Many designers will be familiar with the grades for joinery timber and trim given in European Standard EN 942 <sup>[4]</sup> and British Standard BS 1186-3 <sup>[5]</sup>, unfortunately these are not directly compatible with the appearance grades in EN 975-1, which form the basis for this guide. There are three main differences. Firstly, appearance-grading describes the full range of features found in sawn timber before it is made into products, whereas the grades for joinery and trim only describe the narrower range of characteristics permitted after the timber is made into manufactured items. Secondly, the grades for joinery and trim are mainly designed for specifying softwood timber and so important characteristics of hardwood timber are not mentioned. Finally, the knot criteria used in EN 975-1 differ from those in EN 942 and BS 1186-3. These differences can cause confusion. For example when green oak or sweet chestnut are being used as external cladding the National Building Specification <sup>[6]</sup> identifies BS 1186-3 as the appropriate standard and yet this is not always applicable to hardwood timber. In such cases designers will generally find that the grades in this guide are suitable for specifying the quality of timber required.

**Table 4. Broad relationship between this system and EN 975-1**  
(based on maximum permitted sizes of inter-grown knots in oak)

Inter-grown knot size	6mm	10-20mm	25mm	40mm	80mm	>80mm
The system in this guide	Grade 1		Grade 2		Grade 3	
	1A	1B	2A	2B	3A	3B
EN 975-1 waney-edged oak	QBA		QB1		QB2	QB3
EN 975-1 square-edged oak	QFA	QF1a-b	QF2	QF3		

**Table 5. Differences between this system and EN 975-1**

This system	EN 975-1
One grading system for all UK grown hardwood species	Only oak and beech, each of which are given separate grading systems
Waney- and square-edged pieces are described using the same grades	Different grades for waney- and square-edged timber
Measuring-out is allowed with both waney- and square-edged pieces	Measuring-out is only allowed with waney-edged pieces
Each piece is graded separately	In some cases groups of pieces all from the same log can be graded as a batch (called a boule)
No provision for square section timbers	Separate grades for square timber (balks)
Coloured timber and unusual grain may be permitted if they are a decorative feature	Coloured timber and unusual grain excluded from some grades
Waney-edged boards are always measured from the narrow face	Waney-edged boards in a boule are measured from either the narrow or wide face depending upon their position in the stack.

## Appendix 2

# Measurement of sawn hardwood timber

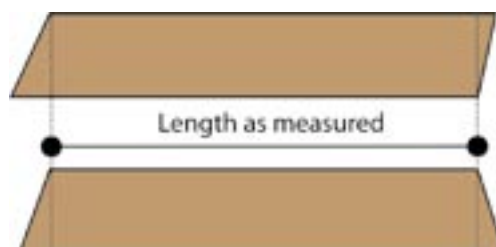
### Recommended practice in the UK

The measurement of hardwood planks and boards in the UK has been described in British Standard BS 5450 [7]. Although this standard is now withdrawn most sawmills continue to use the practices it describes. There are three methods of measurement described:

### Specified widths, square-edged

Where all of the pieces are square-edged, and of the same thickness and width, then the length is measured as the length of the longest piece having square ends rounded down to the nearest 100mm below actual dimension. Width and thickness are measured at the narrowest point. See Figure 3.

**Figure 3. Length measurement with square-edged boards of the same widths**



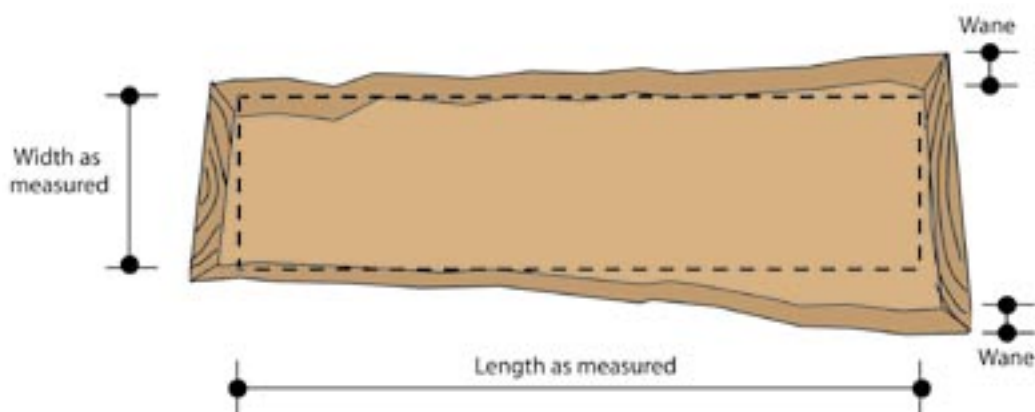
### Random widths, square-edged

Width is rounded down to the nearest 10mm below the narrowest point of the piece. Thickness is measured at the thinnest point. Length is measured as the length of the longest piece having square ends rounded down to the nearest 100mm below actual dimension.

### Random widths, waney-edged

Width is measured across the narrow face including half the width of the wane. Width is measured 300mm in from each end of the piece, and at the centre point. These measurements are added together and then divided by three to get the average width. In practice though the average width of most pieces can be estimated by taking one measurement half way along the length. Thickness is measured at the thinnest point. Length is measured as the length of the longest rectangle having square ends, and uniform width, and thickness. The length measure is rounded down to the nearest 100mm below actual dimension. See Figure 4.

**Figure 4. Measurement of random width waney-edged pieces**



## Measurement of specific features

The British and European standards give specific techniques for measuring characteristics within a plank or board <sup>[7] [8] [9] [10]</sup>. These can be summarised as:

- The sizes of circular knots are given as a diameter measurement while oval knots are measured as the average of the largest and smallest axis.
- A group of knots of the same kind can be taken as one knot whose diameter corresponds to the sum of the average diameter of all knots in the group.
- Cat's-paws are measured as one knot of the average diameter of the cat's-paw.
- Shakes and checks are measured by their length.
- Ring shakes are measured with a cord, which is laid along the curved shake to determine its length.
- Bark pockets, and areas of rot and insect attack are measured by their length and width.

## Imperial or metric measure?

The hardwood trade is very traditional and so many UK mills still work in imperial measure. The calculation procedures for both imperial and metric measure are shown in Table 6.

Table 6. Procedures for imperial and metric measurement	
Imperial	Metric
<p>The volume, <math>V</math>, of a piece is calculated in cubic feet using the formula:</p> $V = \frac{T \times W \times L}{144}$ <p>where:  <math>T</math> is the thickness, in inches;  <math>W</math> is the width, in inches; and  <math>L</math> is the length in feet.                      For example:</p> $V = \frac{2'' \times 10'' \times 9'}{144}$ $V = \frac{180}{144}$ $V = 1.25 \text{ cu ft}$	<p>The volume, <math>V</math>, of a piece, is calculated in cubic metres using the formula:</p> $V = T \times W \times L$ <p>where:  <math>T</math> is the thickness, in metres, to three decimal places;  <math>W</math> is the width in metres to three decimal places,  <math>L</math> is the length in metres to three decimal places.                      For example:</p> $V = 0.050 \times 0.253 \times 2.745$ $V = 0.035 \text{ m}^3$

The approximate conversion factors between metric and imperial measure are:

<b>1 cubic metre = 35.315 cubic feet</b>
<b>1 cubic foot = 0.028 cubic metres.</b>

The term 'cubic foot' should not be confused with the 'board foot' or the 'hoppus foot'. These latter terms are defined in the glossary.



## Permissible size deviations

European Standard EN 1313-2<sup>[11]</sup> recommends that the average thickness and width of a piece shall not be less than the target thickness and width, and it gives permitted deviations at a moisture content of 20%:

**Table 7. Permitted deviation in thickness** (after EN 1313-2)

Basic size (mm)	Minus deviation (mm)	Plus deviation (mm)
Up to 32	-1	+3
Over 32	-2	+4

**Table 8. Permitted deviation in width** (after EN 1313-2)

Basic size (mm)	Minus deviation (mm)	Plus deviation (mm)
Up to 100	-2	+6
101 to 200	-3	+9
Over 201	-4	+12

## Size reductions due to drying

Whatever measurement practices are used, the buyer should remember that the nominal size of a hardwood piece will be reduced by drying. Timber shrinks as it dries and expands as it gains moisture. (These changes only occur when the moisture content of the timber is below a threshold known as the fibre saturation point.) Consequently, to avoid dispute, the moisture content of the timber at the time of measurement should be stated.

## Size reductions due to processing

The size reduction due to processing of hardwood is difficult to estimate but Table 9, adapted from a booklet by John Boddy Timber Ltd.,<sup>[12]</sup> gives approximate allowances, expressed as a percentage of the volume of timber that is required after processing. For example, if a manufacturer plans to use square-edged hardwood pieces to make a staircase with a timber volume (after processing) of 1m<sup>3</sup>, they would need to order between 1.35m<sup>3</sup> to 1.45m<sup>3</sup> of unprocessed timber.

**Table 9. Waste percentages due to processing** (after John Boddy Timber Ltd, undated)

Type of plank or board	% of waste
Square-edged	35 – 45
1 waney- and 1 square-edge	55 – 65
Waney-edged on both edges	100 – 130

The waste percentages given in Table 9 will vary. For example, timbers such as cherry, pear and walnut often have a higher waste percentage than shown. Moreover, these waste estimates are for pieces with few imperfections – grade 3 timber will, in many cases, have a larger wastage than shown. End use is also important and the UK National Annex to EN 1313-2 [11] gives typical reductions in size when square-edged hardwoods are processed for a range of purposes:

Table 10. Size reductions (in mm) from basic size to finished size due to processing of two opposite faces (after EN 1313-2)					
	Target thickness or width of finished piece				
	15 – 25mm	26 – 50mm	51 – 100mm	101 – 150mm	151 – 300mm
Flooring and ‘planed-all-round’	5	6	7	7	7
Trim	6	7	8	9	10
Joinery and cabinet work	7	9	10	12	14

### Practices in continental Europe

Measurement practices for hardwood planks and boards in continental Europe differ slightly from UK practice. The continental methods can be summarised as follows:

- **Single planks and boards**

These are measured using the techniques described in the previous section.

- **Boules**

The first pieces off the boule are measured on the narrow face as described above. The difference comes when the centre piece is reached. In the UK, the remaining pieces are turned over in order to continue measuring the narrow face, whereas in continental Europe the piece isn’t turned and so the wider face of the remaining pieces are measured. As a result, a group of pieces measured on the continent may have been given a slightly larger volume than if they had been measured in the UK. Customers should check which method has been used whenever price comparisons are being made.

# Appendix 3

## Glossary

For the purposes of this guide, the following definitions and descriptions apply:

<b>Appearance grading</b>	<p>Assessing the suitability of a piece of timber for non structural uses, based on the appearance of its surface characteristics. (Appearance grading should not be confused with visual grading which only applies to strength grading of structural timber). There are three main approaches:</p> <ul style="list-style-type: none"> <li>■ Defects system – Each piece of timber is assessed against rules for the maximum allowable size or degree of each type of feature that is permitted within a grade. The grades describe the whole piece of timber including, in some cases, defects that will have to be removed by resawing. This guide is based upon the defects system in EN 975-1<sup>[3]</sup></li> <li>■ Cutting system – This system is based on the amount of timber free of defects, or with acceptable features, assessed as rectangular areas called cuttings. The grades are defined in terms of the minimum area of cuttings (rectangles clear of defects) that are allowed within a single piece.</li> <li>■ Fit-for-purpose – grading rules that describe timber characteristics affecting the performance of a plank or board in demanding product uses such as steam bending, or gun stocks. For example BS 3823 gives rules for ash timber intended for use as tool handles<sup>[13]</sup>. Some of these grades, such as those for decking, are effectively strength grades.</li> </ul> <p>Historically the defects system was used to grade timber cut to specified dimensions (scantlings) for a particular use, while the cutting system was used for pieces not dimensioned for a known market. Nowadays, in countries having large volumes of clear timber, the cutting system is more common, while the defects system tends to be used where the timber is more variable.</p> <p>Most North American hardwood timber coming into Europe is graded to a cutting system developed by the NHLA (National Hardwood Lumber Association of North America)<sup>[14]</sup>. These rules have been summarised in a well illustrated booklet by the American Hardwood Export Council<sup>[15]</sup>. The NHLA grades are frequently used in modified form in other parts of the world. In contrast, European Standard EN 975-1<sup>[3]</sup> is a hybrid of the defects and cutting system. In the case of oak it follows a defects system derived from French grading practice whereas the beech grades in the standard combine both systems; In practice, sawmillers who are aware of EN 975-1 usually work from the summary information on grading contained in two guides to French hardwoods<sup>[16] [17]</sup> as opposed to using the standard itself. No other species are covered in EN 975-1 although a standard for appearance grading of poplar is being prepared.</p>
<b>Arris</b>	Sharp external angle of a piece of wood where two surfaces meet.
<b>Bark</b>	The outer protective covering of a tree.
<b>Bark pocket</b>	A small section of bark that is partly or wholly enclosed within the inner wood.
<b>Basic size</b>	The size by which a piece of sawn timber is known or specified, at a stated moisture content, regardless of sawing tolerances or subsequent reductions by processing.
<b>Baulk</b>	A squared timber with a minimum cross section of 100 x 100 mm.
<b>Black knot</b>	See non inter-grown knot.
<b>Best face</b>	Face that, using a particular grading rule, is judged to be superior to the other face.

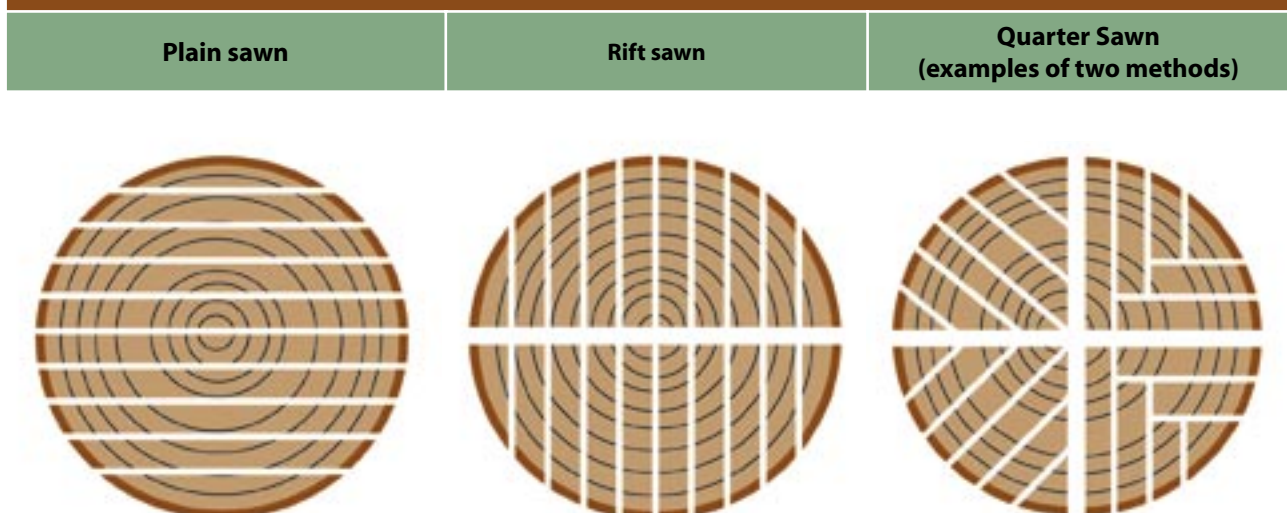
<b>Board</b>	A piece of square- or waney-edged sawn timber 50mm or less in thickness.
<b>Board foot</b>	The North American unit of lumber measurement. A board foot is equivalent to a piece of timber measuring one foot long, one foot wide, and one inch thick; in other words a volume of 144 cubic inches. There are thus 12 board feet to the cubic foot.
<b>Boule</b>	A stack of timber formed from a log that is sawn longitudinally by a series of successive parallel cuts with the resultant waney-edged pieces then assembled to recreate the original form of the log.
<b>Boxed heart</b>	A piece that has been sawn so that it contains the core of the tree known as the pith.
<b>Brown oak</b>	See Tiger oak.
<b>Burr</b>	A spectacular feature comprising the distorted growth rings of large numbers of small knots caused by groups of epicormic shoots.
<b>Cell</b>	One of the small, often microscopic, units that make up the structure of wood.
<b>Character</b>	Hardwood timber with a mix of inter-grown knots, pin knots, heart shake, and colour variation.
<b>Cat's paw</b>	A cluster of pin knots.
<b>Check</b>	Short, narrow, separation of fibres along the grain; often the result of drying stresses. Checks in the ends of a piece of timber are particularly common.
<b>Colour variation</b>	A mix of colour caused by fungi, chemical reaction or other causes.
<b>Conversion</b>	See log conversion.
<b>Crown-cut</b>	See log conversion.
<b>Curly grain</b>	Grain that occurs in irregular curves.
<b>Cutting system</b>	See appearance grading.
<b>Dead knot</b>	See non inter-grown knot .
<b>Defect</b>	An imperfection that lowers the timber quality.
<b>Defect system</b>	See appearance grading.
<b>Discolouration</b>	Stain in timber, due to fungi, chemical reaction, or other causes, that may lower its merchantable value in some markets.
<b>Dote</b>	Early stage of fungal decay recognisable by frequent discoloured spots, streaks or patches.
<b>Drying</b>	The process of bringing timber to a moisture content range that is suitable for an intended use.
<b>Edge</b>	Either of the narrower longitudinal opposite surfaces of a square- or waney-edged piece.
<b>Epicormic shoots</b>	Small buds and branches which appear on the trunk of some timber species usually as a result of an increased exposure to sunlight. Eventually these shoots become engulfed by the enlarging trunk, which creates a decorative feature called a burr.
<b>Durability</b>	See natural durability.
<b>Exposed heart</b>	Timber sawn so that the pith is visible on a face or edge.

<b>Face</b>	Either of the wider longitudinal opposite surfaces of a square- or waney-edged piece.
<b>Feature</b>	Physical, morphological, or growth characteristic of a piece, which could affect its use.
<b>Fibre saturation point (FSP)</b>	A zone at which virtually all moisture has been removed from the cell cavities of timber but where the cell walls remain saturated. In most species it equates to a moisture content of 25 – 30%. Many timber properties change as the moisture content passes the FSP.
<b>Figure</b>	Ornamental markings on the cut surface of timber, formed by the structural features of the wood.
<b>Finished size</b>	The size of a piece after machining, subject to machining tolerances.
<b>Fungal decay</b>	Decomposition of wood by fungi, resulting in softening, progressive loss of strength and density, and often a change in texture and colour.
<b>Grading</b>	A way of sorting pieces of timber into broadly similar groups, according to quality or mechanical performance, so that marketing can be rationalised and selection for a specific use is simplified; it is usually divided into structural and appearance grading.
<b>Grain</b>	Character of wood as revealed by touch or reaction to cutting tools. It is determined by the distribution and size of the various cells.
<b>Green oak</b>	<p>(1) Oak that is used as a construction timber before it has been dried. The oak dries out in service and care is needed to ensure that the resultant shrinkage does not cause unacceptable gaps or splitting. Oak is used green because it is cost effective and easy to work with hand tools.</p> <p>(2) A very rare blue-green colouration in oak caused by the green wood-cup fungus <i>Chlorosplenium aeruginascens</i>. The coloured timber was formally used in the manufacture of marquetry boxes called Tunbridge Wear.</p>
<b>Growth ring</b>	Layer of wood produced in one growing season.
<b>Hardwood</b>	Wood of broadleaved trees, that is, trees from the botanical group <i>Dicotyledonae</i> .
<b>Heartwood</b>	The inner zone of wood that, in growing trees, has ceased to contain living cells. In some species, such as oak, the heartwood is darker than the sapwood while in other species such as sycamore it is not easily identifiable. Heartwood is often more durable than sapwood.
<b>Heart shake</b>	A radial shake originating at the centre of the log.
<b>Heart stain</b>	See discolouration.
<b>Hoppus foot</b>	A unit of roundwood measurement where the cross-sectional area of a log is taken as the square of one quarter of its circumference. One hoppus foot is equivalent to 1.27 cubic feet. A hoppus foot is thus about 21% short of a cubic foot – the reduction helping to compensate the sawmiller the volume loss involved in converting roundwood to sawnwood. Nowadays hoppus measure is generally restricted to hardwoods.
<b>Included sapwood</b>	An area of sapwood enclosed within the heartwood and showing as a light coloured patch. Included sapwood can be a problem in oak and sweet chestnut whenever sapwood free timber is required either for its appearance or for use out of doors where it may be exposed to fungal decay.



<b>Inter-grown knot</b>	A knot that, on the surface considered, is inter-grown with the surrounding wood over all or most of its perimeter. Also called a live knot.
<b>Insect attack</b>	A characteristic tunnel caused by one of several species of beetle larvae that burrow into wood.
<b>Knot</b>	A portion of a branch that became embedded in the wood as the tree grew around it.
<b>Knot cluster</b>	A group of knots around which the wood fibres are deflected.
<b>Live knot</b>	See inter-grown knot
<b>Log conversion</b>	<p>The way in which a log is sawn into planks and boards determines the type of grain and figuring that will appear in the finished sawn timber, and may also affect its stability. There are three main types of log conversion used with hardwood timber: (See Fig 5 below).</p> <ul style="list-style-type: none"> <li>■ <b>Plain sawn</b> – a log sawn longitudinally with a succession of parallel cuts. Initially this yields planks or boards that are sawn tangentially to the growth rings. Later, as the cuts get near the centre of the log, the pieces will be quarter sawn (i.e. with the growth rings running near vertical to the face). Plain sawn timber is also known as ‘crown cut’ or ‘through-and-through’.</li> <li>■ <b>Rift sawn</b> – a log sawn longitudinally through the middle and then at right-angles to the initial cut. Rift sawing yields sawn timber with grain and moisture movement characteristics between plain sawn and quarter sawn</li> <li>■ <b>Quarter sawn</b> – a method of radial sawing used to produce pieces where the growth rings run vertically or near vertically to the face of the plank or board. In practice a grain angle of over 45° is generally accepted as being quarter sawn. When the angle is close to 90° the pieces are very stable and, in the case of oak, have a distinctive silver ribbon figure running across the face. Quarter sawing is expensive and so it is seldom undertaken as part of a normal milling operation. Some mills will, however, select quarter sawn timber, to order, from logs that are plain or rift sawn.</li> </ul>

**Figure 5. Types of log conversion**



<b>Manufacturing joinery</b>	Large volume or specialised joinery fabrication, often for public or commercial buildings.
<b>Marbling</b>	A term sometimes used for an attractive brown colouration in sycamore.
<b>Measuring-out</b>	A measurement technique, most commonly applied to waney-edged timber, where the final dimensions are quoted as if the area containing any defects had already been removed before measurement. This guide permits measuring out in both square- and waney-edged pieces.
<b>Moisture content</b>	The amount of moisture that is present in timber, usually expressed as a percentage of the oven dry mass. European Standard EN 942 <sup>[4]</sup> gives recommended moisture contents for four typical situations (Table 11). Modern houses are becoming increasingly dry and so the moisture content recommendations given in this standard are lower than earlier guidance. They are also different to the moisture content recommendations for structural timber, which are generally less demanding.

**Table 11. Moisture content guidance in EN 942**

Category based on in-service climates		Moisture content
External joinery		12 – 19%
Internal joinery	Unheated rooms	12 – 16%
	Room temperatures of 12 – 21°C	9 – 13%
	Room temperatures over 21°C	6 – 10%

<b>Moisture movement</b>	Ongoing moisture-induced change in across-the-grain dimension exhibited by timber after its initial shrinkage due to drying.
<b>Movement class</b>	Classification of relative moisture movement <sup>[18]</sup> see Table 12.

**Table 12. Movement classification** (after Hislop 2000)

Across-the-grain dimension change within a moisture content range of 5 – 30%	Movement class	Examples of homegrown species
1% for every 3% change in moisture content	Large	beech
1% for every 4% change in moisture content	Medium	oak
1% for every 5% change in moisture content	Small	sweet chestnut

<b>Natural durability</b>	Resistance of timber to damage by wood destroying organisms such as fungi or insects. For example European Standard EN 350-2 <sup>[19]</sup> gives a relative classification of the inherent resistance of wood to attack by wood destroying fungi (Table 13). Note that all sapwood should be considered as being not durable.
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**Table 13. Durability classification** (after EN350-2)

Durability class	Description	Examples of UK grown hardwood species
1	very durable	none
2	durable	oak
3	moderately durable	cherry
4	slightly durable	elm
5	not durable	ash

<b>Non inter-grown knot</b>	A knot that, on the surface considered, is detached from the surrounding wood over all or most of its perimeter. Non inter-grown knots can sometimes become loose and fall out. Also known as a dead knot or black knot.
<b>Occasional</b>	This term should be interpreted according to normal trade usage, e.g. up to 10% of pieces in a parcel.
<b>Off-the-saw</b>	A piece of timber immediately after conversion and before any drying shrinkage has occurred.
<b>Olive ash</b>	An attractive dark brown stain in ash.
<b>Oval knot</b>	Knot cut more or less perpendicular to its long axis so that the exposed cross-section is approximately oval.
<b>Oven dry</b>	Moisture content of timber that has been dried in a ventilated oven at 103°C until there is no further fall in moisture content.
<b>Pin knot</b>	An inter-grown or non inter-grown knot with a maximum diameter of 5mm.
<b>Pip</b>	Pieces with intermittent pin knots, either singly or in clusters, giving a much sought after grain feature. (See also burr).
<b>Piece</b>	One plank or board.
<b>Pith</b>	Zone of soft tissue within the first growth ring.
<b>Plain sawn</b>	see log conversion.
<b>Planed-all-round (PAR)</b>	A piece that has been machined, on all faces and edges, resulting in a square or rectangular cross-section.
<b>Plank</b>	A piece of square- or waney-edged sawn timber more than 50mm in thickness.
<b>Processing</b>	Machining one or more surfaces of sawn timber to specified tolerances at an appropriate moisture content.
<b>Quarter-sawn</b>	See log conversion.
<b>Resawing</b>	Sawing of timber into smaller cross sections.
<b>Ripple</b>	See wavy grain.
<b>Ring shake</b>	A shake that follows the line of a growth ring.
<b>Rot</b>	See fungal decay.
<b>Rotten knot</b>	A knot that is softer than the surrounding wood due to fungal decay.

<b>Sapwood</b>	The outer zone of a tree underneath the bark that, when the tree is growing, contains living cells and conducts sap. Sapwood is frequently paler than the heartwood though is not clearly differentiated in all species. Sapwood has a low natural durability.
<b>Shake</b>	A longitudinal fissure in timber, irrespective of the extent of penetration.
<b>Sloping grain</b>	A divergence in the direction of the grain from the longitudinal axis of the piece.
<b>Softwood</b>	Wood of coniferous trees; that is, from the botanical group Coniferae.
<b>Sound knot</b>	A knot that is free from decay and at least as hard as the surrounding wood. Some splits are generally permitted in sound knots but limits may be set in the supply agreement.
<b>Spalting</b>	Irregular dark lines showing on a wood surface caused by individual wood inhabiting fungi forming sharp boundary zones to separate themselves from other decay organisms of the same or different species. If arrested in the early stages of decay these zones can be a decorative feature in some light coloured timbers, particularly beech. In other timbers such as birch, however, spalting only becomes visible in the later stages of decay by which time the timber is too degraded to be usable.
<b>Splay knot</b>	A knot cut approximately parallel to its axis so that the exposed section is elongated and emerges on the arris.
<b>Spiral grain</b>	Grain that follows a spiralling course in one direction around a log.
<b>Square-edged</b>	Sawn timber of regular cross section, with wane, if permitted, not exceeding a specified limit.
<b>Steaming</b>	Steam is sometimes used as a convenient heat source to enable some timber species such as ash to be bent into tight curves. In other cases steam is used to darken timbers such as beech and pear, and to make them easier to work.
<b>Straight grain</b>	Grain that is parallel or nearly parallel to the longitudinal axis of the piece.
<b>Sticker marks</b>	Unightly stain on light coloured timbers resulting from oxidative reactions between the piece of timber and the spacer (or sticker) used for separating the planks or boards as they dry. It is particularly common in beech, ash, and sycamore.



Above  
**Sapwood in sweet chestnut log. The outer sapwood has started to decay after only a few months in a damp environment.**



Right  
**Elm table with spalted timber used for the drawer front. Woodschool Ltd**

<p><b>Strength grading</b></p>	<p>Assessing the load-bearing characteristics of a piece of timber. There are two main strength grading systems:</p> <ul style="list-style-type: none"> <li>■ Visual grading – assessing the load-bearing capacity of a piece of timber visually, using grading rules that define limits for rate of growth, and for strength reducing factors such as: knots, sloping grain, fissures, and fungal attack. Hardwood timber is almost always visually graded. Note that visual grading and appearance grading should not be confused - appearance grading only applies to grading for non-structural purposes.</li> <li>■ Machine grading – measuring the strength of timber using special grading machines, which, in most cases, exploit a correlation between the deflection of a piece of timber under load and particular mechanical properties. Because it is so accurate, machine grading is preferred to visual grading wherever possible. At present however its use is generally restricted to softwood timber less than 80mm thick. Larger section softwood timber and all hardwood species, except poplar, still have to be strength graded visually.</li> </ul> <p>In the UK the current engineering design code for timber is BS 5268-2<sup>[20]</sup> though this is due to be replaced by Eurocode 5<sup>[21]</sup>. These codes require that timber used for load bearing purposes is strength graded. In practise, however, many building projects using structural hardwoods are approved via an engineers certificate as opposed to formal engineering calculation. In this case the timber quality is selected to a ‘framing grade’ agreed between the engineer and carpenter, with only a few key structural members being formally strength graded<sup>[1]</sup>.</p> <p>Where timber is strength graded it is assigned to specific ‘strength classes’, based on characteristic values for timber strength, stiffness, and density. In European Standard EN 338<sup>[22]</sup> the strength classes for softwood timber are prefixed by the letter C, while hardwood classes are assigned the letter D. The only exception is poplar, which, though it is a hardwood, is given a C class in the standard.</p> <p>The current British Standard for visual grading of hardwoods is BS 5756<sup>[2]</sup>, which gives four strength grades for temperate hardwoods. These correspond to specific strength classes in EN 338. BS 5756 is sometimes criticised because there is a large gap between the two highest and the two lowest grades, and because it does not distinguish between heartwood and sapwood. Thus for specific purposes, such as building conservation, some companies using structural oak still work to the grades in CP 112<sup>[23]</sup>, which was withdrawn in 1980. Whatever visual grading system is used it is important that the grader is properly trained, the grades chosen are specified by a structural engineer, and that the system follows the requirements for visual grading in European Standard EN 518<sup>[24]</sup>. A detailed discussion of the visual grading of UK grown oak is given in a forthcoming book by TRADA Technology<sup>[1]</sup>.</p>
<p><b>Tiger oak</b></p>	<p>An attractive dark brown stripy colouration in the heartwood of oak caused by the beef steak fungus <i>Fistulina hepatica</i>. Unlike most wood inhabiting fungi, <i>F. hepatica</i> does not cause significant breakdown of the timber until a late stage of colonisation. Very rarely the whole cross section of the heartwood is affected, this is known as brown oak. Similar stripy markings are occasionally seen in other hardwoods particularly sweet chestnut.</p>
<p><b>Unedged</b></p>	<p>See waney-edged.</p>
<p><b>Visual grading</b></p>	<p>See strength grading.</p>
<p><b>Wane</b></p>	<p>Original rounded surface of a log, with or without the bark, which occurs on any face or edge.</p>
<p><b>Waney-edged</b></p>	<p>Sawn timber having parallel faces and with one or both edges left unsawn so that the bark or irregular surface is retained. Also called un-edged.</p>



<b>Wavy grain</b>	Grain occurring in fairly uniform waves. A decorative feature, particularly in sycamore. Occasionally found in other species, particularly ash. Also known as ripple.
<b>Warp</b>	Distortion of a piece of timber during the process of log conversion, drying, or storage.
<b>Worst face</b>	Face that, using a particular grading rule, is judged to be inferior to the other face.

**These chairs are made from spalted beech.** (*Woodschool Ltd*)



## Appendix 4

# Properties and uses of UK hardwoods

Main uses of UK hardwoods					
	Manufacturing joinery	Furniture & crafts	Flooring	External joinery	Structural
<b>Ash, European</b> <i>Fraxinus excelsior</i>	✓	✓	✓		
<b>Beech, European</b> <i>Fagus sylvatica</i>	✓	✓	✓		
<b>Cherry, European</b> <i>Prunus avium</i> <sup>(4)</sup>		✓ <sup>(4)</sup>	✓ <sup>(4)</sup>		
<b>Chestnut, sweet</b> <sup>(5)</sup> <i>Castanea sativa</i>	✓	✓	✓ <sup>(6)</sup>	✓ <sup>(7)</sup>	✓
<b>Elm, European</b> <sup>(8)</sup> <i>Ulmus spp.</i>	✓	✓	✓ <sup>(6)</sup>	✓ <sup>(9)</sup>	✓
<b>Lime, European</b> <i>Tilia spp.</i>		✓ <sup>(10)</sup>	✓ <sup>(6)</sup>		
<b>Oak, European</b> <sup>(10)</sup> <i>Quercus robur, Q. petraea</i>	✓	✓	✓	✓ <sup>(12)</sup>	✓
<b>Sycamore</b> <i>Acer pseudoplatanus</i>	✓	✓	✓		

Properties of UK hardwoods				
	Average density Kg/m <sup>3</sup>	Moisture movement <sup>(1)</sup>	Natural durability <sup>(2)</sup>	Regional availability
<b>Ash, European</b> <i>Fraxinus excelsior</i>	710 variable <sup>(3)</sup>	medium	not durable	Widespread except for the far north of Scotland
<b>Beech, European</b> <i>Fagus sylvatica</i>	720	large	not durable	Prime grade logs are rare in Scotland
<b>Cherry, European</b> <i>Prunus avium</i> <sup>(4)</sup>	630	medium	moderately durable	Prime logs normally only found in southern England
<b>Chestnut, sweet</b> <sup>(5)</sup> <i>Castanea sativa</i>	560	small	durable	Most common in south-east England, rare in Scotland
<b>Elm, European</b> <sup>(8)</sup> <i>Ulmus spp.</i>	560 variable <sup>(3)</sup>	medium	slightly durable	Rare outside Scotland due to Dutch elm disease
<b>Lime, European</b> <i>Tilia spp.</i>	560	medium	not durable	Prime grade logs are most common in southern Britain
<b>Oak, European</b> <sup>(10)</sup> <i>Quercus robur, Q. petraea</i>	720 variable <sup>(3)</sup>	medium	durable	Widespread except for the far north of Scotland
<b>Sycamore</b> <i>Acer pseudoplatanus</i>	630	medium	not durable	Prime logs most common in north England, rare in Scotland

**Notes:**

<b>1</b>	See Table 12.
<b>2</b>	Natural durability statements only apply to the heartwood, the sapwood of all species is rated as being of low natural durability.
<b>3</b>	Timber density sometimes varies with growth rate – in these species fast grown timber is denser than slower grown material.
<b>4</b>	Cherry is only available in limited widths.
<b>5</b>	Sweet chestnut is also called Spanish chestnut. It should not be confused with horse chestnut, <i>Aesculus hippocastanum</i> , which has little value for timber.
<b>6</b>	Because of their low density, these species are not suitable for flooring in public buildings subject to heavy wear. They are however perfectly suitable for domestic use.
<b>7</b>	Apart from cladding, most sweet chestnut external joinery is made from cleft coppice timber as opposed to sawn pieces. Cleft timber is outside the scope of this guide.
<b>8</b>	Although still obtainable, elm is becoming less common due to Dutch elm disease, Wych elm, <i>U. glabra</i> , is still available in some areas.
<b>9</b>	Elm is only suitable for external cladding if it is given a suitable surface coating, typically one that is moisture repellent but water vapour permeable.
<b>10</b>	Lime is chiefly used for small carvings and mouldings.
<b>11</b>	European oak is also called Welsh oak, English oak etc. depending upon its country of origin.
<b>12</b>	Oak is used for a wide range of external joinery including cladding, decking, solid and laminated window and door frames. It is also used for fencing and gates.

# Appendix 5

## Specification, sourcing, and certification

### Specifiers and Buyers Checklist

Before writing a specification, or approaching a supplier, specifiers and users should normally consider at least the following:

<b>Purpose</b>	What is the timber going to be used for? If being used outside, it is advisable to choose the heartwood of a naturally durable species such as oak or sweet chestnut. In this case sapwood should be excluded in the specification.
<b>Species</b>	Which species is required? Are there alternatives that will also be suitable? (See appendix 4).
<b>Grade</b>	Is the most expensive grade needed, or is it possible to use something cheaper? Where a grade is particularly important, it is advisable to request a sample of graded timber including the worst characteristics that will be included.
<b>Grading on one or both sides of the piece</b>	Hardwood timber is normally only appearance graded on the best face - is this acceptable?
<b>Size</b>	Is a wide, long piece needed, or smaller pieces that could be cut from other grades?
<b>Moisture content</b>	Where is the timber going to be used? If it is outside, unseasoned pieces may be adequate, but, if the timber is going to be used in a heated room, it will generally have to be kiln dried. (See table 11).
<b>Board Edges</b>	Is it important to have square-edged pieces, or will waney-edged be satisfactory?
<b>Colour</b>	Is uniform colour essential or can colour variation be accepted? It is unrealistic to expect no colour variation and it may be necessary that the parties come to a prior agreement on the basis of samples as to what is acceptable in critical situations.
<b>Quantity or volume</b>	Decide on what number of pieces, or volume of timber is needed. Confusingly the hardwood trade still works in both imperial and metric units.
<b>Board finish</b>	Some suppliers may be able to plane the timber, while others may only be able to supply planks and boards with a sawn finish.
<b>Method of measurement</b>	This guide has shown that there are several ways of measuring pieces. Feel free to ask the supplier which they use.

This list is only intended as a guide. If you are looking for a special feature, or you are uncertain about anything, discuss this with your supplier, who will be pleased to help.

## Sources of Supply

Because it can become dated, a list of suppliers of UK hardwood in the UK is not included in this guide. A list of organisations that may be able to provide assistance in locating a supplier is given on the final page.

Suppliers of UK hardwoods are dependent on the availability of logs in meeting buyers' requirements. Many of the broadleaved woodlands from which the logs could potentially become available are privately-owned, and it is difficult to forecast availability because there are many factors determining an individual owner's decision to fell trees. Also, trees can only be felled with a permit or licence from the national forest authority in each country. Although some large sawmills carry a large stock of UK hardwoods, there are many small mills that do not. Depending on the supplier, it may therefore not always be possible to immediately obtain the quantity of timber required within a grade. The more time a supplier has to fulfil an order, the easier it will be to meet a customer's requirement.

## Woodland management certification

The availability of UK grown hardwood timber that is labelled as coming from a sustainably managed source is limited at present, but is expected to increase in the future. The most well-known certification label is the FSC (Forest Stewardship Council). Where woodlands are under active management, this is increasingly carried out in accordance with the UK Woodland Assurance Standard, which is recognised by the FSC. The reason for the current limited availability of certified material is that many of the hardwood logs come from small, privately-owned woods and their owners have not entered a formal certification process.

The absence of a label, or chain-of-custody certificate from the supplier, on UK grown hardwood timber should not be of undue concern in most cases. There are very strong regulatory frameworks controlled by the Forestry Commission and the Northern Ireland Forest Service. Indeed, some sawmills will know the exact source of all their logs and can provide direct assurance that the forestry practices are acceptable. Many of the smaller hardwood sawmills utilise logs that might otherwise be used as firewood, or go into landfill, and in these circumstances they are making a further contribution to sustainability. These local connections offer an added dimension and interest to using hardwoods from the UK.



Photo: Saltwell Towers

**Public seating and screen,  
Saltwell Towers, Gateshead.  
English oak.**

*Designed by Wales & Wales*

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3.	EN 975-1: 1995. <i>Sawn Timber – Appearance grading of hardwoods. Part 1: Oak and beech</i> .
4.	EN 942: 1996. <i>Timber in Joinery – General Classification of Timber Quality</i> .
5.	BS 1186-3: 1990. <i>Timber for and workmanship in joinery. Part 3. Specification for wood trim and its fixing</i> .
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10.	EN 1311: 1997. <i>Round and sawn timber - Method of measurement of biological degrade</i> .
11.	EN 1313-2: 1998. <i>Round and sawn timber – Permitted deviations and preferred sizes – Part 2 hardwood sawn timber</i> .
12.	John Boddy Timber Ltd. (undated). <i>Illustrated Buyers Guide to the Grading and Measurement of Native &amp; European Hardwoods and Softwoods</i> . North Yorkshire.
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14.	NHLA (1998). <i>Rules for the Measurement &amp; Inspection of Hardwood and Cypress</i> . National Hardwood Lumber Association. Memphis.
15.	American Hardwood Export Council (undated). <i>The Illustrated Guide to American Hardwood Lumber Grades</i> . Washington.
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19.	EN 350-2: 1994. <i>Durability of wood and wood based products – Natural wood – Part 2: Guide to natural durability and treatability of selected wood species of importance in Europe</i> .
20.	BS 5268-2. 1996. <i>Structural use of timber. Code of practice for permissible stress design, materials and workmanship</i> .
21.	EN 1995: 2004. <i>Eurocode 5 – Design of timber structures</i> .
22.	EN 338: 1995. <i>Structural timber. Strength classes</i> .
23.	CP 112: 1952 (withdrawn). <i>Code of practice for the structural use of timber</i> .
24.	EN 518: 1995. <i>Structural timber. Grading. Requirements for visual strength grading standards</i> .



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<b>EN 338: 1995</b>	<i>Structural timber. Strength classes.</i>
<b>EN 975-1: 1995</b>	<i>Sawn Timber – Appearance grading of hardwoods. Part 1: Oak and beech.</i>
<b>EN 844-1: 1995</b>	<i>Round and sawn timber – Terminology – Part 1: General terms common to round timber and sawn timber.</i>
<b>EN 844-3: 1995</b>	<i>Round and sawn timber – Terminology – Part 3: General terms relating to sawn timber.</i>
<b>EN 518: 1995</b>	<i>Structural timber. Grading. Requirements for visual strength grading standards.</i>
<b>EN 942: 1996</b>	<i>Timber in Joinery – General Classification of Timber Quality.</i>
<b>EN 1309-1: 1997</b>	<i>Round and sawn timber - Method of measurement of dimensions. Sawn timber.</i>
<b>EN 1310: 1997</b>	<i>Round and sawn timber – Method of measurement of features.</i>
<b>EN 1311: 1997</b>	<i>Round and sawn timber - Method of measurement of biological degrade.</i>
<b>EN 1312: 1997</b>	<i>Round and sawn timber – Determination of the batch volume of sawn timber.</i>
<b>EN 844-6: 1997</b>	<i>Round and sawn timber – Terminology – Part 6: Terms relating to dimensions of sawn timber.</i>
<b>EN 844-7: 1997</b>	<i>Round and sawn timber – Terminology – Part 7: Terms relating to anatomical structure of timber.</i>
<b>EN 844-9: 1997</b>	<i>Round and sawn timber – Terminology – Part 9: Terms relating to features of sawn timber.</i>
<b>EN 844-10: 1998</b>	<i>Round and sawn timber – Terminology – Part 10: Terms relating to stain and fungal attack.</i>
<b>EN 844-11: 1998</b>	<i>Round and sawn timber – Terminology – Part 11: Terms relating to degrade by insects.</i>
<b>EN 1313-2: 1998</b>	<i>Round and sawn timber – Permitted deviations and preferred sizes – Part 2 hardwood sawn timber.</i>
<b>EN 1995: 2004</b>	<i>Eurocode 5. Design of timber structures.</i>
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<b>EN 975-2 (in preparation)</b>	<i>Sawn Timber – Appearance grading of hardwoods. Part 2: Poplar.</i>

<b>Current British standards</b>	
<b>BS 6100-4.2:1984</b>	<i>Glossary of building and civil engineering terms – Part 4: Forest products – Section 4.2 Sizes and quantities of solid timber.</i>
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<b>BS 3823: 1990</b>	<i>Grading of ash and hickory wood handles for hand tools.</i>
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<b>BS 5756: 1997</b>	<i>Visual strength grading of hardwood.</i>
<b>BS 5268-2. 1996</b>	<i>Structural use of timber. Code of practice for permissible stress design, materials and workmanship.</i>
<b>British standards now withdrawn</b>	
<b>CP 112: 1952</b> (withdrawn)	<i>Code of practice for the structural use of timber.</i>
<b>BS 4047: 1966</b> (withdrawn)	<i>Grading Rules for Sawn Home Grown Hardwood.</i>
<b>BS 5450: 1997</b> (withdrawn)	<i>Sizes of hardwoods and methods of measurement.</i>
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<b>John Boddy Timber Ltd.</b> (undated)	<i>Illustrated Buyers Guide to the Grading and Measurement of Native &amp; European Hardwoods and Softwoods.</i> North Yorkshire.
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<b>American Hardwood Export Council</b> (undated)	<i>The Illustrated Guide to American Hardwood Lumber Grades.</i> Washington.
<b>Ross P., Hethem C. and Holloway H.</b> (in preparation)	<i>Green Oak in Construction.</i> TRADA Technology. High Wycombe.
<b>W L West &amp; Sons Ltd.,</b> (undated)	<i>Oak Grades.</i> West Sussex.

## Further information

The following organisations may be able to provide information on suppliers of UK grown hardwood timber:

### Forestry Commission

The Government Department responsible for the protection and expansion of Britain's forests and woodlands. Responsibility has been devolved to three national offices.

### Forestry Commission England

Tel: 01223 314546

[www.forestry.gov.uk](http://www.forestry.gov.uk)

### Forestry Commission Scotland

Tel: 0131 334 0303

[www.forestry.gov.uk](http://www.forestry.gov.uk)

### Forestry Commission Wales

Tel: 01970 625866

[www.forestry.gov.uk](http://www.forestry.gov.uk)

### Northern Ireland Forest Service

Tel: 02890 524480

[www.forestserviceni.gov.uk](http://www.forestserviceni.gov.uk)

The executive agency within the Department of Agriculture and Rural Development responsible for protecting and expanding Northern Ireland's forests in a sustainable way.

### UK Forest Products Association (UKFPA)

Tel: 01786 449029

[www.ukfpa.co.uk](http://www.ukfpa.co.uk)

The UKFPA represents the technical and commercial interests of the UK forest products industry.

### Association of Scottish Hardwood Suppliers (ASHS)

Tel: 0870 241 2350

[www.ashs.co.uk](http://www.ashs.co.uk)

An independent association of small companies supplying Scottish hardwood timber and timber products.

### Welsh Timber Forum (WTF)

Tel: 0845 456 0342

[www.welsh timber forum.co.uk](http://www.welsh timber forum.co.uk)

Represents and supports small and medium sized businesses in Wales who work with, or wish to work with, Welsh timber.

### Forestry & Timber Association (FTA)

Tel: 0131 538 7111

[www.forestryandtimber.org](http://www.forestryandtimber.org)

The representative body for all those involved in the growing and managing of trees throughout the UK.

### Confederation of Forest Industries (ConFor)

Tel: 0131 524 8080

[www.confor.org.uk](http://www.confor.org.uk)

An organisation formed by the FTA and UKFPA to streamline and concentrate the forest industry's voice.

**Advice about timber certification in the UK can be obtained from:**

**Forest Stewardship Council (FSC)**

Tel: 01686 413916

[www.fsc-uk.demon.co.uk](http://www.fsc-uk.demon.co.uk)

An international non-profit organisation that is introducing an international labelling scheme for forest products to provide a credible guarantee that the product comes from a well-managed forest.

**Information about the properties and use of timber can be obtained from:**

**TRADA Technology**

Tel: 01494 563091

[www.trada.co.uk](http://www.trada.co.uk)

A company providing advice and consultancy services on the specification and use of timber and wood products to the construction and forest-products industries. A sister company, BM Trada, provides timber chain-of-custody services.

**Furniture Industry Research Association (FIRA)**

Tel: 01438 77700

[www.fira.co.uk](http://www.fira.co.uk)

An organisation involved in testing, research, and innovation for the furniture and allied trades.

**Building Research Establishment –  
Centre for Timber Technology and Construction**

Tel: 01923 664814

[www.bre.co.uk](http://www.bre.co.uk)

A centre of expertise on buildings, construction, energy and the environment; providing consultancy, testing and certification services. BRE's Centre for Timber Technology and Construction specialises in the properties and use of timber.

**Napier University – Centre for Timber Engineering (CTE)**

Tel: 0131 4552831

<http://cte.napier.ac.uk>

An educational and research centre providing information, training, consultancy and testing services for the timber construction and associated industries.



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