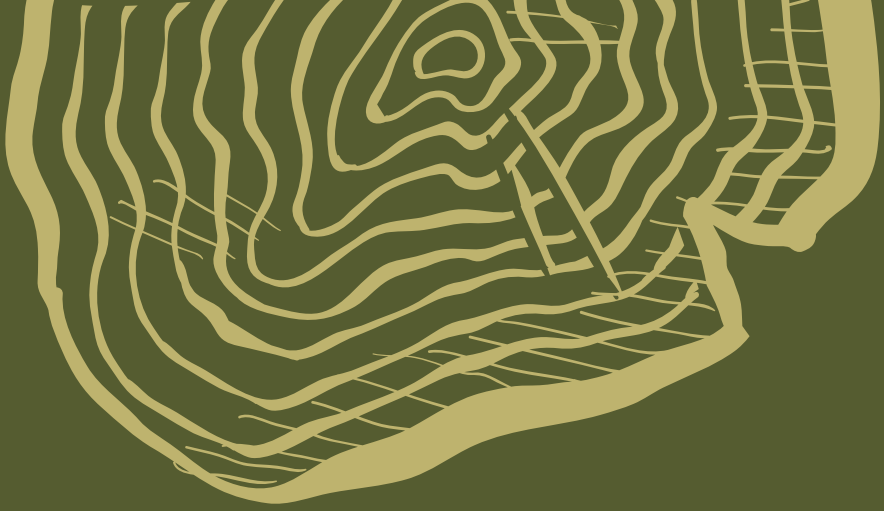


An Introduction to Small-Scale Sawmilling

MAKING THE MOST OF IRISH-GROWN HARDWOOD

IFO
Irish Forest Owners

An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

IFO
Irish Forest Owners

This handbook is part of a project run by Irish Forest Owners in 2024 entitled 'Adding Value to our Hardwoods', supported by funding from the Department of Agriculture, Food and the Marine.

This national peer-to-peer project helped advance the technical skills and knowledge of forest owners from around Ireland in sawmilling, grading, drying and storing Irish-grown hardwood timber, as well as provided training on broadleaf management, timber uses and timber marketing.

The aim of this handbook is to continue the lessons of maximising the economic benefits of broadleaves, to develop the skills of forest owners in delivering Irish-grown hardwoods onto the market, and to create a framework on which to build a national network of 'owner millers'.

Further information on the project and an accompanying video on small-scale sawmilling can be found at www.irishforestowners.com

Contents

1 Introduction

This Introduction to Small-Scale Sawmilling handbook is designed to support farmers, forest owners, woodworkers and anyone interested in developing a sustainable, homegrown hardwood industry in Ireland.

Broadleaf trees make up over a quarter of Ireland's national forestry area[1], with a significant proportion planted in family-owned forests over the last 30 years. These forests, while requiring long-term investment, hold immense potential as a sustainable resource, benefiting both the environment and the economy.

Broadleaf forests provide well-documented environmental benefits. They provide habitats for a wide range of plant and animal species, fostering rich ecosystems that support native wildlife. Additionally, they serve as vital carbon sinks, absorbing CO_2 from the atmosphere and storing it long-term, which helps mitigate climate change.

The economic advantages of Irish broadleaf forests are only beginning to emerge. Wood is a natural, sustainable material that can replace products in construction and other industries where carbon-intensive materials like steel, concrete or aluminium have traditionally been used. The use of timber in building supports sustainable forestry practices, reduces energy consumption and generates local employment. Studies[2] also show that wood interiors provide psychological, physiological and environmental benefits, further enhancing wood's appeal in today's markets, where authenticity is increasingly valued over price.

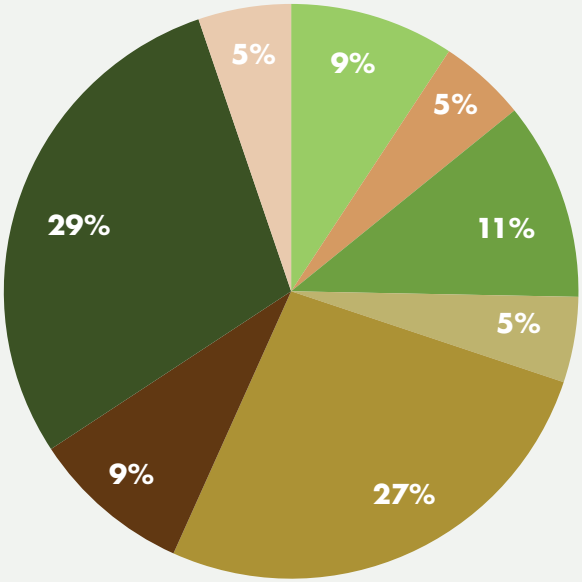
Irish-grown hardwood timber is poised to command a premium price as demand for quality and sustainability rises. While broadleaf trees take about 100 years to mature to full sawlog quality, they offer potential for interim income through careful forest management. The local sawmilling of indigenous hardwoods creates added value, offsetting the economies of scale enjoyed by larger, industrial sawmills.

To maximize the potential of Irish hardwoods, careful management of young plantations is essential. Developing the skills of sawmilling and drying hardwood timber among forest owners and rural communities will reduce reliance on imported timber, foster new market opportunities, strengthen the rural economy and increase the profitability of Irish forests. It will also contribute to carbon storage in high-value, locally produced hardwood products.

In Ireland, a network of small-scale sawmillers is emerging, and as our forests mature, so too will our capacity to mill and market Irish-grown timber locally. This handbook provides an introduction to small-scale sawmilling, helping to equip forest owners and rural communities with the knowledge to develop this promising sector.

1. Forest Statistics - Ireland 2024
2. Wood, Housing, Health, Humanity. Planet Ark, 2015

BROADLEAF SPECIES IN IRELAND

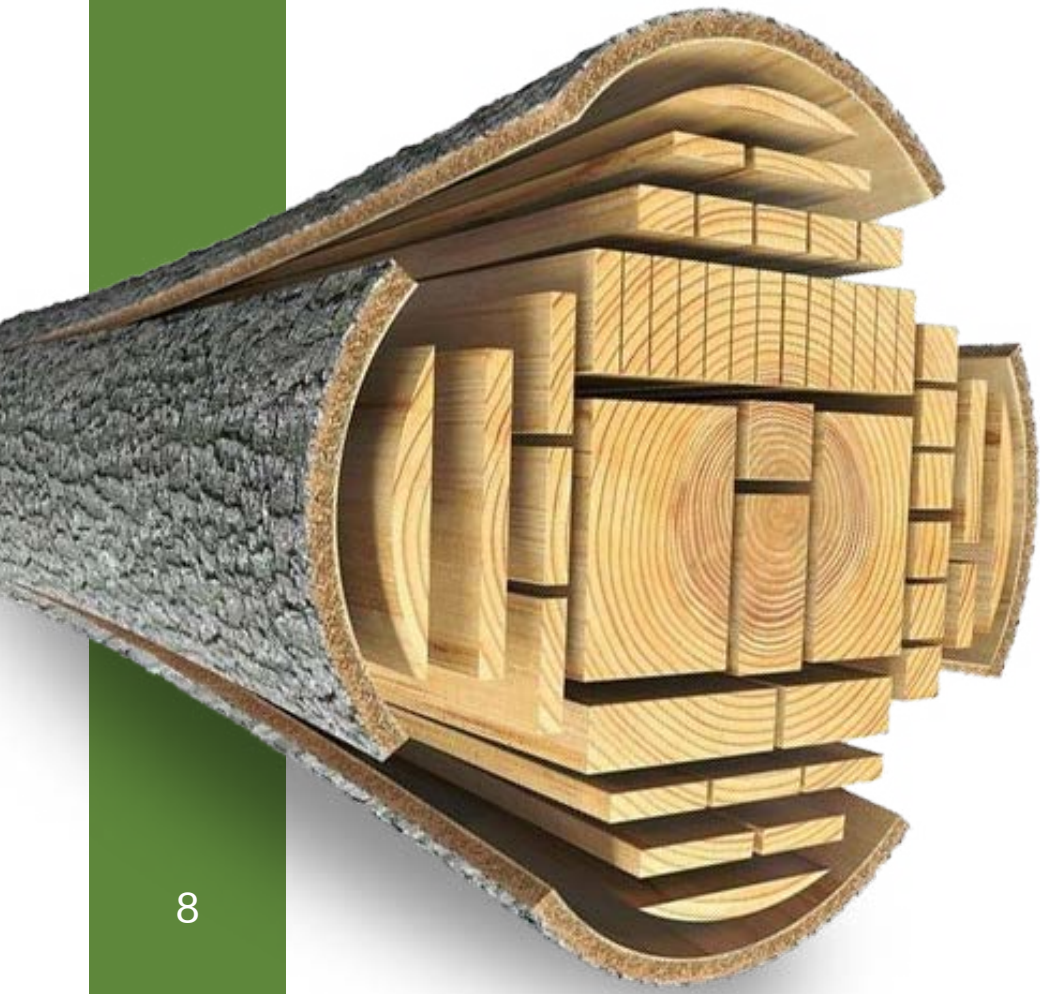


- Pedunculate and Sessile Oak
- Beech
- Ash
- Sycamore
- Birch
- Alder
- Other Short-living Broadleaves
- Other Long-living Broadleaves

National Forest Inventory, 2022

A qudlity broadleaf tree has more than 6m of straight, well-rounded trunk with no obvious defects.

2 Conversion of Timber



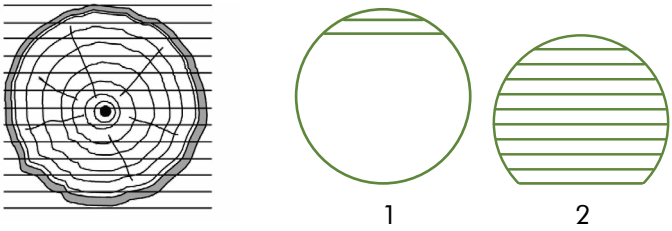
'Conversion' is the process of cutting round logs into usable straight-edge timber sizes.

The main outputs from sawmilling are boards and planks, which can be further processed into an array of timber products, and posts and beams for construction. The aim of conversion/sawmilling is to produce the most valuable saleable product in the most efficient way possible with the least amount of waste.

The 'conversion efficiency' (or conversion rate) is the percentage of wood volume that ends up as a saleable product, and a typical conversion rate achieved in industrial sawmills is around 50%. However, a much higher conversion rate can be achieved by a highly skilled sawmill operator, particularly at the small-scale level.

Type of Sawmill Cuts

THROUGH AND THROUGH SAWING



Also known as plain sawing, live sawing or slash sawing.

The log is sawn on the open face and then turned just once to the opposite face for sawing until the log is finished. It is the quickest and most popular sawmilling method.

Through and through sawing is generally recommended for lower quality logs because of the disadvantages listed below.

Advantages	Disadvantages
Fast and efficient method – most economical	No particular grain pattern on boards
Little wastage	Risk of cupping/warping when drying
Minimal turning needed	Not suitable for structural timber
High throughput	In most cases, the boards have to be edged after sawing

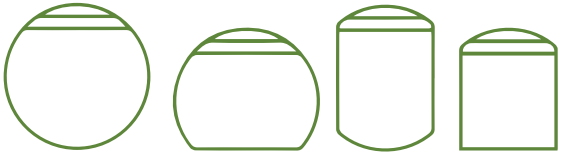
Through and through sawing.

CANT SAWING

First cuts are made across the top of the log and then it is turned 180° to saw the second cuts across the opposite face. The log is then turned 90° to saw the third face and then a final 180° to saw the final face, make a large slab with the heartwood in the centre. This squared-off log is called a cant.

A cant be of any dimension, depending on the size of the starting log. It is recommended that the log is made into the largest cant possible, to avoid unnecessary waste.

The cant can then be processed further, stored until the end-use has been determined, or sold as a large timber slab for processing elsewhere. This method is the most economical way to maximise value of medium and low-quality logs.

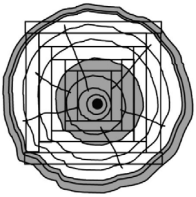


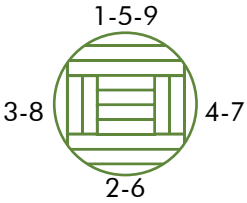
Cant sawing

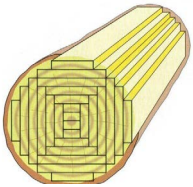
TANGENTIAL SAWING

Also known as grade sawing.

The cut is made at a tangent to the annual rings of the timber. The log is sawn, turned to a new face, sawn, turned again and sawn, and so on. Timber converted in this way will highlight the flame figure that occurs in woods with distinct annual rings. Financially, tangential sawing can be the best sawing method for medium and high-quality logs, even though it is time consuming.



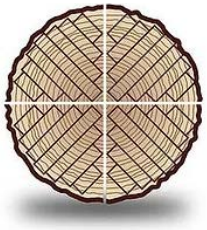


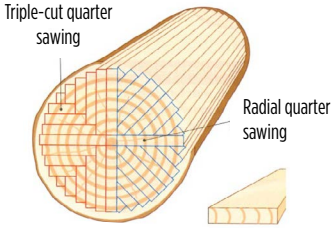


Advantages	Disadvantages
Results in boards with flame figure	Timber milled this way is prone to warping and cupping
Boards season more quickly	Labour intensive, as the log is rotated for each cut
Boards wear well and don't split easily when nailed	

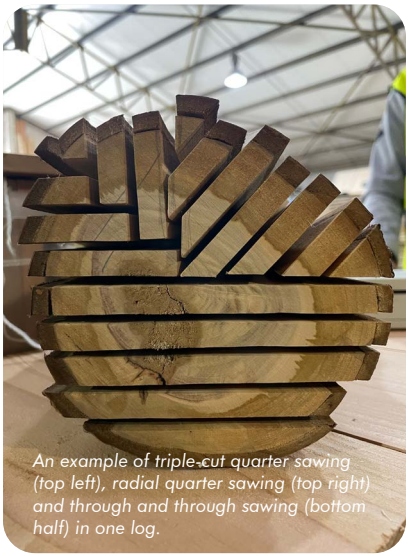
QUARTER SAWING

In this method, logs are first quartered before cutting the boards. This method of conversion exposes the (medullary) ray cells—known as silver grain in oak—and gives an attractive pattern, along with other benefits. Fully quarter-sawn boards are generally defined as growth rings that are 80° to 90° to the face of the board. This type of sawing is only recommended for the highest quality of logs and if a customer is already in place.





Advantages	Disadvantages
Attractive ray fleck pattern is produced; valuable characteristic to woodworkers	Labour intensive as the log has to be turned for each cut and therefore more expensive
The boards are more dimensionally sound: no cupping when drying	Lower yields from a log
Less shrinkage in width compared with plain sawn	Boards requires longer drying time than plain sawn boards
The boards wear more evenly when used as flooring	Has spike knots (compared with circular knots in plain sawn), which reduces strength



An example of triple-cut quarter sawing (top left), radial quarter sawing (top right) and through and through sawing (bottom half) in one log.

WHICH CONVERSION METHOD TO CHOOSE?

Choosing which of the above methods to use when sawing timber is a balance between producing the most marketable product from that piece of timber and the most economical method in both time and achieving a maximum conversion of round log to plank with minimum waste.

For example, quarter sawing, which is a very time-consuming process, is only done when the timber produced will achieve a premium price.

The price you can get for a board should determine the cut.

PRACTICAL TIPS WHEN SAWMILLING

- The initial desire to plank everything is not always a good idea. Consider first the costs with regards time, consumables required (for example, petrol, electricity, blades, handling equipment) and the space required to dry and store the timber.
- Know what your customer wants before you start sawing.
- Be critical of what type of timber you saw. Pick a quality log if at all possible.
- Avoid planking a log below a minimum of 2.4 metres in length. Anything shorter has limited usability and therefore less commercial value. If sawmilling beams, decide beam size before cutting.
- Use only quality blades and take care of them when storing and fitting so to avoid damaging the brittle tips of the blade. If possible, use a lubricant (such as washing-up liquid) along with water. This will help reduce heat build-up in the blade, which shortens the lifespan.
- When sawing, do not stack/sticker timber as you saw it. The most efficient use of power and time is to mill the timber first, and then clean, grade and sticker the timber when you have more time to inspect the timber properly.
- When stacking boards of different thicknesses put a 60x55mm piece of timber between each size group. You will then be able to access the different size groups with a forklift without disturbing the whole stack.
- Avoid stacking timber in direct sunlight or in a hot environment. An ideal spot is shaded, protected from the rain and with good airflow.
- Mark the date the timber was sawn in a few places on the timber stack.

3 Tools of The Trade

Types of sawmill	Advantages	Disadvantages
Chainsaw 'Alaskan' type mill	Comparatively inexpensive initial set up Very portable – can mill logs on site without the need to move them Good for occasional milling needs	Slow to use and hard work on the operator Low fuel efficiency Need a large saw and long bar to accommodate the mill Chain creates a wide 'kerf' and high proportion of sawdust
Mobile sawmill	Very useful in accessing sites, which will save customer on transportation Plenty of potential customers	Output can be slow, as the site may not be optimal for flow of material in the sawing process Customers may feel it's expensive, as travel time and setting up time have to be charged in addition to actual sawing charge Important to highlight saving to customer on transportation of roundwood to a bandsaw mill
Bandsaw mill	Will be set up for maximum production and can use existing power supply No time wasted in travelling and setting up Usually, a more robust machine than a mobile sawmill Probably the best in a financial sense long term	Logs and customers need to travel to the sawmill and planks produced need to be transported back

Chainsaw mill

Mobile sawmill

Bandsaw mill

TOP TIPS

- Ensure the mill is fixed in a level position
- Pay attention to any indicators of debris within a log, for example a black or brown stain can indicate the presence of an iron nail
- A debarker can be specified with saw purchase and will extend blade life

SAWMILL MAINTENANCE

1. Create a maintenance schedule for your sawmill, including visual inspections before and after each use
2. Ensure all parts are lubricated regularly and check fluid levels
3. Replace worn or damaged bearings and parts
4. Follow manufacturer's instructions

BLADES

There is a wide range of blades on the market, each with different characteristics and price tag. It is usually the case that you can expect to sharpen the cheaper blades more often. So, when deciding on what blades to get, you will need to balance your timber output requirements with blade cost and time spent sharpening. Get advice from a trusted blade provider or from other sawmillers.

Taking care of sawmill blades is essential to ensure a high-quality cut and to maintain productivity.

TOP TIPS

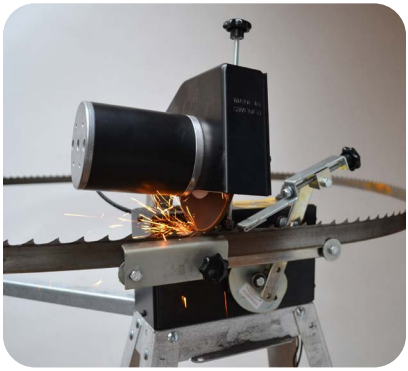
- Eye protection and gloves should be worn at all times when handling blades.
- Use care when fitting the blade to avoid hitting the teeth on the saw structure.
- Rotate blades regularly. New blades should be kept separate from blades sharpened once or twice.
- Check logs before sawing to see if there is any debris on the log that may damage the blade. If unsure, power wash the log so it can be inspected properly.
- After installing a new blade, make the first few cuts at a lower speed to break in the blade.
- Once the blade has been broken in, maintain a steady feed rate. Cutting at a slow speed reduces blade life.
- Maintain drive belt tension when sawing.
- It is recommended to allow blades 'rest' for up to a day before reusing to allow the metal to relax.
- Regularly check for cracks in the gullet of the blade. Small cracks can be ground away when sharpening but if the crack cannot be ground away, the blade should be discarded.
- Never use a damaged blade.

Blade sharpening

- Sharpening any blade is a skilled process and requires specialist instruction. We therefore recommend that you follow the manufacturer's and/or supplier's guidelines for sharpening blades.
- Difficulty pushing the blade through the log, curving of the blade and a change in the sound of the sawmill are all indications that the blade needs sharpening.
- Before removing the dulled blade from the sawmill, run the blade for 15 seconds to allow the lubricant to wash away the sap. If the blade is not sufficient clean after this process, clean with a wire brush.
- Blades can be sent away for sharpening or you can sharpen them using a saw blade grinding robot, which takes approximately 30 minutes, or manually.

Storing blades

- Have a safe environment for storing and managing blades, such as areas with timber walls and floors, to avoid damaging blades on concrete.
- If storing blades of a longer period of time, wipe blades with an oily rag or use a recommended spray to prevent rust and store in a clean, dry place.
- Use a permanent marker to write on the blade the date it was used and how much life is left in the blade.



HEALTH AND SAFETY

Sawmilling is a high-risk business and care must be taken at all times. The Health and Safety Executive UK have produced guidance specific for sawmilling and use of woodworking machinery, links to which are available in the **Additional resources** section.

If using a chainsaw mill, full PPE must be worn and basic training is highly advised.

For all sawmilling operations

- Hearing protection must be worn
- Dust masks and/or full breathing apparatus is advised
- Steel capped boots
- Protective gloves
- Manual handling training
- Adhere to all warning signs and decals on the sawmill
- Follow manufacturer's instructions at all times

4 Drying

"Of all the problems that arise with wood in use, the vast majority are related to moisture or the lack of proper drying" Bruce Hoadley in Understanding Wood, A craftsman's guide to wood technology.

TIMBER MOISTURE LEVELS: WHAT YOU NEED TO KNOW

Timber can be classified into three categories based on its moisture content (MC):

1. **Unseasoned (or 'green') timber:** this timber has a MC higher than the fibre saturation point (~25% moisture content). In green timber, all bound water remains in the wood, along with some free water, which can make the timber feel wet to the touch. Very green timber may even ooze water when a nail is driven into it.
2. **Seasoned timber:** seasoned timber has been dried to a MC of 15% or lower. The moisture levels of wood for interior use should be below 10% and preferably in the range of 6% to 8% and from 9% to 15% for exterior use. During seasoning, the wood undergoes some shrinkage as it transitions from a green to a dry state.
3. **Partially seasoned timber:** With a MC between 15% and 25%, partially seasoned timber has experienced some shrinkage but will continue to shrink as it loses more moisture. Partial seasoning can come from green timber that has not been dried fully or from seasoned timber used in a humid environment, where it absorbs moisture and the MC rises above 15%.

Freshly sawn sycamore boards drying before stacking

Dried sycamore board

Proper seasoning not only strengthens the wood but also stabilizes it for long-term use, minimizing issues like shrinkage or swelling.

MEASURING MOISTURE CONTENT

When it comes to measuring the MC of wood, there are two main methods: oven-dry testing and moisture meters.

Oven-Dry Testing

This is the oldest and most precise method for measuring the MC of wood.

It involves:

- Weighing a wood sample
- Drying it in a well-ventilated oven at 220°F (104°C) and periodically measuring the weight until it stabilizes (no more than 0.1% change over a couple of hours)
- Calculating the moisture content using the following formula:

$$\textbf{MC (\%)} = \frac{\textit{Weight before - Weight after}}{\textit{Weight after}} \textbf{ x100}$$

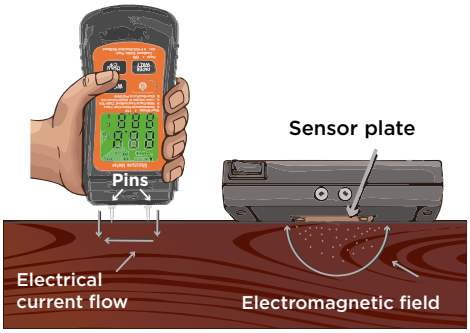
This method is highly accurate but time-consuming and requires an oven that is well ventilated, very accurate and able to maintain a constant temperature for long periods. Plus, the wood can be damaged, making it unusable for projects.

Moisture meters

For quick, on-the-go measurements, moisture meters are ideal. There are two types:

- Pin meters: these measure the MC by running an electrical current between two pins inserted into the wood.
- Pinless meters: these use an electromagnetic sensor placed on the wood's surface to gauge moisture.

By covering a larger area than pin-type meters, pinless meters provide a more thorough picture of the wood's MC. They also don't leave damaging pinholes on the wood's surface.



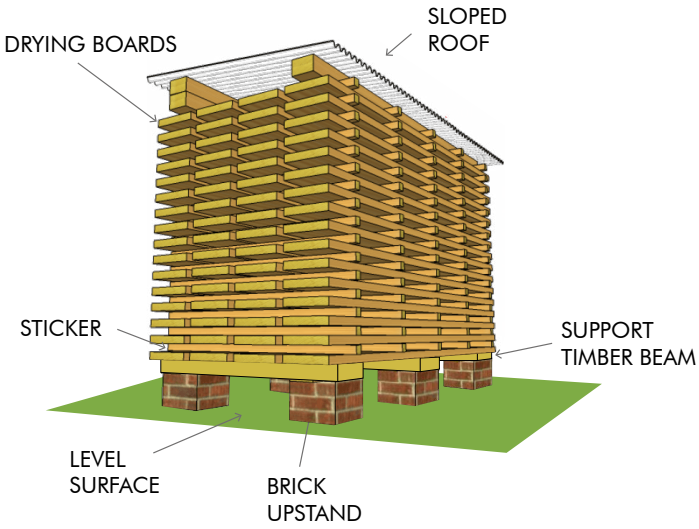
UNDERSTANDING THE DRYING PROCESS

Water in wood normally moves from zones of higher to zones of lower MC. In simple terms, this means that drying starts from the outside and continues towards the centre. It also means that drying at the outside is necessary to expel moisture from the inner zones of the wood.

Airdrying

- Planks are laid on battens and raised off the ground
- Boards of equal thickness should be stacked together
- Stickers are placed between each board to allow air to pass through the stack
- Each stack should be less than 2 metres in width to ensure sufficient air flow through and around the stack
- The stack should be under cover and out of the sun but with sufficient airflow
- The stack should be weighed down to prevent the top boards from warping during drying

Wood dried this way will reach an equilibrium moisture content with its surrounding. In Ireland, air-dried timber has approximately 20% MC.



RULE OF THUMB FOR AIRDRYING OAK

1 year per inch thickness

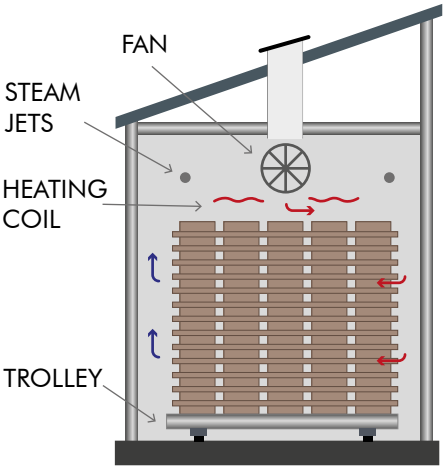
Advantages	Disadvantages
Doesn't require a heat source	Takes a long time
No additional overheads	Dependent on weather/relative humidity
	Requires a lot of storage space
	Timber will not dry down to the MC level required for indoor use

Airdrying

KILN-DRYING

The process of kiln-drying involves circulating heated air to more rapidly remove the moisture from the wood. Each kiln load is sorted by species and dimensions to optimize the process and to ensure that the final MC levels are even across the load.

Based on the species or group of species, a different kiln-drying schedule of temperate, relative humidity and time is used.



Fans circulate steam and warm air to ensure even distribution within the kiln

Steam jets pump steam into the kiln to help regulate humidity

The heating coil heats the air to the required temperature

Trolley facilitates the easy movement of the stack into and out of the kiln.

6m³ kiln by Kiln Services, UK, ready to be loaded in ATU Connemara, Letterfrack.

Shrinkage

As timber dries, the shrinkage in length or along the grain is generally very small. However, the shrinkage in width and thickness can be quite significant.

The degree of shrinkage varies depending on the species, thickness of the cut timber, the part of the log from which the timber was cut, the initial moisture content and the environment in which the timber dries. Generally, hardwoods experience more shrinkage than softwoods. Shrinkage considerations are essential for any timber project.

Unseasoned timber, which dries in place, is particularly affected. For some structural uses, large sections of unseasoned timber might be necessary, but careful design is crucial to manage shrinkage around connections and avoid splitting. To minimize the impact of shrinkage:

- **Consider shrinkage in the design:** Ensure elements aren't affected by shifts in cross-sectional dimensions, especially when using unseasoned timber.
- **Mind the connections:** Good detailing can allow for timber movement as it shrinks. Restrained shrinkage often leads to cracking, so minimizing restraint at connections can significantly reduce shrinkage-related issues.

DRYING DEFECTS

Timber that has not been properly dried can undergo a myriad of issues, including warping, cupping and twisting, binding or kicking during machining, buckling or crowning in an installed wood floor, and adhesive failures in finished products. Other drying defects include sticker staining, surface checking, end splitting, honeycomb splitting, collapse and case-hardening.

The most common drying stress that occurs during kiln-drying is case-hardening, also known as tension set, and it is important to know what it is and how to prevent it.

Case-hardening

Case-hardening refers to unresolved stresses within a board/timber that occur when timber is dried too rapidly. At the start of the rapid drying process, the outside of the timber (shell) dries and tries to shrink but cannot because the core still has a high MC. The shell then 'sets' and resists further shrinkage. As the core begins to dry and shrink, any shrinkage is resisted by the set shell. This results in opposing stresses in the timber: compression stresses on the shell and tension stresses in the core.

To offset case-hardening, water is rapidly added in the form of steam vapour to facilitate the expansion of the shell without increasing the overall MC of the timber. This is done through a process called conditioning: at the end of the drying process, the humidity in the kiln is rapidly increased at as high a temperature as possible until the stresses are sufficiently removed. This is determined by stress samples and experience.

It is important to note that case-hardened wood may warp considerably and dangerously when the stress is released by sawing. Planing the wood can remove the case-hardening stress. However, plane only one side of casehardened lumber and the piece will cup dramatically as the stress in the shell of the un-planed side is still there.

Two-inch oak board showing excessive bow after ripping due to the presence of case-hardening.

5 Storing Timber

Where and how to store sawn timber is often overlooked in the initial excitement of a sawmill purchase. All sawn timber will need to be stacked and stored in a dry environment. This itself is a significant cost for a product that may be on site for at least two years.

Having a method of handling sawn timber is needed, such as with a forklift, as most hardwoods when sawn are very heavy due to the dense nature of the timber.

Timber does not need a high-spec storage facility. An old hayshed or a curtain-side artic trailer at the end of its life, which can be purchased for around €3,000-4,000, is sufficient. The most important considerations are shade, protection from rain and air circulation.

Timber should be stacked in a way that each stack can be identified and accessed into the future.

Identifying the age and species of each stack is essential. Most untreated timber goes grey with time, so it is important that each stack is carefully labelled (in several places) with the timber species, source log and date of milling. A timber database that facilitates full traceability of every board is highly advisable.

Storage costs, per cubic metre of timber, should be included in the business plan. Remember if the production capacity of the business increases, so will the need for storage, so it's important this cost is accounted for.

6 Timber Grading

Grading is a measure of the quality of sawn timber. Quality varies due to a wide range of factors, including species, forest management practices, growth conditions, age at felling and how the timber was milled and stored.

Grading of timber is its own science and many books have been written on the subject. Here, we outline the most basic principles of appearance grading, simply as an introduction to the topic, and refer the reader to the Additional Resources section for more information.

There are two grading categories: structural and non-structural. Structural grading is regulated by a suite of European and national standards and is not discussed here.

NON-STRUCTURAL OR APPEARANCE GRADING

As the name suggests, appearance grading is carried out by assessing timber for non-structural uses by eye and giving it a mark or grade based on the presence, size and/frequency of specific features (see table).

Grade 1

The highest grade and reserved for timber with a uniform appearance and few if any knots, splits or any other features that limit its use where little variation in appearance is accepted.

Grade 2

A medium grade of timber that has some knots, splits or other features. The timber will have some areas of uniformity and some areas with features that can be used in applications where uniformity is not essential.

Grade 3

It will include a wide variety and/or number of features.

It is worth noting that grade 3 timber can have an inherent value due to the high level of character in the timber. It all depends on what the timber will be used for.

The following table is reproduced from: Davis, I. and Watt, G. 2005. Making the Grade – A guide to appearance grading UK grown hardwood timber.

www.forestresearch.gov.uk/publications/

Appearance grades for hardwood timber from the UK

Maximum size or extent of feature on the best face of the piece per specified length[1,2]

Features	The main grades		
	1	2	3
Fully and partly inter-grown knots[3]	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[4,5]	No restrictions providing the appearance and mechanical properties are suitable for its intended use. More detailed criteria may be set in the supply agreement[10]
Non inter-grown knots and rotten knots[3]	Occasional if measured-out	Occasional	
Checks	Occasional surface[6]	Limits may be set[6,7]	
Shake	No	Occasional if measured-out	
Colour	Limits may be set[7,9]	No restrictions	
Grain	Straight or nearly straight[8]	Course grain and minor sloping[8]	
Bark	One surface pocket if measured-out	One surface pocket if measured-out	
Rot and insect attack	No	One small area if measured-out	
Warp	Limits may be set[7]	Limits may be set[7]	
Wane (square-edged pieces only)	Limits may be set[7]	Limits may be set[7]	
Sapwood (oak and sweet chestnut only)	Limits may be set[7]	Limits may be set[7]	

Notes	
1	The table gives the maximum size or extent of features permitted per: • one metre length in the case of square-edged pieces • two metre length in the case of waney-edged pieces
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.

7

Irish Grown Hardwoods

OAK

SOURCE

Both sessile *(Quercus petraea)* and pedunculate *(Quercus robur)* are native to Ireland. Formerly the dominant tree in native woodlands over much of the country but only remnants remain. Widely planted in estate woodlands since the 18th century and latterly in afforestation schemes.

WOOD

Sessile and pedunculate oak wood is usually indistinguishable. The sapwood is pale cream; heartwood ranges from yellowish brown, light tan to deep brown. Growth rings are obvious due to alternating bands of large pored early wood and dense late wood, and produce a flare pattern on flat sawn surfaces. A sought-after wood available in limited quantities from mature estate woodlands. Heartwood is very durable and strong.

DRYING

A very difficult wood to dry with relatively high proportions of defects. Best results if air dried slowly for at least a year before kiln drying.

USES

Building restoration and post and beam structures; boat building; barrel staves (only very high-quality timber and must be quarter sawn), cabinet and furniture making, joinery and panelling, flooring, exterior trim and cladding. Small sections of wood can be readily steam bent. Quarter sawn oak, which exposes the medullary rays, commands a premium price.

NOTES

Bent pieces of timber, including branches, can be used in boat building and post and beam structures.

Beware of Turkey oak, a separate species that has very little heartwood and is even more difficult to dry.

ASH

SOURCE

A native tree of woodland and hedgerows where it has readily regenerated as a pioneer species. Has been planted in monocultures since the 1980s. Currently being decimated by ash dieback (caused by the fungal pathogen *Hymenoscyphus fraxineus*).

There is, and will be, huge quantities of mature trees for sawmilling, at least several hundred thousand m^3 in the coming years.

WOOD

White to light brown, usually no distinction between sap and heartwood. May have irregular dark brown to black heartwood ('olive' heartwood) which is sound and can give an attractive feature. Growth rings distinctive with band of obvious pores which give an attractive figure on flat sawn surfaces. Attractive joinery timber that is tough and flexible but is not durable.

DRYING

Ash timber dries relatively easily and quickly.

Trees affected by ash dieback should be felled and planked within 12-18 months of infection; otherwise, significant rot will develop.

USES

Hugely popular for hurley making. Ideal for indoor uses including furniture, floors, kitchens and doors, as well as handles for tools and implements. Can be easily steam bent for chairs etc.

BEECH

SOURCE

Widely planted in the late 18th and early 19th centuries. These trees are now mature and often in decline and being felled for safety reasons. Latterly planted in afforestation schemes but usually of poor quality.

WOOD

No clear distinction between sap and heartwood; pale, usually bland timber when cut fresh except for flamed beech — red discolouration of the heartwood of some mature trees; ray tissue showing as small spindle-shaped marks on flat sawn surfaces to dark irregular flecks on quarter sawn.

A common procedure in continental Europe is to steam the sawn timber before it is dried to give the wood a distinct pink or reddish tinge and reduce colour variation.

Logs can be left for 1-2 years before milling to encourage initial fungal decay with markings and streaks in the wood, termed 'spalting'. Once planked and dried, the decay ceases and it is a desirable wood that commands a premium price.

DRYING

Relatively easy to kiln dry but best results obtained if air-dried first.

USES

Not a durable timber; furniture and interior joinery, construction and flooring, domestic woodware, tool handles, turnery and craft.

SYCAMORE

SOURCE

Widespread tree of woods and hedgerows. Can withstand coastal environments and high altitudes better than other hardwoods. A good alternative to ash on many replacement sites.

WOOD

An attractive white diffuse-porous wood. Timber is usually straight-grained, some trees can have marked grain patterns, such as fiddleback grain, which are highly prized.

DRYING

Timber is very prone to discolouration, in particular sticker-stain, when fresh. Best results obtained when boards are surface dried by storing vertically for a period before stickering. Trees should also be felled and sawn during winter months to avoid staining.

USES

Timber not durable outside; traditionally used for table tops and kitchenware but can be used for all general furniture, floors, fitted kitchens. The wood is easily sanded and takes stain well.

ALDER

SOURCE

A native species that on deep soil and sheltered sites can attain sawlog proportions. Widely planted on peat where it rarely thrives. It can be coppiced for timber and firewood.

WOOD

Not a durable timber and very vulnerable to woodworm, but is durable if kept wet. Freshly cut timber should be quickly milled and dried to prevent decay. Extremely pliant timber with unique reddish colour that is very overlooked in Ireland. Freshly felled alder logs develop a strong orange-brown colour on the end grain, which gradually fades. Saws and machines easily.

DRYING

Timber dries fairly rapidly and well.

USES

Making sluice gates, water pipes, bridge piles and small boats. Indoor floors, skirting, doors, kitchen cabinets, end-grain tiles, furniture (Irish Mahogany), harps and clogs.

BIRCH

SOURCE

An attractive pioneer species that can thrive on poorer and exposed acid soils. The timber of the two native species, downy birch *(Betula pubescens)* and silver birch *(Betula pendula)*, is indistinguishable. Does not normally attain large proportions but is overlooked as a timber species and normally ends up as firewood.

WOOD

A white or pale-coloured timber with fine even grain, often with a lustrous sheen. Occasional darker flecks may be present. Wood is hard, of high density and with good wearing properties. Should be sawn and dried promptly after felling to avoid discolouration and decay. Older trees have discolouration in the heartwood.

DRYING

Timber dries rapidly with little degrade other than a slight tendency to distort, and a susceptibility to staining if drying is delayed.

USES

Not durable but ideal for indoor uses: furniture, household articles such as breadboards, brush backs and toys. It is now being used by kitchen manufacturers because of the attractive flecked appearance. Widely used in Europe for manufacture of plywood.

ELM

SOURCE

Several species and cultivars present in Ireland but all, except the most recent disease-resistant plantings, have succumbed to the Dutch Elm disease. Mature Wych elm, which is probably the only native species, have survived in small numbers. Any large logs that become available are from dead trees and decay can be present. Regrowth from trees that succumbed to disease in the 70s and 80s become susceptible to reinfection when they reach semi-maturity.

WOOD

Timber from mature trees has a variable but attractive colour and grain. There is little colour differentiation between heartwood and sapwood. Wych elm frequently has a greenish tinge or may have distinctive green streaking. Small sawlogs from dead regrowth are worth salvaging and can yield good boards.

DRYING

Elm dries quickly but is very prone to warping; care is needed in stacking and stickers should be carefully positioned at close intervals. Difficult to split due to cross grains.

USES

Not a durable wood unless kept permanently damp. Ideal for indoor use including furniture, craft items, and flooring.

8 Glossary & Additional Resources

GLOSSARY

BARK The outmost layer of the tree that protects the tree from the environment. The outer layer of the bark is dead while the inner bark (phloem) transports nutrients.

BOW A curve along the face of a board caused by the wood on one face shrinking more than on the opposite face.

CAMBIUM LAYER The growing part of the trunk. Produces new bark and new wood below the bark and outside the sapwood.

CHECK A long crack that appears parallel to the grain as the sapwood shrinks around the heartwood during the drying process.

CROOK An edgewise curving of a board caused by uneven shrinking.

CUPPING A hollowing of a board throughout its length on its bark-side face.

END GRAIN The narrow, porous top and bottom edge of the board.

FLAME FIGURE A particular grain pattern that resembles the ripples seen in a burning flame.

HEARTWOOD Older, non-functioning wood. Central supporting pillar of the tree.

KERF A slit or notch made by a saw or cutting torch.

KNOT An imperfection from a dead branch that cause living wood grain to grow around it. A live knot is from a branch attached to the tree when it's harvested and is generally considered okay. A dead knot is from a branch that has fallen out of the tree and can create problems by leaving a hole or weakening the wood.

MEDULLARY RAYS Horizontal thin fibrous tissues that extend radially from the cambium layer towards the core or from the pith towards the bark.

PITH Inner-most part of the tree. Soft tissue that is the original stem.

SAPWOOD Outer 4 to 20 rings of the tree. The living material of the tree.

SHAKE Lengthwise separation of the wood along the grain, usually occurring between or through the rings of annual growth. A surface shake occurs on only one surface, while a through shake extends from one side to the opposite or adjoining side of the piece.

SPALTED WOOD A discolouration of wood, producing dark lines or streaks in the grain of the wood, that is caused by a fungus. Spalted wood is highly coveted by woodworkers.

SPLIT A crack that tends to occur at the end of a board and goes through from one side to the other.

STICKERS Small pieces of wood used to separate boards during the drying process.

STICKER STAIN A chemical or enzymatic process that leaves marks under the stickers used to separate boards.

TWIST A variation in grain direction and shrinkage over the length of a board that results in one end of a board not being in the same plane as the other; likely to occur more in thin boards than thicker ones.

WANEY EDGE An edge that retains its natural appearance, sometimes even with the bark on.

ADDITIONAL RESOURCES

An accompanying video on the small-scale sawmilling project can be found at www.irishforestowners.com/resource/sawmilling

Books

Hardwood sawmills and lumber yards: Enhance your profit by Bruce Nesmith.

Understanding Wood, A craftsman's guide to wood technology by Bruce Hoadley, The Taunton Press.

Websites

Wood-Mizer	Sawing logs into lumber
Radial Timber	Radial Timber Sawing
Frank Miller Lumber	Quartersawing Animation
The wood database	www.wood-database.com
Teagasc	Production of quality hardwood timber
Teagasc	Felling, presentation and grading of hardwood timber
Timberpolis	www.timberpolis.com/wood-calculators
Wood Defects	https://www.youtube.com/watch?v=9zT3qaZJxlw
HSE UK	HSG172 Health and safety in sawmilling
HSE UK	L114 Safe use of woodworking machinery

PDFs

Coed Cymru Chainsaw Milling

Davis, I. and Watt, G. 2005. Making the Grade – A guide to appearance grading UK grown hardwood timber.

Denig, J., Wengert, E.M. and Simpson. E.T. 2000. Drying hardwood lumber. Gen. Tech. Rep. FPL–GTR–118. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory.

Joyce, P.M., Huss, J., McCarthy, R., Pfeifer, A. and Hendrick, E. 1998 Growing broadleaves: silvicultural guidelines for ash, sycamore, wild cherry, beech and oak in Ireland. COFORD, Dublin.

Knaggs, G. and Xenopoulou, S. 2004. Guide to Irish Hardwoods. COFORD.

Planet Ark. 2015 Wood, housing, health, humanity

Robinson, B. and Davis, B. 2020 Grading Structural Timber COFORD

Projects

The Harwood Focus Project 2019/2020, Limerick Tipperary Woodland Owners https://limerickandtipperarywoodlandowners.ie/hardwood-focus/

Hardwood Focus 2020, Teagasc

Woodland to Workshop Project 2021/2022, North East Forestry Group https://northeastforestrygroup.ie/news/woodland-to-workshop-project/

www.irishforestowners.com/resource/sawmilling Irish Forest Owners

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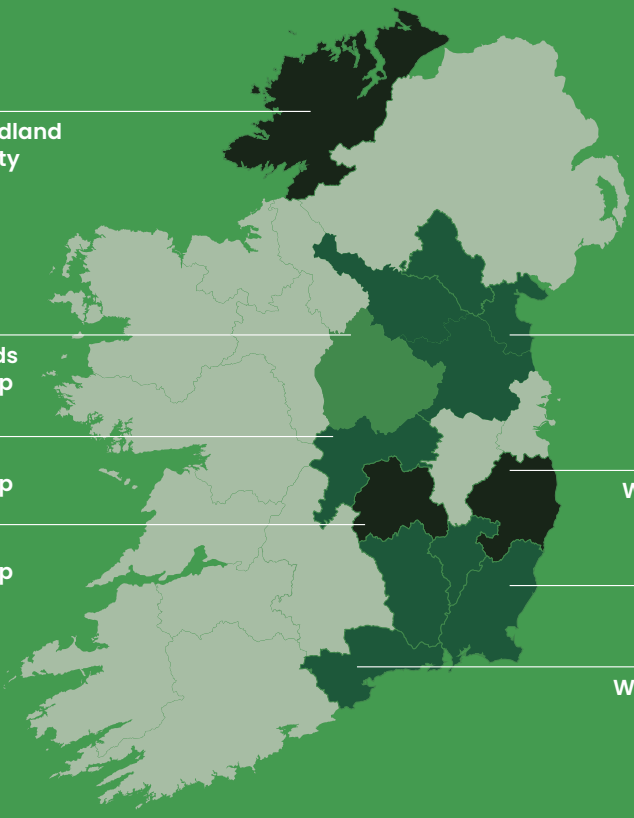
Irish Forest Owners

Supporting and representing forest owners across Ireland through a vibrant producer group network



Donegal Woodland Owners Society

North Midlands Forestry Group

Offaly Farm Forestry Group

Laois Farm Forestry Group

North East Forestry Group

Wicklow private woodland owners group

Irish Wood Producers

Waterford Forest Owner Group

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