

**VALUE ADDING
OF UNITED STATES HARDWOODS**

TONY PEPPER

1992 GOTTSTEIN FELLOWSHIP REPORT

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JOSEPH WILLIAM GOTTSTEIN MEMORIAL TRUST FUND

The Joseph William Gottstein Memorial Trust Fund was established in 1971 as a national educational Trust for the benefit of Australia's forest products industries. The purpose of the fund is *"to create opportunities for selected persons to acquire knowledge which will promote the interests of Australian industries which use forest products for the production of sawn timber, plywood, composite wood, pulp and paper and similar derived products."*

Bill Gottstein was an outstanding forest products research scientist working with the Division of Forest Products of the Commonwealth Scientific Industrial Research Organization (CSIRO) when tragically he was killed in 1971 photographing a tree-felling operation in New Guinea. He was held in such high esteem by the industry that he had assisted for many years that substantial financial support to establish an Educational Trust Fund to perpetuate his name was promptly forthcoming.

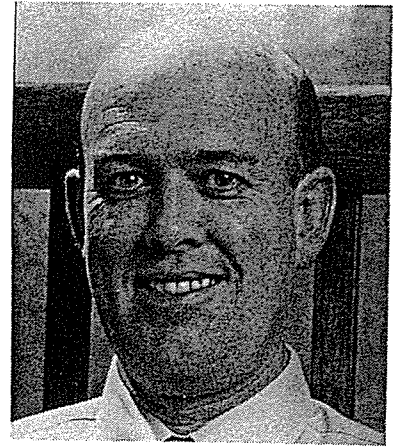
The Trust's major forms of activity are,

1. Fellowships - each year applications are invited from eligible candidates to submit a study programme in an area considered to be of benefit to the Australian forestry and forest industries. Study tours undertaken by Fellows have usually been to overseas countries but several have been within Australia. Fellows are obliged to submit reports on completion of their programme. These are then distributed to industry if appropriate.
2. Seminars - the information gained by Fellows is often best disseminated by seminars as well as through the written reports.
3. Wood Science Courses - at approximately two yearly intervals the Trust organises a week-long intensive course in wood science for executives and consultants in the Australian forest industries.
4. Study Tours - industry group study tours are arranged periodically and have been well supported.

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Tony Pepper has had an twelve year career at the Victorian Timber Promotion Council. He started as TPC's Technical Advisor providing authoritative advice on a wide range of timber related subjects to architects, builders and the general public.

He was subsequently Products Manager and Promotions Manager before taking on his current role of Market Development Manager some three years ago. In this position, Tony is implementing programs which assist the Victorian timber industry's transition into value added markets.

The further development of Victorian hardwoods into kiln dried structural non appearance products for both domestic and international markets is a key facet of Tony's role.

The Gottstein Fellowship provided an excellent opportunity for furthering Tony's experience in an area that is becoming increasingly significant to the timber industry in Australia. It is anticipated that the information contained within this Gottstein Report will be of direct use to the industry as it moves into non structural markets for eucalypt hardwoods.

GOTTSTEIN FELLOWSHIP REPORT

A Report of value adding of United States
Hardwoods

**TONY PEPPER
GOTTSTEIN FELLOW**



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ACKNOWLEDGMENTS

This study tour was undertaken with the financial support of the J.W. Gottstein Memorial Trust Fund.

I wish to offer my sincere thanks to the trustees of the fund in granting me the privilege of making the study tour and the ensuing report possible.

I also thank my employer the Timber Promotion Council whose ongoing support and encouragement have enabled me to undertake the work.

Finally many individuals have given me much of their time and support for which I am most grateful.

Special thanks go to Norman Huon and other members of TPC staff, Anne Pepper and my family.

INTRODUCTION

My Gottstein Study Tour was aimed at obtaining an assessment of the United States hardwood market. It was motivated by the inevitable changes taking place in the Australian market. Much has been written of the increased quantities of domestic radiata pine becoming available in the market from plantations established during the 1960's and 1970's. Plantation softwoods have proven to be a very good substitute for hardwood in commodity applications.

The challenge for producers and organisations such as the Timber Promotion Council of Victoria is to ensure that softwood withstands assaults from alternative materials in traditional structural markets and becomes competitive in export markets. The priority for hardwood producers is to retreat as quickly as possible from domestic commodity markets where pine has a comparative advantage, in order to pursue higher value added markets that take advantage of hardwood's durability, appearance, strength and hardness. Export is an essential part of this equation if available timber volumes are to be fully utilised - we are truly operating in a global market.

The United States has considerable attraction as a learning ground for Australian hardwood producers. The construction industry is dominated by softwood. The hardwood sector concentrates on other markets, presumably based on demonstrated competitive advantage. Given the broad direction being taken by Australian hardwood producers it seemed that an examination of several key market segments in the United States might provide some useful pointers for particular value adding opportunities. The areas in which I was especially interested were flooring, the furniture industry and any other markets that could utilise short lengths. The tour included visits to sawmills, flooring and furniture plants and Industry Associations.

Some examination of export opportunities was an important part of the study. It is estimated that significant shortages of timber are looming around the Pacific Rim. Australia, with a growing plantation base and with an expectation that Regional Forest agreements will provide a stable supply of timber from native forests is in a position to fill some of the supply gaps.

At the time my study tour was proposed, the Timber Promotion Council was considering the possibility of exploring export opportunities for Victorian hardwood under an Innovative Agricultural Marketing Program (IAMP). Industry subsequently decided on a more cautious approach because of concerns about current export capability and a Marketing Skills Program (MSP) through the Federal Department of Primary Industry and Energy (DPIE) was

finally negotiated. The initial focus was the Japanese market and significant export sales have flowed from that initiative.

A second project, also supported by DPIE has been commenced, targeting the North American Market for "Natural Feature Grade" Australian hardwood timber. The programme is aiming at the highest value added market for this previously down graded green commodity product in Australia to the furniture market. The initial feedback has been most encouraging. I have been closely involved in these projects and the knowledge gained during my Gottstein tour has proved to be very valuable.

The body of this report examines the following areas:

- Value adding
- Hardwood dimensioned products industry
- Hardwood flooring
- Furniture industry
- Export
- Industry associations
- Case study sawmill visits and practices.

Analysis of the findings together with recent developments in the Victorian hardwood sawmilling sector identify the following areas for further investigation.

Following are some conclusions and recommendations for consideration from this Gottstein Fellowship report. "Value adding of United States hardwoods".

CONCLUSIONS AND RECOMMENDATIONS

Secondary Processing - The Dimension Industry

The dimension industry is not a significant outlet for Australian hardwood sawmills. Many sawmills have planers and relatively unsophisticated machinery that often doesn't work to capacity. The recovery of short lengths, and glueing components back together to manufacture high value specialist products for downstream industries makes good sense.

The furniture, cabinet and joinery industries in Australia is adding domestic value to an increasingly scarce resource is a sound strategy typified by companies employing less than 20 people and operating out of small factories. Supplying set length, set width blanks on semi finished components ensures far less wastage, fewer timber storage problems and a consistent high quality product. The sawmill begins to produce what the market wants rather than endeavouring to sell what it produces ie. market driven not production oriented.

The hardwood sawmilling industry in Australia (particularly in Victoria) is committed to adding value to the hardwood resource. More and more companies are investing in new technology and equipment to allow them to do so.

A major key to successful value adding is to find export markets for our timber and timber products. The Australian resource is certainly not large by global standards, producing less than 1% of world hardwood production. This creates a unique opportunity to establish niche international markets and develop long term strategies to service them.

By servicing these niche markets Australian sawmillers can avoid exporting commodity timber products that are subject to fierce competition from other countries trading in timber. Our eucalypts are characterised, in the main, by kino or gum veins that has traditionally down graded the material.

Edge glued raw wood which has been graded by each face and edge can often conceal these character markets for some applications and markets.

Short length material can therefore be upgraded rather than be a 'residual material' for sawmillers - this is an important adjunct to natural feature developments.

Essential Points Of The Flooring Market

Innovation and the leading edge in technology changes are coming from Europe. Currently the principle difference between Australia and the U.S.A. flooring producers is utilization of short length.

The U.S. provides end matched flooring which only a few major Australian companies produce - mainly Bunnings, Boral, Gunns (the Big 3). No Victorian producer is end matching although a new investment is reportedly imminent. End matching allows for cross docking and up grading short clear length rather than downgrade longer lengths with imperfections. The U.S. flooring market allows for lengths down to 9". 'Short' packs or bundles average only 15" in length. Even longer bundles average no more than 4' (1200) and 8' long and under is the norm for strip flooring products.

The whole approach by U.S. sawmillers and the flooring products industry is to make it easier for the layer and/or builder. Short bundles can be easily handled which is particularly important in multi-level construction and also suited to small rooms. Far less material is wasted. Strip floors are laid over a panel floor substrate, not directly onto joists providing a safe workplace. All strips are secret nailed with efficient and effective purpose built tools. Flooring is a specialist trade not just another task for the builder.

Grading

There is a recognised need for education and training in this area. Courses cover grading, timber knowledge, installation, finishing and floor care - a complete package.

There is an association which promotes, educates and researches specifically flooring issues. This might provide a suitable model for Australian producers.

Pre-finished floors

This will be the long term future for the Flooring Industry due to eventual bans or restrictions on insitu coatings that may be harmful. Pre-finished floors look better. Consumers can make a decision based on what it looks like, not what it may look like. Pre-finished floors are less messy and disruptive during installation. Product is guaranteed. High quality and higher prices are obtained. Factory controlled quality finishes are applied which are hard, durable and long lasting.

Thinner surface layers are used. Lower grade material may be used as the substrate as solids or a ply base. The world wide trend is to concrete slab. Of course development programs focussed on regaining market share for timber sub floors are an appropriate strategy.

However, programs designed to integrate the use of timber with concrete slabs are equally important.

All pre-finished floors are arrissed on the edge to disguise movement in service. All edges have tongue and groove not square edge.

Australia needs to extend research on overlay flooring systems that suit our conditions. Precise information is required regarding moisture content in various environments e.g. airconditioning, central heating, slab heating. Australia's range of humidity and moisture content recommendations from Perth to Queensland also needs to be documented.

Packaging, Marketing, Merchandising

Product is well positioned to the D.I.Y. market by specialist suppliers, merchants, etc. Bundled shoulder packs with all trimmings would be the recommended approach.

Currently I believe the D.I.Y. consumer consider there are too many processes, some of which they may lack confidence in getting the finish they expect - Sanding, sealing, docking etc. A pre-finished flooring pack or semi finished floor product with instructions may increase timber floor sales.

Flooring Recommendations

The following initiatives deserve increased attention:

- Review the current Australian Standard for flooring to include shorter length and educate the construction industry to accept short length.
- Encourage acceptance of character marked timber.
- Investigate cost effective end matching equipment, possibly through co-operative centralised facilities.
- Promote secret nailing to avoid presentation of "man made" defect every 450mm with 2 face nails.
- Develop a floor product suitable for installation over concrete slabs. 71% of new house construction in Victoria uses concrete slab.
- Develop an overlay timber floor that is pre-finished and 'consumer friendly'.

Furniture Industry

Australia's furniture industry is vigorously pursuing export markets for its productions. The best outcome for Australia would be for every stick of hardwood to be exported as fine furniture exploiting local design skills, manufacturing techniques, and, of course, unique timber resources.

Identifying the uniqueness of Australian furniture in international markets is relatively straightforward.

Australia's furniture industry may find it difficult to compete on manufacturing costs compared to the cheap labour costs of Asia and the Eastern Block countries. But it has some distinct advantages, the Australian furniture industry is world competitive in technology, it has the machinery and produces high quality products. The unique advantage is Australian timber. The timber industry needs to develop a closer relationship to assist furniture manufacturers in pursuing and developing export markets for Australian timber furniture providing cut to length blanks, semi finished, solid or laminated Australian hardwood products to this industry will add value domestically for export markets.

There is considerable potential for more laminated stock in the furniture industry. Australia must move towards supplying component blanks, semi finished components or fully finished components. Provision of short length product to suit specific end use i.e. table rails at 1800mm not 3600mm or 5400mm is a further opportunity.

Timber Grade

Introduction of pallet packs of particular grades, cuts etc. e.g. chair parts, tables etc. require investigation. Drawer fronts for example may need to be grade to 2 faces 4 edges, whereas a drawer bottom only requires grading to one face.

Natural Feature

Marketing natural features in our hardwood has begun in Victoria with encouraging success. This market both domestically and internationally has tremendous potential. High value added markets such as furniture, flooring and housing fix outs for natural feature grades are critical to the overall success of value adding to Australian's unique hardwoods.

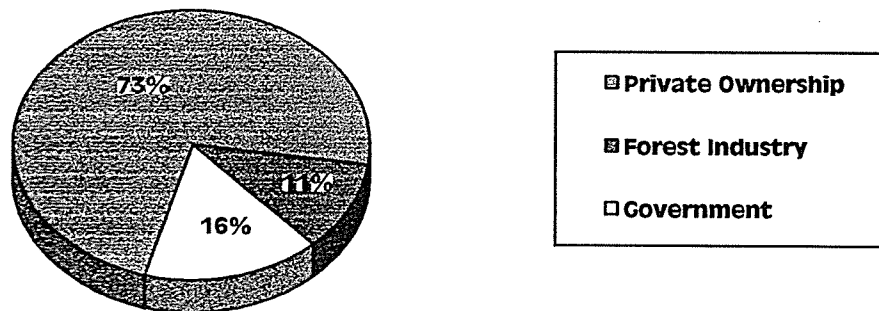
OVERVIEW

U.S. HARDWOODS - THE RESOURCE

The U.S. is the world's largest hardwood timber producer. Based on FAO statistics the U.S. produces 40% of the world's temperate hardwood.

In Australia we are more familiar with softwood timber from the U.S. - dominated by one species - Douglas Fir. However over 45% of the total U.S. timber resource is hardwood. Hardwoods are dominant in the Eastern half of America and softwoods in the Western States. The Mississippi River is a rough natural boundary which may be used as dividing East/West.

90% of all U.S. hardwood forests occur in the Eastern States. A major difference between the softwoods of the western states and the hardwoods of the eastern half of the U.S. is forest ownership. Almost three quarters of America's hardwood forested lands are privately owned - 11% by forest industry and 16% by federal, state or local government.



U.S. HARDWOOD FORESTED LAND OWNERSHIP

There is a total of 154 million hectares of forested land in the Eastern United States. There are 19,000 professional foresters in the U.S. many of whom work directly to help landowners manage their timberlands responsibly.

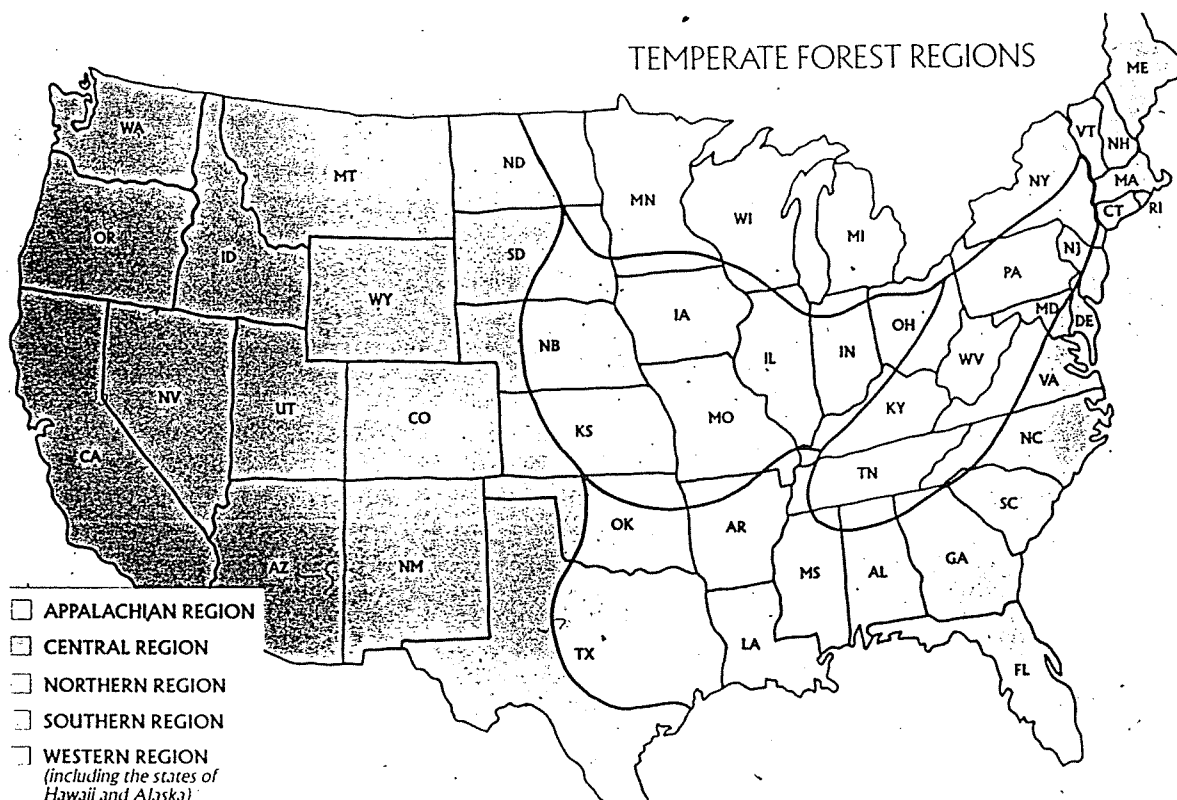
The Industry asserts that hardwood resource is managed on a sustained yield basis with trees being harvested on an average 80 year rotation.

Based on information from the Appalachian Hardwood Association the average annual growth of timber in the Appalachian region is $70 \text{ ft}^3/\text{acre}$ (2m^3 per acre).

Hardwoods are most often managed for natural regeneration rather than planting. Hardwoods also reproduce by seeding and by stump and root sprouts after cutting.

Planting seedlings is the preferred method used on lands owned and managed by the forest products industry. They plant 5 seedlings for each log removed.

Through this active forest management process the U.S. hardwood resource is achieving healthy growth rates. For the last 40 years growth has exceeded harvesting.



'Hardwood forest regions in the eastern United States'

COMMERCIAL SPECIES

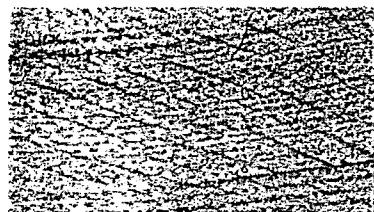
As in Australia there is a wide range of species. In the U.S. the Oaks are the dominant species making up just under half (47%) of the commercial hardwood production in the U.S.A. Of the 47% Red Oak makes up 24% of the volume and White Oak 17%. Although there are up to 60 Oak species in the U.S. only 14 species have commercial importance. However these 14 species are generally marketed under the description of Red and White Oak.

Oak is cut in 40 of the 52 states but most Oak production is confined to regions east of the Great Plains with the greatest production in the Southern States of Mississippi, Louisiana and the Appalachian Mountain Region.

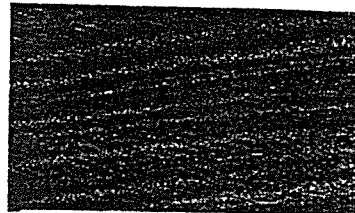
Red and white oak are the premier volume all purpose and the most commercially used of all American woods. They rank amongst the leading cabinetry timbers and are the most commonly used species for modern furniture possessing all the properties required for a good furniture timber. It is readily shaped, planed and turns and glues well. Combined with good stability this species lends itself to many decorative effects as its natural colour of light pale cream to warm reddish brown can be enhanced through stain finishing to match most interior applications. It also has other properties that allows Oak to perform very well in utility and specialist needs such as bending (chairs and boat components).

AMERICAN HARDWOODS

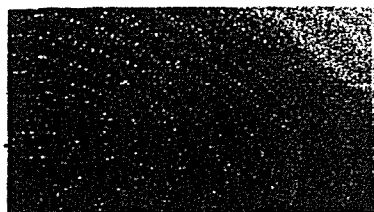
A selection of widely used species



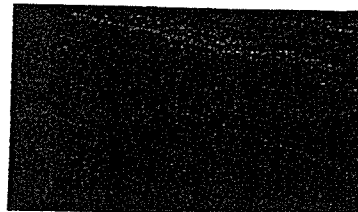
Red Oak



White Oak



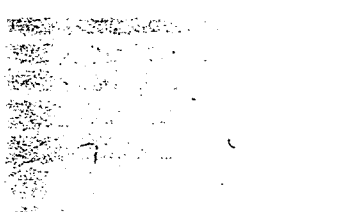
Sassafras



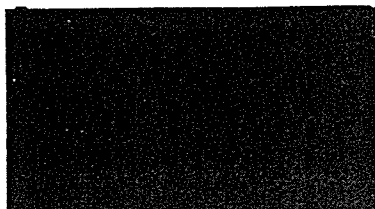
Cherry



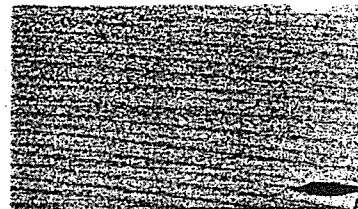
Tulipwood



Ash



Walnut



Maple

'8 common American hardwoods'

Principal markets for U.S. hardwoods

The largest user of hardwood in the U.S. is the wood pallet and container market which has historically held this position for many decades. This is slowly changing as less wood is now required in pallet construction. Softwoods, ply and other competitive materials have seen a weakening in market share. The markets for dimension products and furniture are the next largest consumers of timber. Fluctuating housing starts impact on domestic growth and exports and have sustained strong growth. Most of this growth is in higher quality material. This market growth for U.S. hardwood and its products is expected to continue.

Estimated Hardwood Lumber Used in Selected Industries & The Export Market, 1987-1990, and Annual Rate, 1991

Industry/Market	1987	1988	1989	1990	1991
	- in million board feet -				Annual rate *
Wooden pallets & containers	4,435	4,649	4,724	4,749	4,624
Hardwood dimension	1,359	1,371	1,369	1,355	1,294
Wood household furniture	1,058	1,062	1,034	971	912
Millwork	713	725	710	681	627
Railroad ties & timbers	535	710	652	629	636
Wood kitchen cabinets	612	625	631	626	573
Export market	688	688	748	801	850
Hardwood flooring	476	532	559	554	529
Commercial furniture	417	444	440	424	399
Upholstered furniture	309	315	312	303	286
SUM: Industrial Use/Export	10,602	11,121	11,179	11,093	10,730

* An annual rate of hardwood lumber use extrapolated from data for the first nine months of 1991.

Value adding opportunities for hardwood sawmills in the U.S. comes about from the competitive pressure on America's woodworking industry by imported wood products.

Sawmills acknowledge that they must raise their product quality and merchandise and present their products better than they have in the past.

To compete with foreign competition in both domestic and international markets means that sawmills have to move away from being primary processors to become secondary manufacturing businesses. It is evident that it is becoming increasingly difficult to simply rely on efficiently cutting sawn timber. This sounds very familiar to what is recognised in the Australian sawmilling industry. Relying on unseasoned low value added markets has a limited future.

Sawmills are now turning to secondary processing, turning rough green and sawn dry into a value added processed product for industrial and consumer markets. Industrial products manufactured at the sawmill include pallets and packaging containers to semi and fully processed wood products that now flow through dimension plants that are integrated into the sawmilling operation.

These processing facilities maximize the resource recovery by ripping and docking and then re-gluing short wood components into dimension stock such as flooring, stair components cupboard doors, furniture parts down to clear dressed, short boards for the do-it-yourself and ready to assemble markets.

Global competition is changing the face of the forest products industry. The industry's reliance on the cyclical home building industry and increased global competition is forcing the industry, and in particular the sawmilling sector, to pay more attention to individual markets and consumers and to focus on providing them with more value added and useable wood products.

U.S. Sawmills are looking to secondary manufacturing and processing to shift away from relatively low value commodity markets to growth markets that are infinitely more specialised. These value added products often result in higher margins and greater profit for the producer. For example low grade, shorter length and alternative species can be much more effectively utilised by sawmillers through precise docking to length grade and then edge gluing boards into table tops or other similar product types.

Making products, not commodities, provides tremendous marketing flexibility to a sawmill. It can respond quickly to new trends and new markets not previously considered.

International markets also become viable. All of these opportunities exist but come at a cost.

New markets have to be identified, researched and serviced, new products have to be sold and undertaking these roles take more time and skill than just trading timber.

Each customer will have different needs and wants and each market will possibly have a segment or niche which can be serviced with a quality product that meets the customers specification and expectations.

The labour used at the sawmill will change as new skills are introduced and new methods are adopted. A value adding sawmill will be more labour intensive than a traditional board only producing mill. For most Australian hardwood sawmills the American experience is relevant. Developing value adding processes focussed on niche, high value added markets is the key to prosperity, if not survival.

AMERICAN HARDWOOD DIMENSION INDUSTRY

American hardwood sawmillers have a similar challenge to their Australian counterparts. Traditional high value markets for the higher grades of the more popular species eg Ash, Tas Oak, Jarrah in Australia and Oak, Cherry and Maple in the U.S. have been relatively easy to find.

The major challenge has always been one of finding, developing and maintaining outlets for the lower grades and less commonly known species.

In Australia, lower grade timbers have been sawn green and sold into commodity house framing markets with little additional value adding.

In the U.S., low grade, short lengths and less commonly available species are being value added into high quality products at competitive prices. This process is relatively simple but is capital intensive. It is however, potentially highly suited to Australian type eucalypts.

History Or Background

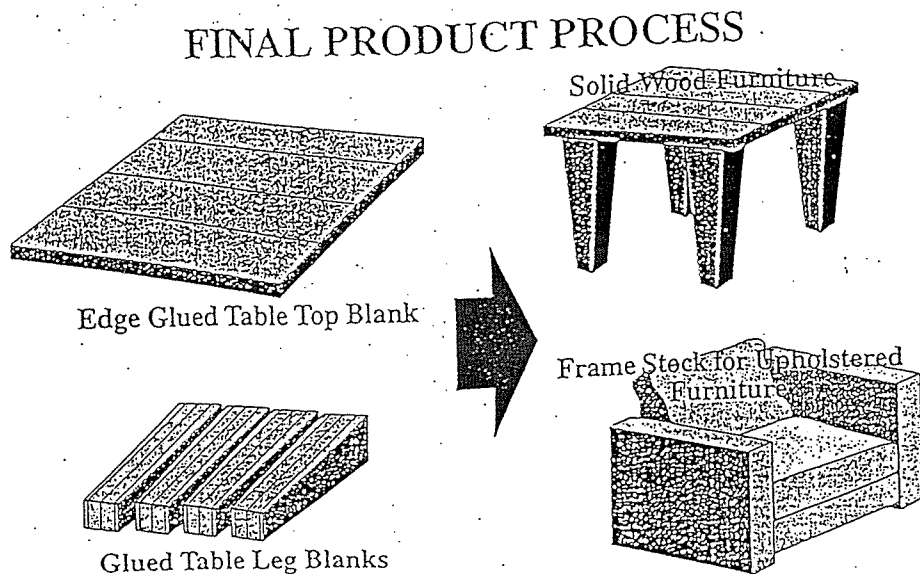
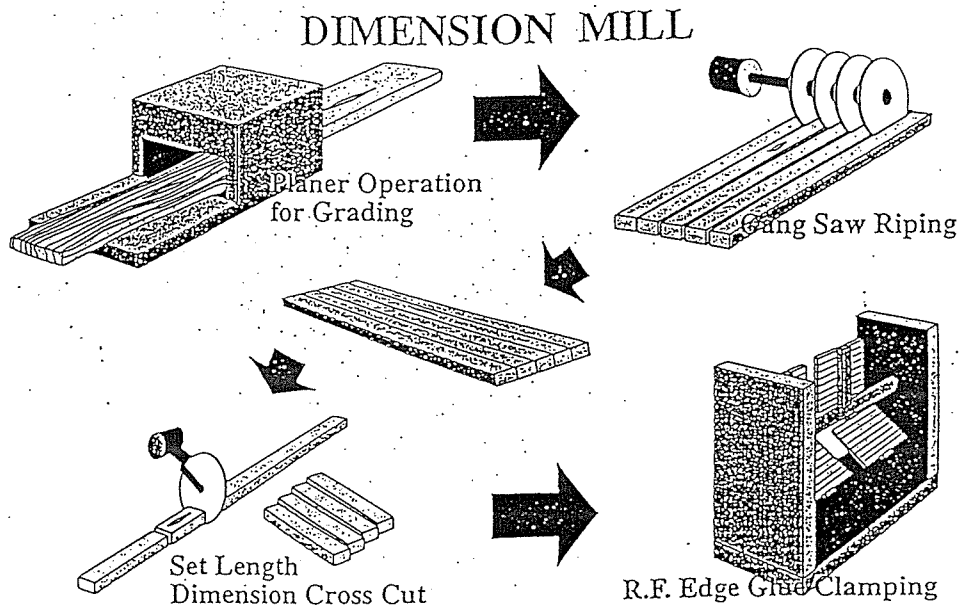
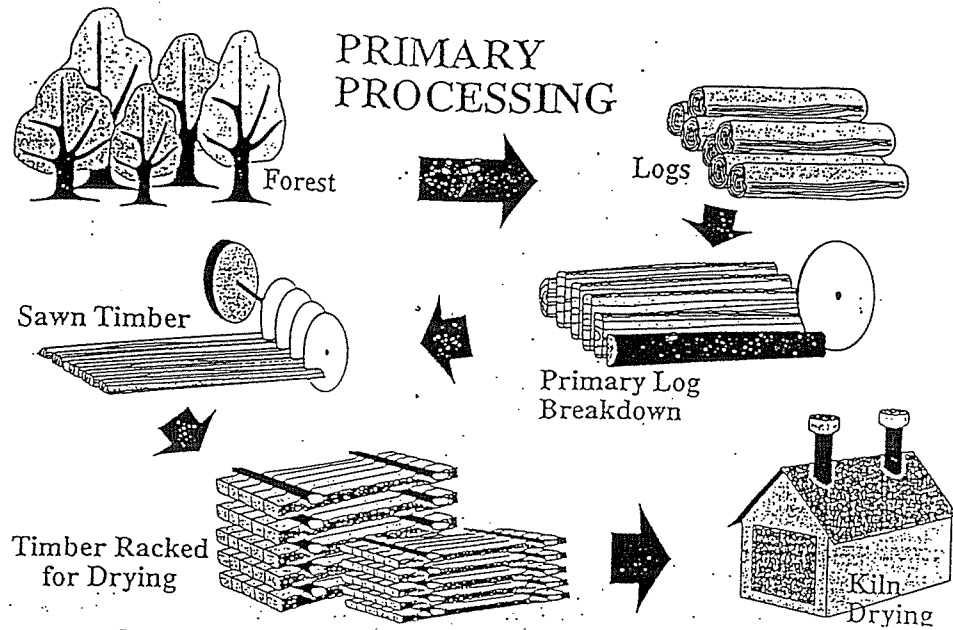
In the US nearly all hardwood products are used in non structural applications and there is wide disparity in terms of quality and value among various U.S. hardwoods.

One solution to finding ways to better utilise low grade timber has been to process more lower grades into various hardwood dimension products. The hardwood dimension industry has been in existence since the 1920's and relied on higher grades of timber producing rough sawn kiln dried boards of specific widths, thicknesses and lengths to meet the specifications of a particular customer.

The dimension industry today maximizes their returns by gluing and finger jointing where required to supply customers with many varying types of solid wood products.

Product Description

Hardwood dimension components are solid wood kiln dried to 5-9% moisture content and are processed to a point where minimum waste is left at the dimension plant and the maximum utility is delivered to the user.

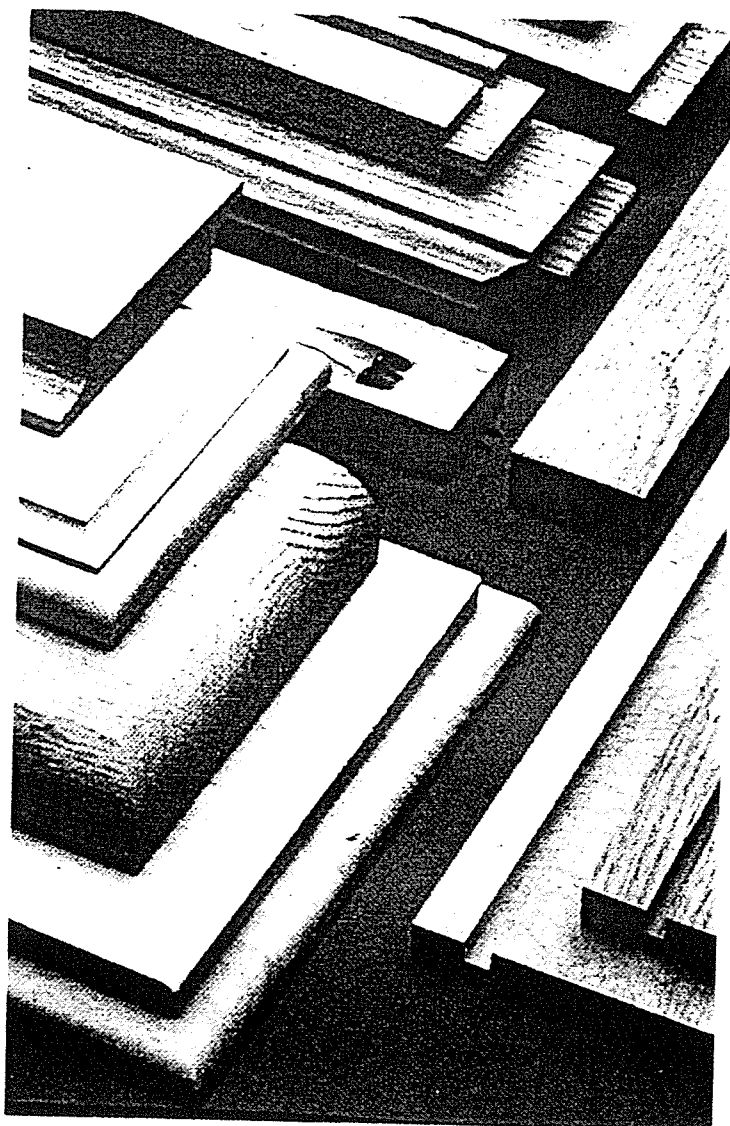


They are manufactured from rough boards, bolts, cants or logs of varying thicknesses to the specific requirements of a particular plant or industry. Components may be solid or glued up as specified.

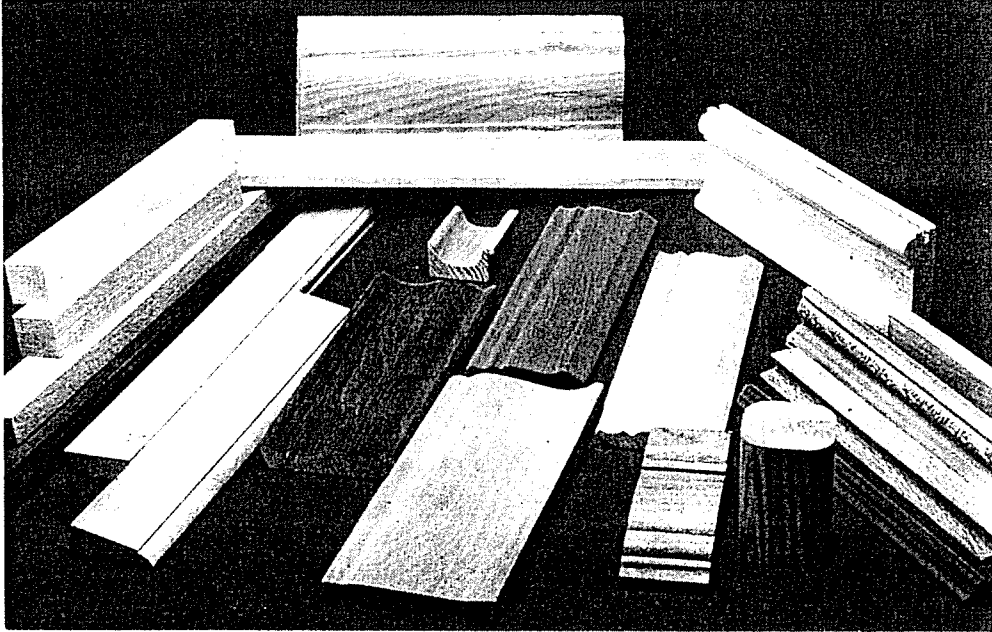
The dimension industry produces a very diverse range of products which can be divided into three general categories. Dimension stock is normally classified as rough dimension, semi-machined or fully machined dimension.

1. Rough dimension consists of blank cut and ripped to specific sizes, normally rough surfaced two sides or more to a nominal size.

'Furniture industry dimension parts'

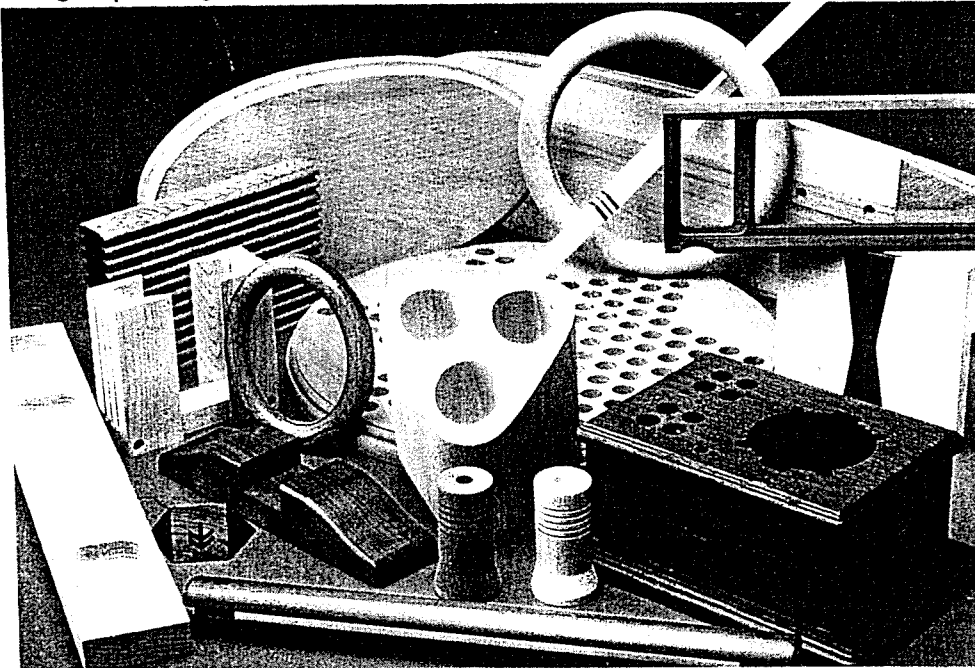


2. Semi-machined dimension components are rough dimension parts that have been carried one or more steps further in the manufacturing process. These processes may include one or more of several wood working operations including edge or face gluing, surfacing, moulding, tenoning, turning, sanding, equalizing, trimming, mitring, boring, embossing, shaping, routing and carving, but will not make the product a completely machined part ready for final assembly.



'Semi machined dimension components'

3. Fully machined dimension parts are completely machined with no additional machining or work to be done prior to assembly except for a final polish sanding operation prior to staining or painting.



'Fully machined dimension components ready for assembly'

MARKETS

Product uses and applications

Most hardwood dimension component products are used for household and office furniture, kitchen and bathroom cabinets, decorative building materials and a wide variety of other types of speciality wood products. Included among the typical dimensioned wood products produced by dimension manufacturers are:

- cut to size blanks
- edge-glued panels
- solid or laminated
- squares
- mouldings
- turnings
- bendings
- upholstered frame stock
- interior trim
- millwork
- flooring
- panelling
- stair treads
- risers
- staircase parts
- toy parts
- casket parts
- chair components
- doors
- piano parts
- fireplace mantles
- picture frames
- drawers and fronts
- solid rounds

Size of Industry

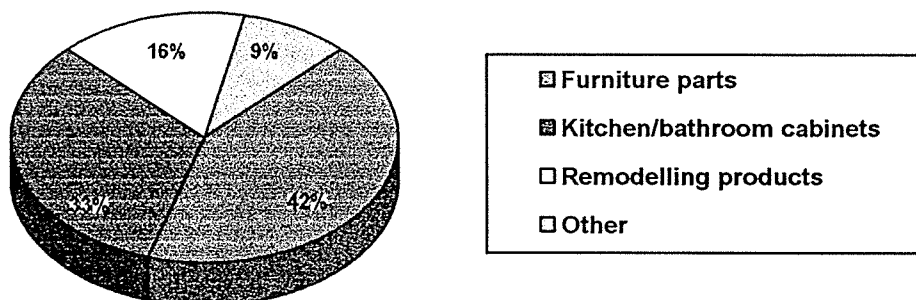
Total sales for the American Hardwood Dimension Industry grew nearly 10% a year during the 1980s mainly servicing domestic markets. In 1990 the U.S. industry sales were \$1.7 billion U.S. in 1992 sales passed the \$2 billion U.S. level. This represents a slight decrease in growth from that experienced in the 1980's. However sales growth of 3-5% is expected to continue into the mid nineties.

Major Market Categories

There are 3 major segments as illustrated in the following chart:-

Hardwood Dimension Sales - 1992

MARKET CATEGORIES BY SALES - 1992



The market outlook is favourable. Leading indicators such as housing starts, disposable income, consumer credit and mortgage rates are closely monitored. An increase in the average age of the population is leading to growth in the number of smaller individual dwellings, with a new range of furniture requirements.

Following is a review of a visit to a larger sawmilling dimension manufacturing business.

COASTAL LUMBER COMPANY/THE VIEW OF A LARGER DIMENSION PRODUCER.

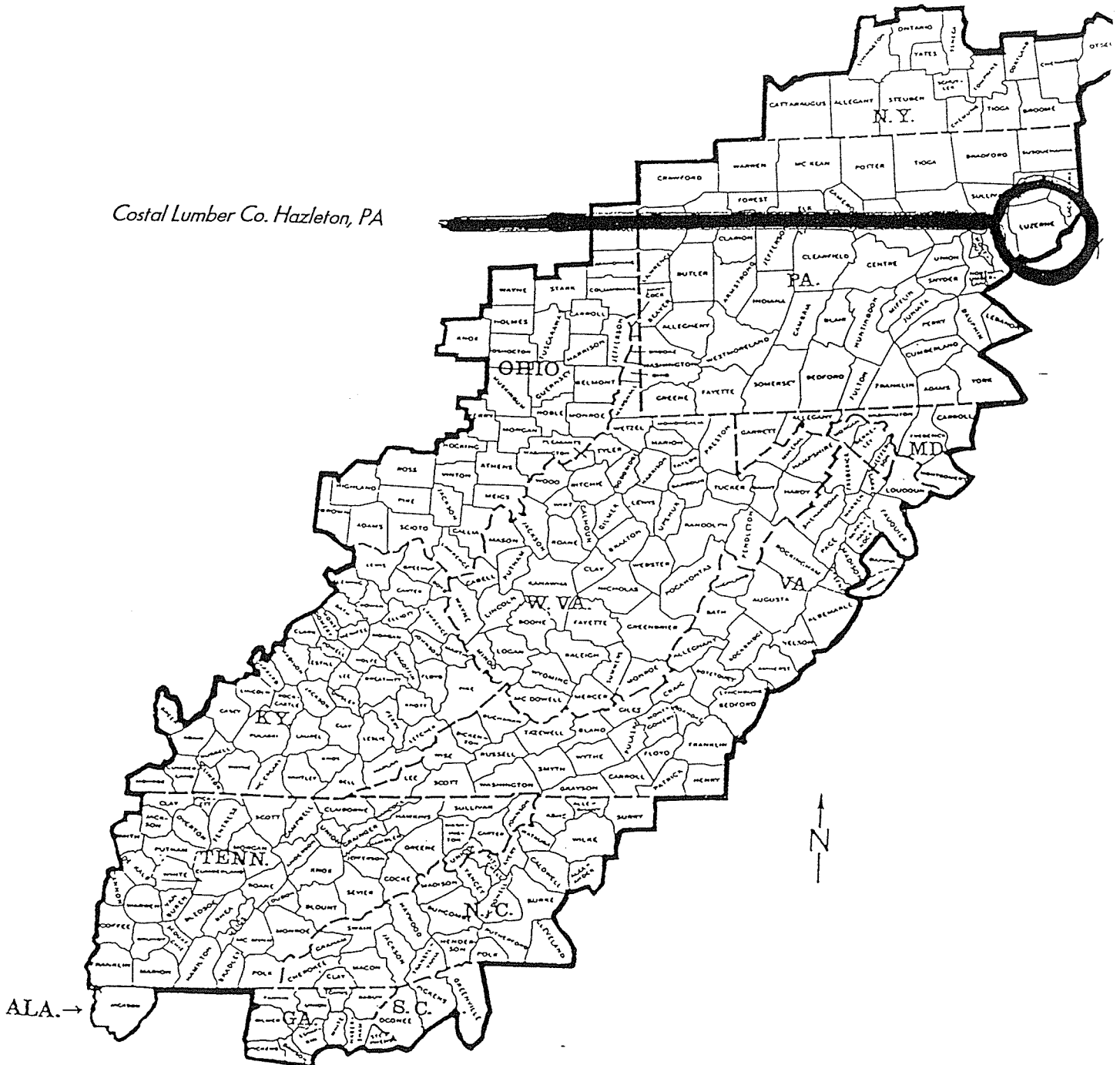
The tour of this dimension plant was a complete surprise, because of the scale of operations and the degree of integration.

Located in a small country town at Hazelton, West Virginia, it has placed the 4166.6 sq mts (45,000 sq ft) dimension plant within 75 miles (120 kms) of six (6) of their sawmills and 2 (two) of their concentration yards.

These 6 sawmills produce over 60 million board feet (141,600m³) guaranteeing the dimension plant an abundant supply of timber. The most commonly used species from this Appalachian region are:

- Ash
- Basswood
- Cherry
- Hard Maple
- Soft Maple
- Poplar
- Red Oak
- White Oak

Costal Lumber Co. Hazleton, PA



"Appalachian mountain range Eastern United States"

Within that 120 km circumference, they own 110,000 acres of private, high quality hardwood resource.



"Typical multi aged hardwood forest in Virginia"

The dimension plant was commissioned in 1988 and has an output of 3 million board feet (7080 m^3) of kiln dried dimensioned product p.a. This dimension plant produces a range of products from rough, semi-dressed and fully machined wood components, for furniture, cabinets and other specialist manufactured items.

Coastal Lumber Pty Ltd buys in green timber from their own and other regional sawmills, grades and dries it to particular order specification. In addition to purchasing green timber, they also buy in dried dimensioned timber from many other sawmills. This is facilitated by the clearly defined "appearance" grading rules.

Thickness seemed to be the critical dimension. Random widths and lengths were not so much of a problem as it was resawn within the dimension plant for component manufacture.

Dry Rough Mill

Packs of kiln dried timber are de-stacked automatically and the rough sawn boards are sent through a skip planer which dresses the materials on (2) two faces.

It was then moved to the Gang Rip Saw where it was cut into dimension strips. These strips then went by conveyor to chop saws or Cross Cut Saws, where defects were removed and boards were then re-stacked according to size and length.



"Timber is popular in American kitchens and often contains mill produced dimension components"

Market Products

Kitchen door components are a major production line, which incorporated short length clear wood, fully finished, machined components which went through a colour matching quality control line. This enabled customer specific orders that would be clear coated to be grain and colour matched.

Edge-glued panels

Panels were a single layer of blanks glued edge to edge - however the edges were fine sawn, not sanded. This fresh sawn edge is vital to ensure a good long lasting 'key' for the glue. Colour matched blanks were placed on conveyors, where glue was automatically applied and were then placed on one of three clamp glued carriers. These carriers had individual arms holding the blanks side by side, hydraulic pressure was then applied to the sides and top to prevent bowing and cupping during curing. Panels could be produced up to 42" wide (1.067mts).

After curing, glue joints were closely inspected and sent on to the appropriate line for planing or fine sanding. The sanding line can cope with panels up to 48" wide (1.220 mm). The planing capacity was 44" (1.118 mm).

One product line, utilised low grade White Oak flecked with defects such as mineral stain, wide colour variations etc. The pieces were the remains of off cuts in lengths no greater than 500 mm of any width.

These short pieces were edge-glued, without being colour matched, precision docked to lengths of 450 mm and widths of 300 mm, and then simply moulded on one edge, packaged and exported to German manufacturers of hi-fi speaker box components. The German company simply stain finished the components black and marketed these solid speaker boxes as having a better sound than speaker boxes manufactured from particle board or sheet product alternatives.

This is a good example of using low-grade timber at a low cost providing a high quality, marketable product. The sawmill has up-graded the timber rather than down graded the timber which may be difficult to sell.

Squares

Square blanks were very popular items for furniture customers from 4" x 4" (100mm x 100 mm) up to 6¹/₂" x 6¹/₂" (165mm x 165mm). They are dimensioned, very stable and are edge

glued with up to 10-15 pieces and colour matched. However low grade material can be face graded and defective faces concealed internally.

These square blanks are then supplied to turners for period or fancy turned posts/legs. Applications for this type of product are table and chair legs, newel posts, verandah posts, desks, beds, hand rails and banisters. These "4 x 4" (100 x 100) laminated squares are of an exceptionally high quality and very stable. In 4' (1200) lengths they sell for around \$7 U.S.

Finishing & Packaging

A twin blade edge trimmer is extremely accurate and provides a finish which is almost identical to a sanded finish to touch.

Packaging of these components, being of set length and set width is very easy. They are palletized with corner protection and plastic vacuum wrapped. Computerized freight forwarding and transportation allow customers to receive instant answers to questions regarding inventory, availability and shipping.

Transportation from this remote plant was all arranged in-house, with their own flat bed semis, fully utilising their transport by backloading from timber deliveries.

Quality Control

All 45,000 sq ft of this facility was climate controlled due to the highly finished nature of the products and the precision expected by customers. Quality control was closely monitored throughout production from the rough sawn timber to the finished dressed products. The timber was continually checked for moisture content to be within the range of 6-8%. This low moisture content, in Australian terms, appears to be the most suitable range to suit environmental conditions throughout the world and to cater for extremes in temperature found throughout America (i.e.) from the freezing conditions of Alaska to hot dry desert climates of Texas.

Production Equipment

Production Equipment at this dimension plant included:-

- straight line rip saw
- gang rip saw
- chop saws
- mitre saws
- routers
- radio frequency driers
- planers
- "Wadkin" 6" moulder
- Weinig 9" moulder
- automated glue clamp carriers

COASTAL LUMBER SAWMILL VISIT

A further visit was made at the invitation of Coastal Lumber Sawmill to see a typical large hardwood sawmill production facility in North Carolina.

Coastal Lumber has grown from one Hardwood Sawmill in 1937 to be one of the largest privately held forest products companies in the U.S. It now has 22 sawmills and plants in 9 (nine) states. Species they have access to include:

- Ash
- Basswood
- Beech
- Cherry
- Cyprus
- Hickory
- Hard Maple
- Soft Maple
- Poplar
- Red Oak
- White Oak
- Sap Gum
- Tupelo
- Walnut

In total the Coastal Lumber Company have 33 kilns with a dry capacity of 50 million board feet per annum. They also supply 70 million broad foot per annum in green and air dried hardwood to the furniture industry, who often have their own kilns.

The company expanded into export in 1971 and maintains a sales office in Belgium, covering Europe and are also active in markets in the Pacific Rim, Asia and the Middle East.

Its export markets consist of Softwood, Plywood, Hardwood Log, select grade sawn into Japan mainly in the following sizes: 4 x 4" (1 inch), 8 x 4 (2 inches), widths up to 9" and lengths up to 24 ft. Dimensioned and componentry is their fastest growing market.

The sawmill I visited incorporated a dip diffusion tank to eliminate mould, 4 kilns and through put of approx. 5 million board feet producing dried sawn and dressed timber. This is predominantly for export and to supply the domestic furniture industry which is based in Sth Carolina.

All storage of dried timber was under cover and any air dried stock was under open sided sheds. As most of the timber is back sawn, this procedure helps prevent surface checking and down grading of stock through discolouration.

FITZPATRICK AND WELLER PTY LTD.

During my study tour I visited a sawmill located near Buffalo in New York state which has been for the past 15 years pursuing value adding opportunities in processing timber suited to short length and semi or fully dimensioned timber for use in the furniture and cabinet industries.

This 100 year old family operated business is situated in the northern end of the Appalachian mountains in New York state, an area renowned for its high quality hardwood resource.

RESOURCE AND FORESTRY

Most of the hardwood resources east of the Mississippi River are on privately owned land whereas the bulk of the USA's softwood resource west of the Mississippi River is from public land.

Fitzpatrick and Weller have over 11,000 acres (4452 hec) of company owned forest and have cutting rights to a further 6000 acres (2430 hec)

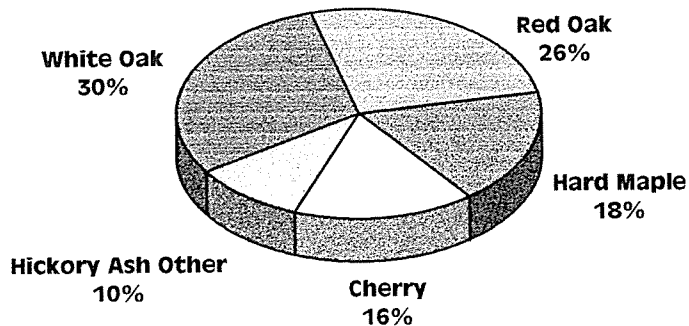
An experienced forester has been employed to ensure logs are a suitable quality for their operation. All forests are selectively felled. No clear felling operations are undertaken due to the multi-aged forests. To ensure an age of approximately 80 years of maturity foresters seek trees that measure 18" (450mm) diameter at breast height. The forester then negotiates with the land holder for these logs. This is a vitally important task delivering basic quality material to the mill.

SUPPLEMENTARY RESOURCE

Fitzpatrick and Weller have established export markets for finished dimensioned products from their two dimension processing plants and have supplemented their own resource by purchasing sawn timber, principally unseasoned, from as many as 70 other sawmills.

The following table indicates Fitzpatrick and Weller's resource mix by species

SPECIES MIX

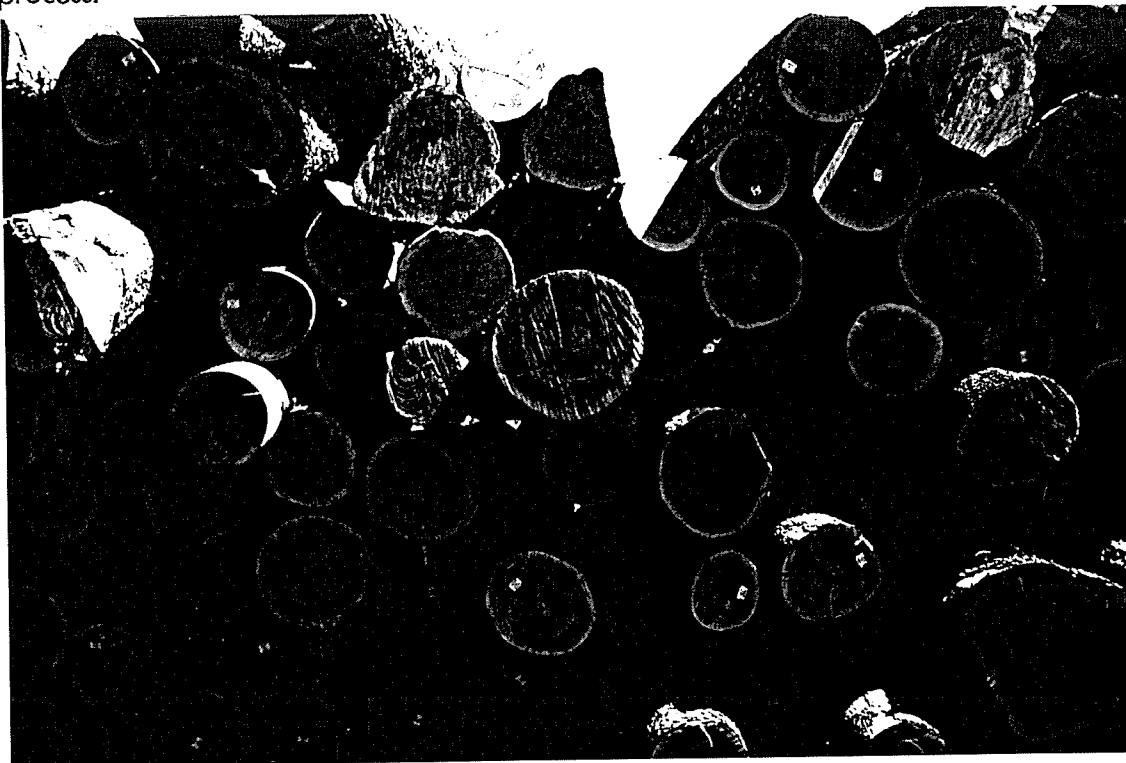


See Appendix for species description and properties

LOG STORAGE

I was surprised at the varying quality, particularly the short lengths and sweep of logs. No water spraying is done and all logs are separated according to grade.

Veneer log (and other figured logs) buyers are then contacted who visit regions regularly purchasing for their processing requirements. The marketing and value adding has already started. Log trading ensures that the sawmill gets a fair price for material they cannot process.

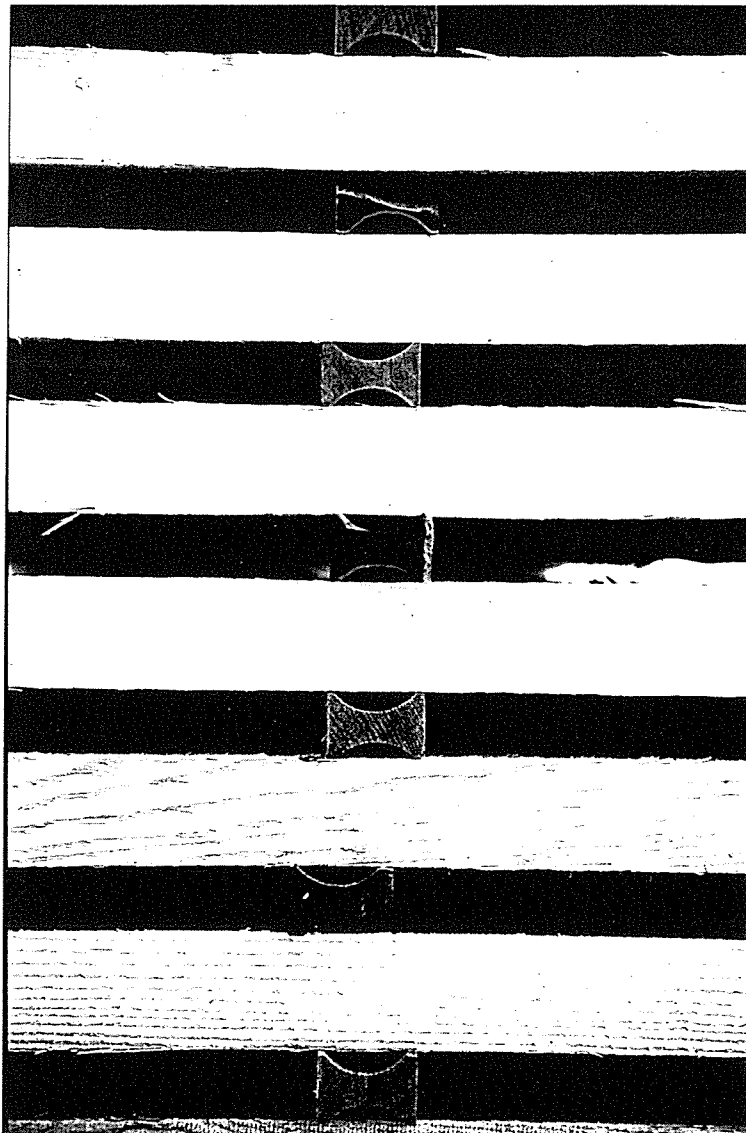


"Furniture grade Cherry logs some of very small diameter at log yard."

SAWMILL

Through constant upgrading the sawmill produces $18,864\text{m}^3$ (8 million board feet) p.a. with daily production running at around 30,000 board feet (approx. 71m^3 per day) (Note 1000 board feet sawn = 2.358m^3). All green lumber is cut, graded and stickered into appropriate packs.

An innovative development at this mill was the use of a new sticker which does not show up shadow stain on light coloured timber and allows a more even moisture content of boards during the air drying process. This was particularly suitable for hard maple, a high value hardwood improving both recovery and grade.



"photo of profiled sticker to eliminate shadow stain during drying process"

Any purchased pre sawn material is regraded and if not up to grade they contact their supplier to discuss and correct the situation. This often involves size, manufacture, colour matching and grading. This is vitally important as export sales now account for over 50% of their business. All material ends up in appearance grade applications or finished dimensioned components.

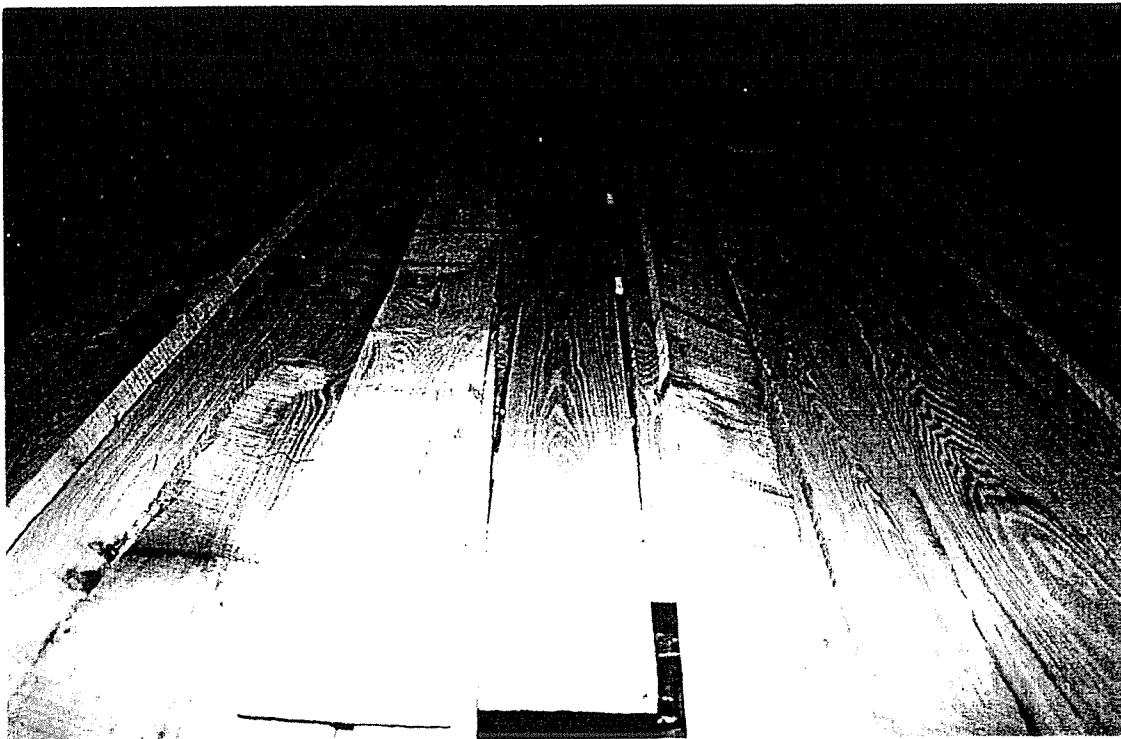
Sorting

Sorting is one of the first in a very long series of value adding processes. Green sawn boards are slid onto a sorting conveyor which is a one man operation. Sorting simplifies stacking and also aids in placing material of similar drying characteristics in the same kiln charge.

Timber is sorted by:

- | | |
|--------------------|--------------|
| • species | • grade |
| • moisture content | (appearance) |
| • heartwood and | • thickness |
| sapwood | • length |
| • grain | • colour |

This important process is relatively inexpensive but essential to avoid too much downgrade after kiln drying. For example the time to kiln dry 1" (25mm) Red Oak to 7% Moisture Content is 2 to 3 times longer then drying 25mm(1") hard rock maple.

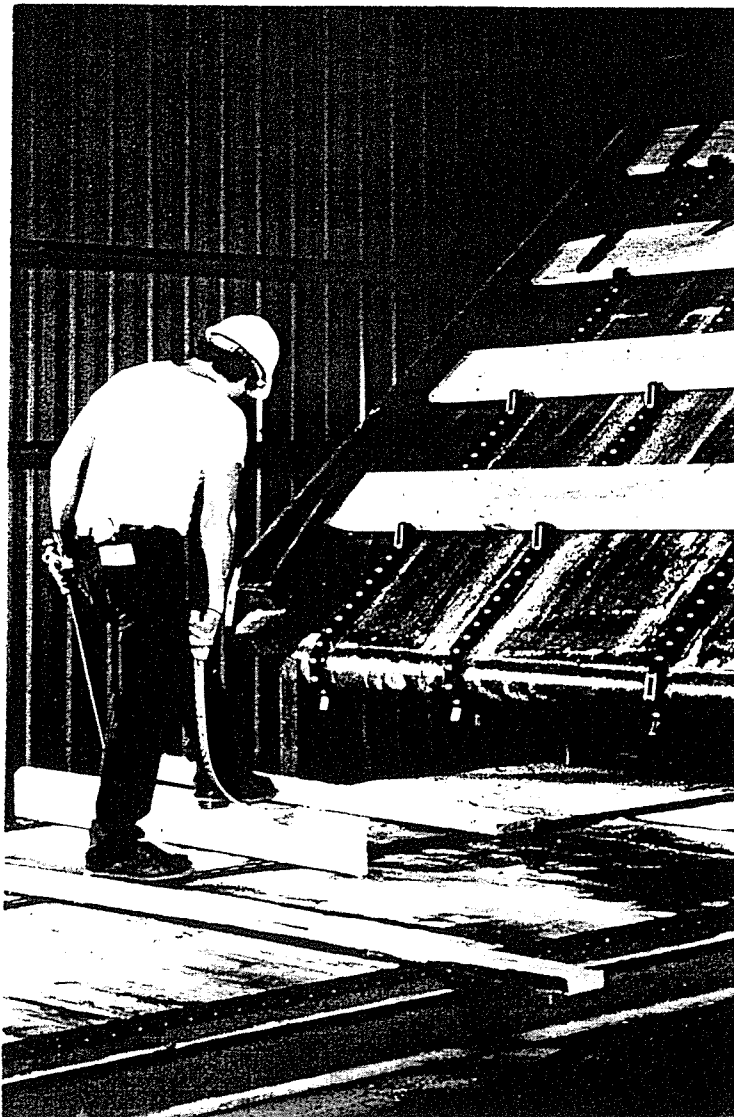


"No 2 common grade Oak boards awaiting sorting"

PRE DRY PROCESS

Fitzpatrick & Wellers experienced kiln operator has developed a pre-drying shed. This controlled facility which has a capacity of 8,000,000 board feet (18,864m³) for initial low temperature high humidity drying.

They don't put their timber outside to air dry if possible. It may wait outside for a few days before going into the computer controlled environment of the pre-drying shed. Any material left outside is immediately covered with timber pallets which insulate the pack from temperature extremes and weather. With the high proportion of back sawn boards this system of controlled initial drying directly from the saw has virtually eliminated surface checking, one of their biggest problems.



"A qualified grader measuring and marking unseasoned boards"

KILN OPERATIONS

This mill operates a number of large kilns, all computer controlled having a total drying capacity of 400,000 board feet (945m³). Kiln dried material is brought down to 7% or 8% Moisture Content (M.C.) to suit both domestic furniture and export markets. Most of the production is 25mm and 38mm of varying widths.

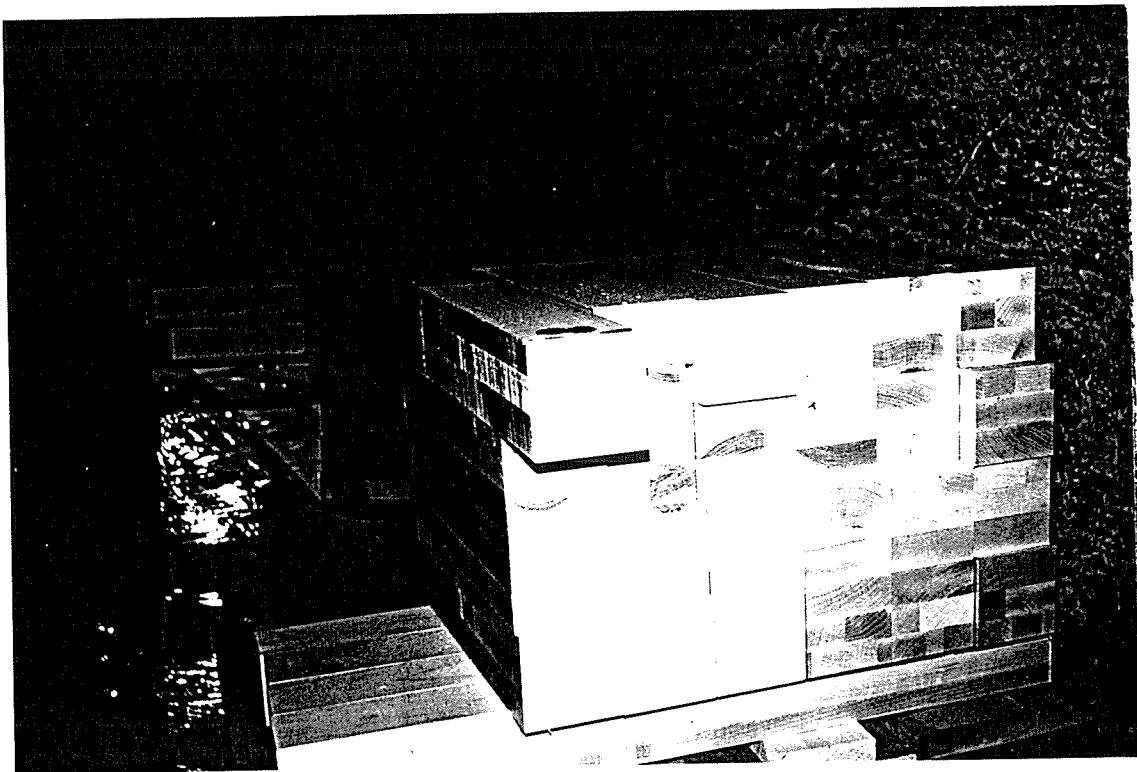
THE DIMENSION PLANT

To cater for growing export markets and to allow the company to expand into value adding two (2) plants have been commissioned to produce kiln dried hardwood dimensioned products for the component assembly industries and export markets.

CAPACITY

This plant has been in operation since 1987 and produces in excess of 100,000 board feet (236m³) per week. The building of around 30,000 ft² (2787m²) features state of the art machinery including computer controlled multiple-rip saw line, a chop-saw line both of which allow the precision dimensioning of timber to match the varied demands of their customers.

A high capacity Rosengisist electric glue machine and a double end trim and tenon machine allows them to produce glued up solid panel furniture components, staircases and kitchen cupboard doors.



"Solid laminated hardwood blanks for turned bed legs"

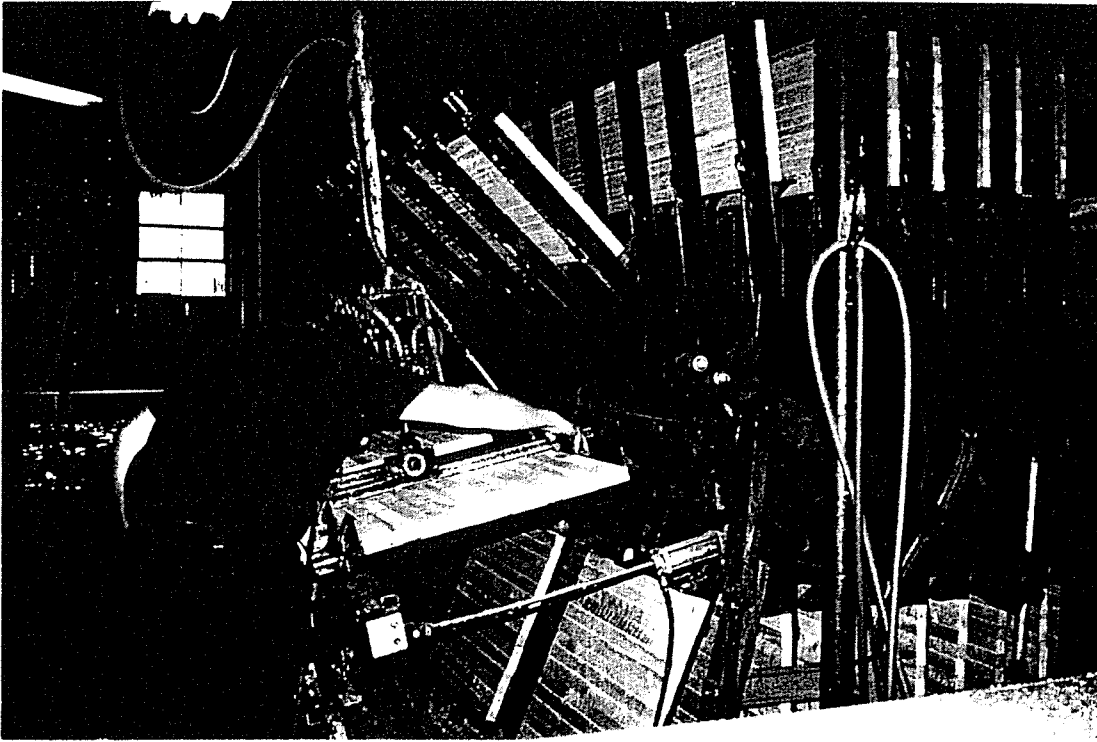
Market Products

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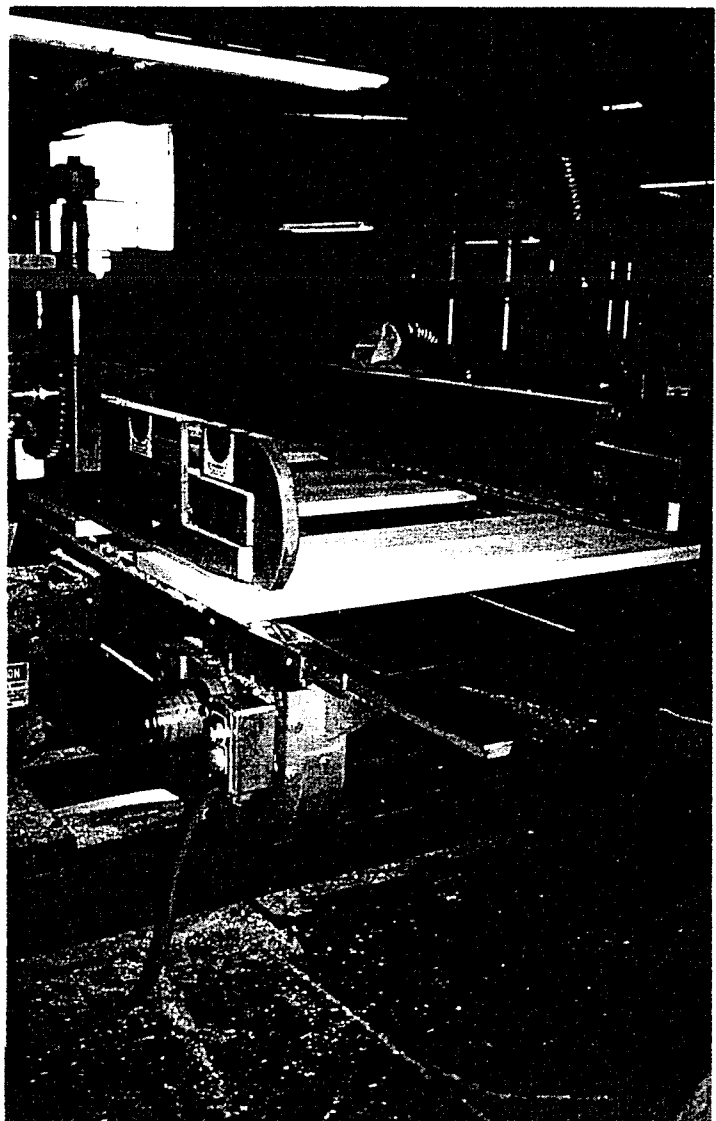
These components were then palletted and shrink wrapped for delivery to the customer. In this case a casket supplier who simply assembled and finished the individual pieces.

Other Markets included:

- 4" x 4"s (100 x 100) laminated from both face and edge gluing for bed ends, table legs, staircase newel posts and turning blanks. The turning blanks are sold to wood machining specialists who then supply turned components such as table, chair, bed legs and other decorative mouldings to the furniture and cabinet making industries.
- Kitchen cupboard doors - colour and or grain matched
- drawer sides, fronts, runners, backs, etc. for ready to assemble markets
- stair components - treads, risers, stringers, posts, handrails
- precision end docking



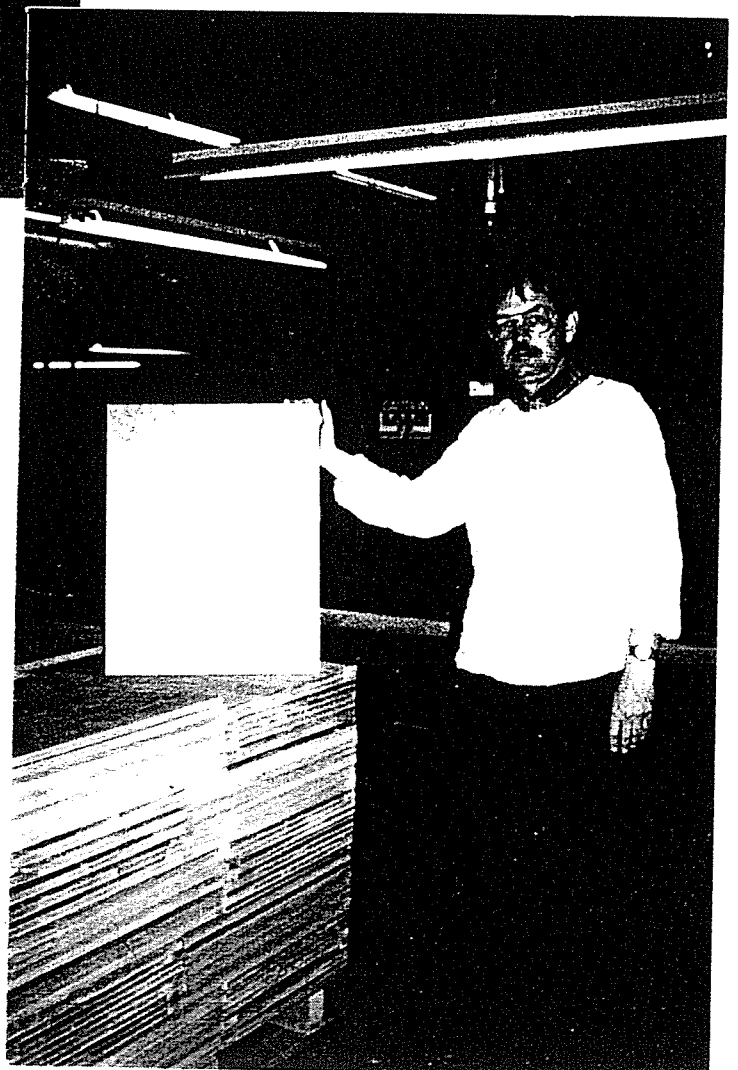
"Glueing up panels prior to radio frequency drying"



"Precision end docking of completed laminated blank"



*"visually colour and grain matching
for cupboard doors"*



"finished colour matched dimensioned blank"

PACKAGING

The dimension plant is around 30,000 ft² under roof and is a totally controlled environment. This ensures kiln dried material remains at a specific moisture content (7-8%) before being vacuum wrapped and containerized.

QUALITY CONTROL

This company of 230 employees is committed to total quality management with regular customer liaison from graders, kiln dry operators and dimension plant staff. International customers from Canada, Japan and Europe are encouraged to regularly visit their operation with the intention of contributing to improvements in the manufacture of their product.

The overall impression of this organisation was one of great potential to grow into new and expanding markets. The most important elements of their business were:

- Total Quality Management
- Regular customer communication
- Ability to value-add on site
- Production efficiency
- Dimension plant ensures market flexibility
- No commodity products allows for less competition and higher prices in niche markets

NATIONAL HARDWOOD DIMENSION MANUFACTURERS ASSOCIATION (NHDMA)

The NHDMA was originally formed in 1929 to establish and maintain specifications and commercial standards and to assist in development of this 'new' industry. Originally 'dimension' was defined as specific widths, thicknesses and lengths similar in most respects to Australian approaches. These blanks of timber were then onsold to various markets such as furniture mouldings and the cabinet manufacturing industry.

The dimension industry has since grown into a manufacturing industry in itself providing the markets previously described with a wide and ever expanding range of semi and fully machined components.

In the past 10 years the association has seen significant expansion in the industry. The expansion has been export focussed and is currently involved in various promotional, educational and legislative activities.

NHDMA MEMBERSHIP

Currently with a membership of 103 these companies vary greatly by size and type of product produced. Most of these companies are not large by American standards and are generally located in rural areas, often as part of a sawmilling facility. This predominantly rural industry is crucial to the economic well being of many regional communities.

OBJECTIVES

The major objectives of the NHDMA are to:

- Promote a friendly exchange of ideas among those engaged in the dimension manufacturing business (mill/plant tours).
- Develop and promote a general demand for the industry's products and services.
- Collect and distribute useful economic and technical information concerning industry trends and developments.
- Serve as a business referral clearing house by responding to inquiries from dimension buyers and passing this information on to dimension manufacturers.
- Conduct seminars and meetings that will satisfy the educational needs of its members.

- Encourage improvements in wood working technology and worker productivity by exposing its members to the latest woodworking manufacturing techniques.
- Establish and maintain standard rules and specifications for the dimension manufacturing industry.
- Co-operate and interact with other wood products trade associations and appropriate government agencies to promote and protect the interests of the industry.

The National Hardwood Dimension Manufacturers Association has implemented many new programs and activities in its ongoing effort to meet the changing needs of the growing hardwood dimension manufacturing industry.

PROMOTIONAL ACTIVITIES

As expected the trade shows are a major focus for the NHDMA targeting U.S. woodworking machinery and furniture supply shows along with major national kitchen and bathroom fitout fairs.

EXPORT

Most hardwood product trade associations throughout the United States including the NHDMA, have formed the American Hardwood Export Council (AHEC). This group represents active wood product exporters and was established to assist in the development of growing international markets.

Hardwood dimension exports have increased dramatically since 1985 and by the end of 1991 were worth U.S \$140 million a 15% increase over 1990. By comparison to timber only exports of around 20% increase over the previous year. The competition in the U.S. domestic markets for dimension wood products has come from cheaper imports. What the American industry has in their favour is that U.S. timbers are widely recognised and highly sought after. Overseas dimension buyers have realised significant cost savings in transportation, storage, handling, processing and wood waste disposal.

U.S. dimension products have good export prospects as there are few countries with readily available temperate hardwoods. Most of the international competitors are tropical timbers, with perceived inadequate forest management processes and where the impact of environmental debates can be severe.

Through the American Hardwood Export Council, the NHDMA is consistently exposing dimension products and capabilities in Europe and Asian markets at furniture and machinery fairs, e.g. Tokyo International Furniture Fair

Milan Woodworking Machinery and Supply Fair

All sales enquires are provided to its membership base for follow-up.

MARKET RESEARCH AND STUDIES

A range of studies beneficial to industry are conducted to help identify potential new markets and investigate ways of improving member operations.

The results of research and market study reports are designed to give dimension manufacturers access to specific sources of information to help create a database of potential customers. This information can then be evaluated to provide more specific data for smaller niche markets, helping dimension manufacturers develop appropriate marketing strategies for dimension products.

Regular reports to members include:

- Dimension shipment reports
- Sales trend reports
- Industry wide performance reviews
- Forecast reports
- Industry newsletters

GOVERNMENT REGULATIONS

The NHDMA works with other industry representative bodies to protect the wood products industry from unfair or unwarranted legislation or regulations that may adversely affect them. Issues such as wood dust and the environment are two areas where all sectors of the timber industry have made major contributions in recent times.

MEETING AND SEMINARS

Two major meetings are conducted each year for members with an 'industry' education programme designed to cover several important issues for dimension manufacturers. Subjects include:

- Total quality management programs
- Rough mill improvement programs
- Technological advances in production methods and woodworking machinery
- Export market opportunities for dimension manufacturers
- Dimension market trends and forecasts
- Labor productivity improvement programs
- Advanced timber drying techniques
- Employee training and incentive programs
- Cost accounting methods and procedures

PLANT AND FACILITY TOURS

Once a year members are invited to tour production facilities of several dimension and related woodworking companies. Sawmill processing plants are also visited as the dimension industry is often an integral part of a sawmill. The plant tours provide a unique opportunity to observe other dimension manufacturing operations and to exchange ideas.

I consider this strategy to be a very useful means of improving the overall functions of these businesses and of helping manufacturers develop appropriate marketing strategies for dimension products in both export and domestic markets. This requires an understanding of the importance of customers needs and wants, controlling quality and production innovation to find uses for everything that is cut from a log.

Other important issues such as packaging, customer service, delivery and particular requirements for niche markets can be readily observed and just as importantly they can be openly discussed. This inclination for openness and co-operation is probably related to the fact that the dimension industry is export focussed and the industry is looking to expand in this area - co-operation is therefore often seen as an advantage.

Domestic markets, on the other hand, may be more competitive and therefore individual companies may be less willing to be so open. This is understandable in the short term, but the long term vision for this industry is to expand the market for solid wood dimension products internationally. The competition for solid wood dimension products is from panel products such as particle board, Medium Density Fibreboard (MDF) and plywood. It is expected that veneer of suitable quality will be harder to obtain for use on panel products.

PURCHASING GUIDE FOR BUYERS

A directory of NHDMA members is produced listing information on the following:

- type of products they produce
- special woodworking capabilities
- available species of wood

The following page is an extract of the purchasing guide and contains a comprehensive range of information on each business's 'dimension' capability through simple codes.

NATIONAL DIMENSION MANUFACTURERS PARTIAL LIST OF MEMBERS

Company	Location	Production Capabilities	Contact	Phone	Fax
Hunterwood Special Products	Huntersville, NC	ACDFGHJ-5-figl	Don Newell	704-875-2080	704-875-6657
Interphase Wood Mouldings, Inc.	Marietta, GA	BCDEFGHJMO-bcdfighl	Dwight Rehkop	404-421-1294	404-426-4930
Jasper Woodworking Company	Jasper, IN	ACFGHJMN-156789-bcdfighl	Bob Brosmer	812-482-5616	812-482-9580
Keystone Hardwoods, Inc.	Julian, PA	ADEJM-cdfigl	Tom Brown	814-355-0953	814-355-1884
Keystone Wood Specialties, Inc.	Lancaster, PA	CEJL-15689-bcdfighl	Sam Stoltzfus	717-299-6288	717-299-9654
Kidder Wood Products, Inc.	Avoca, NY	DEJfgl-bcdfigl	Barry Kider	607-566-2530	607-566-2530
Kitchen's Brothers Manufacturing	Utica, NY	ACDMN-bcdfigl	John Clark	601-894-2021	601-894-1069
Klingler Products Corporation	Elkhart, IN	EFJK-156789-bcdfigl	Mary Sells	219-264-2554	219-262-3720
Love Dimension Products, Inc.	Kinston, NC	BGH-bcdfigl	Elbert Harris	919-522-0288	919-522-2552
Marini Timber Co., Inc.	Castroville, CA	ACEGJLMNO-5-bghl	James Morgan	800-299-5174	318-443-0159
McMillen Lumber Products Corp.	Sheffield, PA	AFHJ-5678-bcdfigl	James McMillen	814-968-3241	814-968-3843
McMinnville Manufacturing Co.	McMinnville, TN	CDM-gl	William Mullican	615-473-2342	615-473-2342
Mi-Lin Wood Products Corp.	Paoli, IN	FHJMN-156789-bcdfigl	Bob Lindley	812-723-3799	812-723-5933
Mongold Lumber Enterprises, Inc.	Elkins, WV	ACDEFGHJLMNO-1456789-bcdfighl	Max Armentrout	304-636-2081	304-636-4000
New Horizons Manufacturing Co.	Union, MS	CJKN-15679-ghl	Larry Proctor	601-774-8833	601-774-8874
North Douglas Wood Products, Inc.	Draft, OR	ACDEFHJ-48-agh	Jim Korth	503-836-7332	503-836-7058
Northern Hardwoods	South Range, MI	ACEGKM-cl	Michael Lorence	906-487-6416	906-487-6416
Northwest Hardwoods	Titusville, PA	ACFGJMN-458-bcdfigl	Randy Weed	814-827-4621	814-827-4052
Norton/Smith Hardwoods, Inc.	Kill Buck, NY	BGJO-g	Arthur Smith	716-945-3667	716-945-3668
Norwalk Furniture Corp. of TN	Cookeville, TN	ACFGHJLMN-156789-bcdfighl	R.A. Campbell	615-432-4171	615-432-4176
Oak-Dale Hardwood Products	Spring Valley, WI	CFHJMN-1689-ig	Dean Aamodt	715-778-5754	715-778-4638
Owens Forest Products	Duluth, MN	ACF-48-bcdfigh	Luanne Kaspszak	218-723-1151	218-724-9486
Partridge River, Inc.	Hoyt Lakes, MN	ABCDEFHJMN-59-cfigl	Andrew Richey	218-225-2557	218-225-2573
Premium Hardwoods, Inc.	Bremen, KY	ACDEGJLMN-bcdfigl	Michael Perry	502-525-6213	502-754-2248
R & J Manufacturing Company	Georgetown, KY	ABCGIK-57-eg	Sherman Wallen	502-863-0520	502-868-9068
Rapid Lumber, Inc.	Pointe Claire, QC	BOEGH-45-bcdfigl	Geoffrey Sar	514-694-4950	514-694-0016
Rich Lumber Company, Inc.	Beardstown, IL	ACDEFGHJLMNO-4569-bcdfigl	Darrell Rich	217-323-1718	217-323-1626
Salem Frame Company, Inc.	Salem, VA	GFGHJMN-156789-ghl	Buddy Dunbar	703-389-8661	703-387-0755
Salem Hardwood & Moulding Co.	Salem, OR	ACE-abcdg	Dean Thompson	503-362-0506	n/a
Savage Lumber Company, Inc.	Doylesville, TN	ACDEFHJLMNO-48-bcdfigl	Jackie Savage	615-657-2211	615-657-2214
Schweiger Industries, Inc.	Jefferson, WI	ACFGHJLMN-146789-bcdfighl	Jim Rinden	414-674-2440	414-674-4468
Selling Wood Ltd.	Goderich, ON	ABCGJLMN-15-1	Robert Sellinger	519-524-2651	519-524-4252
Smith, Inc.	South Londonderry, VT	CDFHJ-15678-bcdfigl	Dick Smith	802-824-5515	802-824-6664
Sonoco Products Company	Somerset, KY	ACDFM-bgl	Steve Merrick	606-561-4146	606-561-6337
Spauld Spoke Factory, Inc.	Laurinburg, NC	GH-bl	Robert McWally	919-276-7595	919-276-1806
Sul-Cro Valley Hardwoods, Inc.	Spartanburg, TN	ABJJK-156789-bcdfigl	Les Tubbs	815-738-2231	815-738-2230
Superior Moulding Company	Luck, WI	ACEGHJLMN-1789-bcdfighl	Dan Schneider	800-230-7098	715-472-2108
Thompson Maple Products, Inc.	Troy, AL	CEFGHJLMNO-156789-bcdfighl	Burt Brown	800-467-DOOR	205-666-0181
Tri-State Hardwoods	Corry, PA	BGG-bcdfigl	Chuck Hennes	814-664-7717	814-664-7746
Wellborn Cabinet, Inc.	Whiteland, WJ	ACEGJMN-578-bcdfigl	Jerome Thirany	715-538-4285	715-538-4505
West Jefferson Wood Products	Ashland, AL	ACF-g	Bill Bowen	205-354-7151	205-354-7022
Wood Products Company, Inc.	West Jefferson, NC	ACFGHJLMN-156789-bcdfighl	Alice Thompson	919-246-7121	919-246-5180
Wood Specialty Company, Inc.	Newport, TN	LKO-156789-bcdfigl	Mary Lindsey	615-623-3003	615-623-0207
Woodcraft Industries, Inc.	Philadelphia, PA	FH-8-dfigl	Stephen Skaskl	800-786-WOOD	215-483-2282
Woodcraft, Inc.	St. Cloud, MN	CEFGJLM-156789-bcdfigl	Steve Wilhelm	612-252-1503	612-252-1504
Woodline Manufacturing, Inc.	Monticello, TN	ACFGHJLMN-bcdfigl	James Elliott	615-691-5413	615-691-2857
Woodruff Lumber Company, Inc.	Evalet, MN	CDEFGHJLMN-156789-bcdfighl	John Baxter	218-744-5966	218-744-5969
Young Manufacturing Company	Millersburg, OH	ACEHJO-48-bcdfigl	Paul Dow	216-893-3121	216-893-3031
Young's Furniture Mfg. Co., Inc.	Beaver Dam, WI	ACEFGHJLMN-156789-bcdfighl	Bill Boardman	602-274-3306	602-274-9522
	Whitesburg, TN	ACEGJMN-156789-bcdfighl	Tony Hayes	615-235-6548	615-235-4871

CODE OF PRODUCTS PRODUCED

- A - Kiln dried lumber
- B - Solid rounds/dowels
- C - Cut-to-size blanks
- D - Flooring
- F - Edge-glued panels
- G - Solid squares
- H - Laminated squares
- I - Turnings
- K - Chair parts
- L - Cabinet doors
- M - Cabinet parts
- N - Unholstered frame stock

WOODWORKING CAPABILITIES

- 1 - Boring
- 2 - Carving
- 3 - Embossing
- 4 - Finger jointing
- 5 - Routing
- 6 - Sanding
- 7 - Sanding edge
- 8 - Sanding face

CODE OF WOOD SPECIES

- a - Alder
- b - Ash
- c - Birch
- f - Maple (hard/soft)
- g - Oak (red/white)
- h - Pine

Additional information, including the "Rules and specifications for dimension wood products" to assist buyers in their purchasing decisions is also readily available. (See Appendix immediately following this section).

These grading rules cover the following product range:

- Flat stock and edge glued
- Squares, laminated
- Squares, solid
- Woodwork - Interior trim and moulding
- Stair treads and risers

MARKET COMPETITION

American dimension manufacturers are experiencing competitive pressure from importers of semi-finished and finished wood products. Companies around the world are gearing up to process timber from sawmills into high value markets such as furniture, cabinet and dimension products.

To compete, U.S. producers must raise product quality and merchandise their products more effectively. More attention is being given to markets and consumers and to focus more on finished wood products. U.S. sawmills are looking to secondary manufacturing to smooth out the up and down production cycles that they have experienced in the past. Shifting from low value production in commodity markets such as pallet and green boards for furniture manufacturers to produce kiln dried and laminated timber for highly specialized non commodity markets such as components for furniture manufacturers. These high value niche markets often result in higher margins and greater profits.

DIMENSION INDUSTRY OPPORTUNITIES

Why would a sawmill look at secondary wood manufacturing when they can sell most of the timber they currently cut?

Although they would have to deal in new and unfamiliar markets these opportunities are not available to mills who do not process green boards further. The dollar incentive is also there. Total dollar sales of secondary processed products are roughly double those of primary wood products. According to most interviewees, value adding increases return on investment.

VALUE ADDING - OPPORTUNITIES FOR SAWMILLERS

- As log costs rise, secondary processing can normally improve pricing to make up some of the difference. Commodity markets do not have that flexibility.
- Secondary processing of products by value adding and meeting specific customer needs can earn higher prices and profits.
- Lower grades and shorter lengths can be more effectively utilised in the production of dimension stock and other value added wood products - for example, by edge-gluing boards into bench tops or table tops. Shorter length material such as for table legs or cupboard doors are more readily utilised.
- Making value added products instead of commodities allows a sawmill to take full advantage of new markets and to reduce reliance on commodity products which may be effected by large markets beyond the producers control.
- Dimension or secondary processing makes a mill more flexible (but also requires more flexibility) and allows the producer to respond quickly to new trends as fashion changes in home remodelling or furniture.
- Broadens the companies customer base relieving the traditional dependence on a few major customers.
- Assists sawmills to compete in world markets. Many international companies like the American hardwoods, but can't find the wood product they require. Some Japanese companies for example have purchased American hardwood sawmills to produce their own wood products.
- Speciality products, not commodities help protect wood markets from continued encroachment by alternative materials such as metal and plastics. Customers will buy the alternative material product if attractive wood products are not available.

BENEFITS AND ADVANTAGES OF DIMENSION PRODUCTS FOR CABINET AND FURNITURE INDUSTRIES

- **Higher return on investment**

By purchasing parts from dimension manufacturers downstream processors such as kitchen cabinet manufacturers and furniture makers can improve their return on investment by concentrating their resources on design, assembly, finishing, promotion and marketing.

- **Capital Investment Reduction**

By purchasing kiln dried components, furniture and cabinet manufacturers can operate with a minimum investment in land, labour, buildings, machinery and ancillary equipment. Small volume production furniture or cabinet manufacturers cannot justify the substantial investment required.

- **Location**

Most dimension plants are in country regions close to the resource whereas most furniture and cabinet manufacturers are located near major furniture markets where land buildings and labour costs are higher.

Historically furniture manufacturers often have their own timber storage yards and kilns to process into dimension for manufacturer.

- **Transportation Costs**

Rough sawn air dried timber is expensive to transport and handle. More than half of its weight is water or waste material.

Transport costs dramatically decrease as almost two-thirds of the weight and bulk of the raw timber is removed at the dimension mill.

- **Improved Cost Control**

Exact material costs can be determined for dimension products making it easier to determine the profitable selling price for the finished product.

- **Quality Assurance**

By specializing in dimension products a great deal of experience and expertise in processing timber into semi-fabricated and completely finished wood parts is acquired.

Conformity to the standard rules and specifications means consistent quality for the industry and a high proportion of useable dimension products for sale.

- **Timber Inventory**

Furniture and kitchen cabinet manufacturers who produce their own dimension parts find it necessary to carry a three to four-month supply of timber of all species used, which ties up working capital that could be more effectively used elsewhere. High interest rates and fluctuation in the market price of timber can add significantly to the costs of maintaining adequate timber supplies. By purchasing wood parts, a smaller investment is made in inventory of prefabricated wood parts.

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Preplanning of inventory requirements means components can be ready on call from 1 door or drawer to 1000 of each.

- **Waste Disposal & handling costs**

Unusable timber can be more effectively utilised at a sawmill as fuel for operating kilns or as chips.

Handling costs of degrade waste timber is greatly reduced as the component is fully utilized and quality guaranteed. The major benefit to furniture and cabinet manufacturers is that they use everything they specified thereby eliminating waste storage and disposal problems particularly in small operations.

- **Overheads**

Overhead expenses may be expected to reduce without affecting a reduction in sales volumes by the furniture and cabinet manufacturing industries. A reduction of the raw material inventory and of dimension machinery purchases will cut the cost of:

- timber grade compliance inspection
- supervision
- maintenance
- labour costs
- indirect costs
- insurance
- depreciation on machinery
- taxation

Obviously the argument is that specialisation works. Many management texts expect business to "stick to the knitting" - according to my interviews this works the furniture industry. On the other hand sawmills frequently integrate forward to produce finished or semi-finished dimension products.

- **Specializing**

The principle advantage for dimension manufacturers is that they can justify more and better equipment because they cater to a variety of markets within the furniture and cabinet industries.

Advantages include:

- Maximize sawn board yields by cutting sizes for more than one customer from each board
- Utilize lower grades of timber
- Utilize narrow widths
- Utilize short lengths
- Opportunity to develop more skilful personnel
- Advantage of basic raw material procurement
- Less reliance on commodity markets
- Closer liaison with customer
- More knowledgeable about production costs
- Can supply dimension parts more economically than furniture and cabinet industries
- Market flexibility
- Export material potential

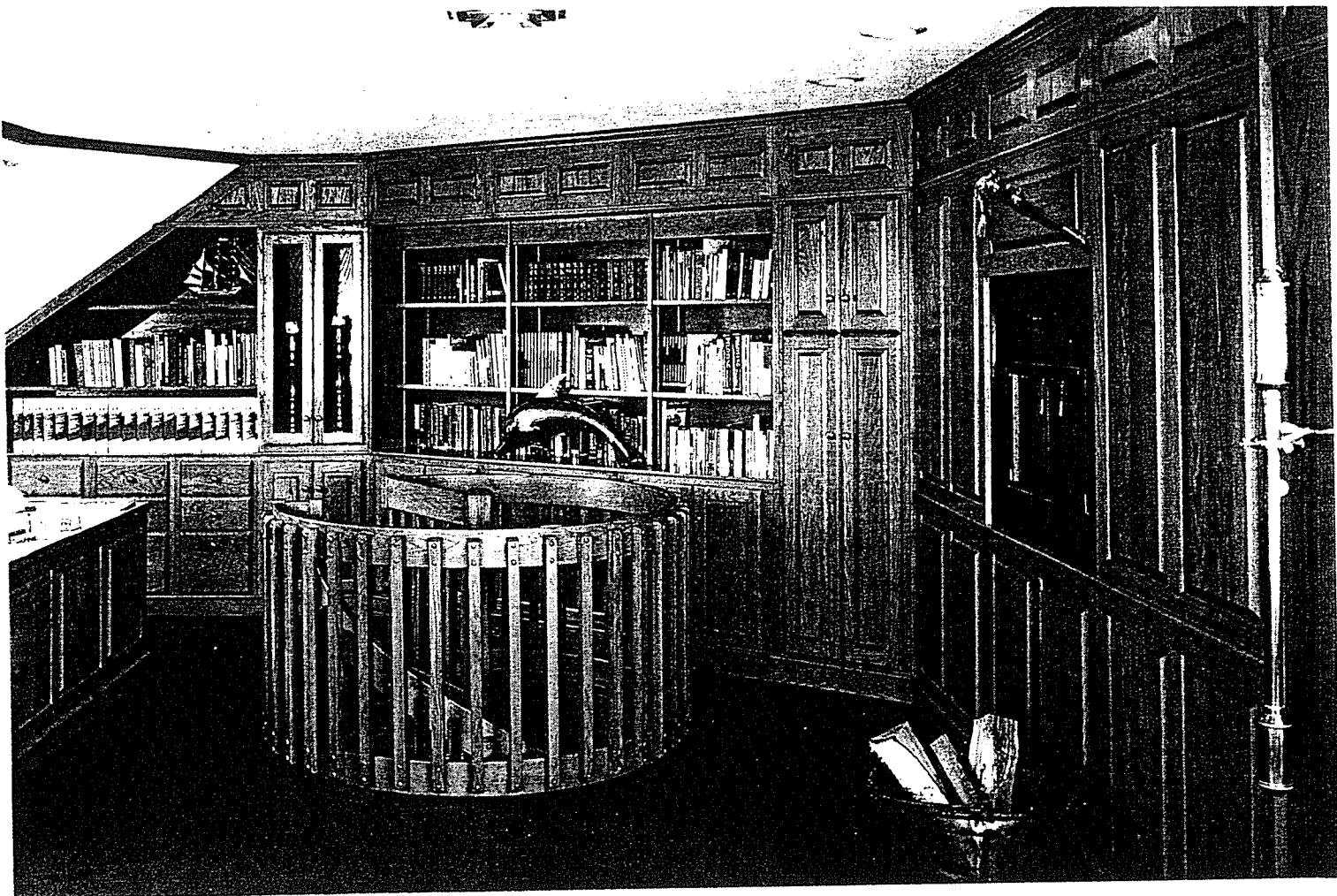
- **Market and product flexibility**

New markets for furniture and cabinet industries can be evaluated and met without regard to limited machinery and or production. With dimension manufacturers able to provide those facilities this allows furniture and cabinet industries to more economically purchase all the necessary parts and concentrate their efforts in the areas of design, assembly and marketing.

SPECIALIZED WOODWORKING CAPABILITIES OF THE AMERICAN HARDWOOD DIMENSION INDUSTRY

The following is a general listing of specific woodworking capabilities of 103 NHDMA members across 23 eastern states of the USA. The listing has been prepared to give the reader an understanding of the equipment required for the full range of dimension products manufacture.

- Assembly of components
- Sub assembly
- Boring
- Carving
- Contouring
- Cut to size blanks
- Dowelling
- Docking (precision)
- Edge glued panels
- Embossing
- Finger jointing
- Finishing
- Gluing (radio frequency)
- Mortising
- Moulding
- Machining
- Planing
- Routing
- Routing - CNC
- Sanding - face, edge, profile
- Shaping
- Steam bending
- Surfacing
- Tenoning (including double end)
- Veneer wrapping



"finished dimension timber components in the home - furniture, cabinets, doors, stair parts and mouldings"

HARDWOOD DIMENSION GRADING RULES

GRADING RULES SET BY THE NATIONAL HARDWOOD DIMENSION MANUFACTURERS ASSOCIATION (NHDMA) FOR AMERICAN HARDWOODS

GENERAL REQUIREMENTS

All dimension parts sold as conforming to these rules shall meet the following general requirements.

Seasoning--Material shall be properly kiln dried according to accepted methods for the species and thickness to within a range of 5-9%. Uniformity of moisture content within a 3% variance (i.e., 6-8%) is most desirable, especially in the manufacture of glued parts. A low moisture content (5-7%) is desirable for parts manufactured and shipped during the winter season when plants are operating their heating systems and the relative humidity is lower. The same is true for parts being shipped to dry climates. Due to the tendency of wood to change in moisture content because of changes in atmospheric conditions, no specific moisture content can be guaranteed when dimension parts reach their final destination. Dimension manufacturers shall exercise all possible care in the seasoning, drying, handling and shipping of their products to assure delivery in a suitable condition.

Gluing--Dimension parts glued for width, length and/or thickness shall be bonded with high-grade glue and in such a manner as to provide strong joints. The type of glue and joint used shall be a matter of contract between buyer and seller.

Tempering--Glued stock will be tempered for the proper time required before surfacing and machining. This is to prevent sunken glue joints and stabilize the size prior to machining.

Workmanship--All dimension parts shall be well manufactured and shall conform to the various grades as hereinafter defined.

Thickness--The maximum finished thickness obtainable is dependent on the width of the piece. The following table indicates thicknesses which can be obtained from various thicknesses of rough lumber as related to width of stock.

Table 1 -THICKNESS

Rough	Rough Surfaced	Finish Surfaced 2 Sides	
		Less than 6" Wide	6" and Wider
Inches	Inches	Inches	Inches
1 (4/4)	$1\frac{5}{16}$	$2\frac{5}{32}$	$\frac{3}{4}$
$1\frac{1}{4}$ (5/4)	$1\frac{3}{16}$	$1\frac{1}{32}$	1
$1\frac{1}{2}$ (6/4)	$1\frac{7}{16}$	$1\frac{1}{4}$	$1\frac{3}{16}$
2 (8/4)	$1\frac{7}{8}$	$1\frac{11}{16}$	$1\frac{5}{8}$
$2\frac{1}{2}$ (10/4)	$2\frac{7}{16}$	$2\frac{13}{16}$	$2\frac{1}{8}$
3 (12/4)	$2\frac{1}{4}$	$2\frac{11}{16}$	$2\frac{5}{8}$

Machining

Rough--(RO) is sawmill cut.

Rough surfaced--(RS) is hit or miss planed or 20/36 grit abrasive that will clean up in subsequent finishing.

Finish surfaced--(FS) is a smooth uniform knife finish or 60 grit sander finish that will clean up with a .0 15"-flat sander cut. Finish surfaced can be surfaced two sides or surfaced four sides (S2S or S4S).

Moulded to pattern--(PAT) is moulded in the lineal direction to the customer's specification or drawing, inside of the line to govern.

End Work--Machined to customer specifications (see abbreviations for suggested codes).

Shaping, Routing, Boring, Turning, etc.--are done per customer specifications.

GRADES

In rough or semi-machined dimension parts of any grade, those blemishes that will be removed in planing or machining to finished sizes will be permitted. Flat stock dimension parts may be solid or edge glued, rough, rough surfaced or finish surfaced. Solid squares cut directly from bolts, cants or logs will be kiln dried after cutting. Laminated squares are cut from kiln dried lumber. Solid or laminated squares may be sold rough, rough surfaced or finish surfaced. In glued dimension parts, matching for direction of grain, figure and colour, if required, shall be matter of agreement between manufacturer and user. Normally, staves with similar grain and colour are together.

FACE GRADE--HARDWOOD

"A" Face--Material which is acceptable for prominent surfaces such as tops, doors and drawer fronts. This grade will permit small sound knot specks, small dark mineral streaks or

pitch pockets up to $1\frac{1}{16}$ " x 1", light discolouration, and strips from 1" min. to 5" maximum in size, with narrow strips to be well scattered.

This grade will not permit birdseye, any knots other than small specks; splits, checks or shake; holes, gouges or other open areas deeper than $\frac{1}{32}$ "; bark or wane; mineral streaks larger than $1\frac{1}{16}$ " x 1"; large dark discoloured areas; and punky or unsound wood.

"B" Face--Material which is acceptable for surfaces of intermediate visibility such as the exterior of most end panels, the interior of end panels on an open case, shelves and the inside of drawer fronts.

This grade will permit occasional pin knots and small sound knots not over $\frac{1}{8}$ " occasional mineral streaks not over $\frac{1}{8}$ " x $1\frac{1}{2}$ "; moderate discolouration; occasional birdseye; and strips from $\frac{3}{4}$ " to 5" max. in size -- narrow strips to be well scattered.

This grade will not permit any knots over $\frac{1}{8}$ ", splits, checks or shake; holes, gouges or other open areas deeper than $\frac{1}{32}$ "; bark or wane; punky or unsound wood; mineral streaks over $\frac{1}{8}$ " x $1\frac{1}{2}$ " and large dark discoloured areas.

"C" Face -- Material which is acceptable for low visibility parts where strength and smoothness is the deciding factor such as back edges of rails, underside portion of any table that is susceptible to touch or feel.

This grade will permit unlimited discolouration or mineral streaks; solid knots up to $\frac{1}{2}$ " diameter; surface checks; open defects up to $\frac{1}{8}$ " x 1" or $\frac{1}{4}$ " diameter; unlimited birdseye; small areas of punky or unsound wood; and boards of any width, up to 5".

This grade will not permit large open knots; wane; and large areas of punky or unsound wood.

OTHER GRADES

Paint (PNT)--This grade will permit on the best face, defects such as burls and tight knots which, when properly filled will be concealed when finished with non transparent material. The reverse face or back may contain defects of a sound grade, patches, and slight imperfection in surfacing.

Sound (SND)--This grade is a utility grade that may contain any defects that will not materially impair the strength of the individual piece for the use intended. Slight skips in dressing on either face will be permitted.

GRADE SPECIFYING

A key purpose of these standards is to provide a system where the buyer can choose only those grades that meet his needs and not overspecify which adds unnecessarily to the product cost. Considering the natural characteristics of wood, it is the dimension manufacturer's objective to always maximize his utilization reducing the material cost to the customer.

The following codes are used to simplify specifying:

AF = All Faces

1FIE = 1 Face and 1 Edge

FE = 1 Face and 4 Edges

PNT = Paint Grade

1F = 1 Face

SND = Sound Grade

1E = 1 Edge

List of Grades

AAF = "A" All Faces

CIF = Remainder Sound

BAF = "B" All Faces

A1E = Remainder Sound

CAF = "C" All Faces

B1E = Remainder Sound

AFE = "A" 1 Face 4 Edges, "B" Back

C1E = Remainder Sound

BFE = "B" 1 Face 4 Edges, "C" Back

A1FIE = Remainder Sound

CFE = "C" 1 Face 4 Edges, Sound Back

B1FIE = Remainder Sound

A1F = Remainder Sound

C1FIE = Remainder Sound

B1F = Remainder Sound

Scale

As referred to in this section the word SCALE shall mean the footage content that the customer is charged for in each piece of dimension.

FLAT STOCK SOLID AND EDGE GLUED

Thickness--In computing the footage of dimension components, the rough nominal thickness required for its manufacture is used. Surface measurement is to apply on rough 1-inch and thinner lumber, and board foot measurement is to apply on lumber over 1-inch rough thickness.

Width--in computing footage when edges are surfaced moulded, or sawed to net width, $\frac{1}{4}$ " shall be added to the net finished width if under 6" wide and under 50" long. If 6" or wider, all lengths, and 50" or longer, all widths, $\frac{1}{2}$ " shall be added to the net finished width. If widths are in fractions of less than eighths of an inch, assume the next higher $\frac{1}{8}$ ". All pieces having a net width of $\frac{3}{4}$ " or under shall be counted as 1" wide.

Length--For dimension parts supplied in rough lengths, 1" shall be added to the net finished length. If lengths are in fractions, the measurement shall be to the nearest $\frac{1}{4}$ " with 1" to be added for equalizing. For those measurements falling exactly at midpoint between quarters of an inch, the lower quarter shall be used.

"Sawed to net width" refers to stock sawed on a straight line rip saw or double end tenoner, producing a piece of stock in which the edge is satisfactory for its ultimate use.

Example of Scale, Flat Stock

Required Sizes (inch)	Measured As (inch)
$\frac{3}{4} \times 1\frac{1}{2} \times 22$	$1 \times 1\frac{3}{4} \times 23$
$\frac{3}{4} \times 1\frac{1}{2} \times 51$	$1 \times 2 \times 52$
$\frac{3}{4} \times 1\frac{5}{16} \times 23\frac{1}{8}$	$1 \times 1\frac{5}{8} \times 24$
$\frac{7}{16} \times 4\frac{5}{8} \times 30$	$1 \times 4\frac{7}{8} \times 31$
$\frac{7}{16} \times 7\frac{1}{4} \times 25\frac{1}{8}$	$1 \times 7\frac{3}{4} \times 26$
$\frac{5}{16} \times 6\frac{3}{16} \times 18\frac{9}{16}$	$1 \times 6\frac{3}{4} \times 19\frac{1}{2}$
$\frac{5}{16} \times 8\frac{9}{16} \times 21\frac{11}{16}$	$1 \times 9\frac{1}{8} \times 22\frac{3}{4}$
$1 \times 2\frac{1}{4} \times 36$	$1\frac{1}{4} \times 2\frac{1}{2} \times 37$

SQUARES, LAMINATED

In laminated stock, exact specifications as to number of plies shall be determined between the producer and customer. In the absence of this specification, the number of plies used shall be based upon the most economical manner to produce required thickness.

Thickness--When stock is laminated, each ply is to be figured from the rough thickness necessary to produce the dressed piece as set forth in Section 3.6.

Width--In laminated stock, the width shall be figured $\frac{1}{4}$ " over the net width in two-ply stock, and $\frac{1}{2}$ " over in three-ply stock or more.

Length--When laminated stock is equalized, 1" shall added to the net length.

Example of Scale--Squares, Laminated

Required Sizes S4S Equalized (inch)	(Count As) (inch)	Made From
$1\frac{5}{8} \times 1\frac{5}{8} \times 29$	$2 \times 1\frac{7}{8} \times 30$	2 Pcs. 4/4"
$2\frac{1}{16} \times 3\frac{1}{8} \times 29$	$2\frac{1}{2} \times 3\frac{3}{8} \times 30$	2 Pcs. 5/4"
3-Ply Stock:		
$2\frac{3}{8} \times 2\frac{3}{8} \times 29$	$3 \times 2\frac{7}{8} \times 30$	3 Pcs. 4/4"
$3 \times 3\frac{1}{2} \times 29$	$3\frac{3}{4} \times 3\frac{1}{2} \times 30$	3 Pcs. 5/4"
$3\frac{3}{16} \times 6 \times 45$	$3\frac{3}{4} \times 6\frac{1}{2} \times 46$	3 Pcs. 5/4"

SQUARES, SOLID

Rough--Squares shall be of sufficient size after kiln drying to surface four sides to the following thicknesses: 4/4 S4S $\frac{25}{32}$ inch, 5/4 S4S $1\frac{1}{32}$ inch, 6/4 S4S $1\frac{1}{4}$ inch, 8/4 S4S $1\frac{11}{16}$ inch. These squares shall be measured on the basis of the rough lumber required to produce them.

Examples of Scale--Squares, Solid

Required Sizes S4S Equalized (inch)	Size of Rough Blank to Produce (inch)
$\frac{3}{4} \times \frac{3}{4} \times 15$	$4/4 \times 1 \times 16$
$1\frac{3}{8} \times 1\frac{3}{8} \times 20$	$8/4 \times 1\frac{5}{8} \times 21$
$2 \times 2 \times 30$	$10/4 \times 2\frac{1}{4} \times 31$

COUNT

Dimensions parts shall be ordered in specific quantities in terms of number of pieces, sets of pieces, lineal feet of random length or number of feet. The manufacturer will ship the order complete, with no back orders, unless previously agreed to by the buyer. The buyer shall accept up to 5% overrun in pieces, feet or sets of pieces if ordered in sets, in any or all items ordered.

ORDER METHOD

In the absence of other requirements by the customer, the following steps for writing orders shall be followed: Quantity, the thickness, width, length, grade, machining and any other specifications required by the customer. Sizes shall be in ascending order with similar thicknesses grouped thinnest first, then all parts of the same width, and lengths from shortest to longest.

Examples

Qty	Thickness (inch)	Width (inch)	Length (inch)	Machining (inch)	Grade
100	$15/16$	x 2	x 14	FS S4S	AFE
150	$15/16$	x 2	x 19	FS S4S	AFE
500	$15/16$	x 2	x $20\frac{1}{4}$	FS S4S	AFE
300	$15/16$	x $2\frac{1}{4}$	x 16	FS S4S	AFE
350	$13/16$	x $2\frac{1}{2}$	x $18\frac{1}{2}$	FS S2S	BIF

TOLERANCE

Rough Dimension

Tolerances for rough hardwood dimension parts shall be agreed upon by customer and seller.

Rough Surfaced Dimension

Unless otherwise agreed upon by customer and seller, sizes which will be changed in the process of further fabrication by the customer shall be subject to the following tolerances:

Thickness	Plus $1/16$ "	Minus $1/16$ "
Width	Plus $1/16$ "	Minus $1/16$ "
Length	Plus $1/8$ "	Minus $1/8$ "

Semi Machined and Fully Machined Dimension

In machine dimension a normal tolerance of plus or minus $1/32$ " will be allowed in all machining operations at time of working unless otherwise specified. Mating parts shall meet requirements agreed to by the buyer and seller. It should be recognized that atmospheric conditions may cause a later change in dimensions over which manufacturers have no control.

Packaging and Shipping

Packing and shipping shall be in accordance with methods accepted in the trade to insure proper protection of the product in transit. Any variations and special requirements shall be a matter of agreement between the buyer and seller.

Receiving and Inspection

No complaint shall be justified unless the number of dimension parts not meeting specification exceeds 2%. No claim shall be honored on material that has been machined by the customer.

Receiving

Purchasers of dimension parts, upon receipt of shipments and prior to further machining and processing, shall handle and store the stock in a manner customarily accepted in the trade in order to prevent the occurrence of degrade. This shall include protection against moisture and temperature changes as well as physical damage.

INSPECTION, DOMESTIC

In case of complaint, the purchaser shall notify the seller within 5 days after receipt of shipment. Any rejected material shall be held intact, properly protected, in its original form for a period up to 5 weeks after notice of rejection, and pending adjustment.

INSPECTION, EXPORT

In case of complaint, the purchaser shall notify the seller, by cable, within 2 days after receipt of shipment, and shall make a supporting detailed written report within 5 days after such goods have been received by the purchaser. Any rejected material shall be held intact, properly protected, in its original form for a period up to 5 weeks after notice of rejection, and pending adjustment. Any inspection shall be made by a party agreed upon by the purchaser and seller with complete reports being given to both.

WOODWORK

Hardwood Interior Trim and Moulding

General Requirements

All hardwood interior trim and moulding sold as conforming to this standard shall be clear-face trim, except where characteristics of the wood and seasoning defects, as hereinafter specified, may be present in not to exceed 10 percent of any shipment. It shall be well manufactured in accordance with the following requirements.

Seasoning--Material shall be kiln-dried according to accepted methods for the species in question to a moisture content which shall be 5 to 9% when shipped from the mill.

Workmanship--All woodwork shall be well manufactured and shall conform to the various grades hereinafter defined.

Grading--All hardwood interior trim and moulding shall be graded from the face side.

Allowable Characteristics--Those characteristics covered by member mouldings, or covered when the stock is installed, and characteristics on the reverse side that do not impair its use shall be allowed.

Detail Requirement--Grade "A"

The characteristics and seasoning defects allowed in any one piece shall be only as covered by not more than any two of the following paragraphs.

Sapwood--Sapwood shall be allowed in all items of hardwood interior trim and moulding, except when made from cherry, selected red birch, red gum, or unsteamed walnut. In these woods the sapwood shall not exceed 25% (surface measure) in the aggregate in any one piece and not more than 5% of the quantity of any one item (pattern, style, or total of same kind of units). This grade is suitable for natural and highest quality paint finishes.

Stain--Stain covering not more than 25% in any one piece (surface measure), and not more than 5% of the quantity of any one item, shall be allowed.

Streaks--Slight streaks shall be permitted in not more than 10% of the quantity of any one item.

Worm holes--Worm holes not larger than $\frac{1}{16}$ " in diameter, and not more than one to each 3 linear feet, shall be allowed. Maximum quantity of material containing worm holes shall not exceed 5% of the quantity of any one item.

Knots--One knot, tight, sound and smoothly dressed, not to exceed $\frac{1}{2}$ " greatest diameter, in stock 6 ft. long or less, and not more than two in stock over 6 ft. long shall be allowed. Maximum quantity of material containing knots shall not exceed 5% of the quantity of any one item. Burls that do not contain knots over $\frac{1}{8}$ " in diameter or unsound centers shall not be considered a defect.

Machine imperfections--Slight machine imperfections which can be eliminated by hand-sanding shall be allowed.

Torn grain--A maximum depth of $\frac{1}{32}$ " will be permitted on machine-run stock in not over 10% of the length in any one piece and not more than 5% of the quantity of any one item.

End splits--End splits $\frac{1}{4}$ " in length for each linear foot, or its equivalent, per piece will be allowed, except that where exact lengths are specified, stock shall be useable for the purpose intended, without waste.

Surface checks--Surface checks not to exceed $\frac{1}{32}$ " wide, 1 inch long, and one check to each foot (surface measure), or its equivalent, per piece, shall be allowed. Maximum quantity of material containing surface checks shall not exceed 5 percent of the quantity of any one item.

Warp--Warped stock that will lie flat or straight with ordinary nailing shall be allowed.

Detail Requirement--Grade "B"

This grade shall be the same as grade "A" except that when sold and marked "grade B", there shall be no restriction as to sapwood and stain in any of the species, as this grade is normally confined to a paint finish.

MOULDINGS

Designs And Sizes

Standard design and sizes shall conform to Industry Standard Wood Moulding Patterns, latest edition, as published by the Wood Moulding and Millwork Producers, P.O. Box 25278, Portland, Oregon 97225, (503) 292-9288.

Special design--Shall be: As per full size detail drawing (inside of line of govern); as per template (stock must fit flush, not tight at time of machining); or as per sample.

Special sizes--Shall be as specified.

Random lengths--Length 4 to 16 ft. shall be counted on 6-in breaks. Each shipment may contain not more than 20% of lengths under 8 ft. 5% may consist of lengths under 6 ft. A variation of 5% over or under the quantity ordered, in linear feet on random-length orders will be allowed.

Specified lengths--When specified lengths are ordered, all lengths up to and including 4 ft. 6 in. shall be counted on 6-in. breaks. Example: Stock 3 ft. 2 in. long will be counted as 3 ft. 6 in.; 4 ft. 6 in long will be counted as 4 ft. 6 in. Lengths over 4 ft. 6 in. shall be counted on 6-in. breaks, to which an additional 6 in. shall be allowed for cutting. Example: Stock 4 ft. 7 in. long will be counted as 5 ft. 6 in.; 7 ft. long will be counted as 7 ft. 6 in.

Tolerance--A variation in size of $\frac{1}{32}$ " plus or minus will be allowed for all unsanded hardwood interior trim and moulding, with an additional allowance of $\frac{1}{32}$ " scant for machine sanding.

Bundling--Moulding shall be bundled and measured by averaging the lengths, which may vary 6" over or under the nominal length.

MEASUREMENT

Hardwood interior trim and moulding shall be sold on a linear foot basis.

INSPECTION

All hardwood interior trim and moulding sold as conforming to this commercial standard is subject to inspection in the condition as received, and complaints regarding any shipment shall be made within five days after receipt thereof. Any rejected material shall be held intact in its original form, properly protected, for a period up to three weeks after notice of rejection and pending adjustments.

HARDWOOD STAIR TREADS AND RISERS

General Requirements

All hardwood stair treads and risers sold as conforming to this standard shall be well manufactured in accordance with the following requirements:

Seasoning--Material shall be kiln-dried according to accepted methods for the species in question to a moisture content not to exceed 7% when shipped from the mill.

Workmanship--All woodwork shall be well manufactured and shall conform to the various grades hereinafter defined.

DETAIL REQUIREMENT--STANDARD GRADES

Hardwood stair treads and risers shall be graded according to the face, side and nosing. The reverse side of all grades may contain imperfections and characteristics which do not materially impair the strength. The standard grades for hardwood stair treads and risers, which may be glued-up for width or one piece, shall be as follows:

Clear grade--The tread nosing and the face of treads and risers shall be clear and free of sapwood. In glued-up stock, the pieces shall be well-matched for colour and grain. Streaks may be admitted, but not more than two in any one tread or riser and not over 6" long in the aggregate.

Select grade--The tread nosing and the face of treads and risers may contain slightly chipped grain; streaks; bright sapwood; sound tight knots not over $\frac{1}{4}$ " in diameter and not more than two in each piece, spot-worm holes $\frac{1}{16}$ " in diameter or less, to the extent of one per linear foot.

Character--marked grade--The tread nosing and the face of treads and risers shall display various character markings inherent. The character markings may include tight knots, worm holes, bird pecks, swirls, burls and other grain irregularities, stain, streaks and other colour variations occurring in the growth of the wood. It shall be free from rot, decay, and heart center.

Paint grade--This grade covers risers only which are intended for a paint finish. The face may contain tight knots, stain, or other sound imperfections which do not materially impair the strength or which would prevent a smooth paint finish. Open defects when properly filled and sanded shall be permitted.

TREADS

Stair treads are available in Clear Grade, Select Grade, and Character-marked Grade.

Thickness--The standard thickness for treads shall be 1" after moulding, less customary allowance for sanding. Special thicknesses of $\frac{25}{32}$ " and $1\frac{5}{16}$ " may also be graded according to this standard.

Width--The standard widths for treads shall be $9\frac{1}{2}$ ", $10\frac{1}{2}$ ", and $11\frac{1}{2}$ ". The width shall be measured from the extreme point of the nosing to the back edge.

Length--The standard length for treads shall be 3 ft., 3 ft. 6 in., 4 ft., 4 ft. 6 in. and 5 ft.

RISERS

Stair risers are available in Clear Grade, Select Grade, Character-Marked Grade, and Paint Grade.

Thickness--The standard thickness of risers shall be $\frac{3}{4}$ " after moulding, less customary allowance for sanding.

Width--The standard widths of risers shall be $6\frac{1}{2}$ ", 7", $7\frac{1}{2}$ ", and 8"

Length--The standard lengths of risers shall be 3 ft., 3 ft. 6 in., 4 ft., 4 ft. 6 in., and 5 ft.

TOLERANCE

A manufacturing tolerance of plus or minus $\frac{1}{32}$ " in the thickness, width, and length shall be allowed. All treads and risers shall be furnished with square ends and with side edges parallel.

Inspection

All hardwood stair treads and risers sold as conforming to the commercial standard are subject to inspection in the condition as received, and complaints regarding any shipment shall be made within five days after receipt thereof. Any rejected material shall be held intact in its original form, properly protected, for a period up to three weeks after notice of rejection and pending adjustments.

ABBREVIATIONS

General

BF Board Foot
 LF Linear Foot
 SM Surface Measure
 AD Air Dried
 KD Kiln Dried

AF All Faces
 FE One Face, 4 Edges
 FL Face laminate
 MC Moisture Content

GRADES

AAF "A" Grade, All Faces
 BAF "B" Grade, All Faces
 CAF "C" Grade, All Faces
 AFE "A" Grade, 1 Face
 4 Edges, "B" Back
 BFE "B" Grade 1 Face.
 4 Edges, "C" Back
 CFE "C" Grade 1 Face,
 4 Edges, "C" Back

BFEB "B" Grade 1 Face,
 4 Edges, "B" Back
 PFE Paint Grade, 1 Face,
 4 Edges, Sound Back
 PFEP Paint Grade, 1 Face,
 4 Edges, Sound Back
 SND Sound Grade

MACHINING:
LINEAL WORK:

HorM	=	Hit or Miss	S4S	=	Finish Surface	4 Sides
SIS	=	Finish Surface	1 Side	EAS	=	Finish Surface
S2S	=	Finish Surface	2 Sides			4 Sides
S3S	=	Finish Surface	3 Sides	PAT	=	Mould to Pattern

END OPERATIONS:

NE	=	Not equalized to length cut reasonably square	MIE	=	Mitre 1 end, square cut other end
EQ	=	Equalized square to length	M2E	=	Mitre 2 ends
TIE	=	Tenon 1 end, square cut other end	CIE	=	Cope 1 end, square cut other end
T2E	=	Tenon 2 end	C2E	=	Cope 2 ends
HTIE	=	Half tenon (rabbet) 1 end, square cut other end	SLIE	=	Slot 1 end, square cut other end
HT2E	=	Half tenon (rabbet) 2 ends	SL2E	=	Slot 2 ends

CROSS WORK:

Dadoes:

Dd1	= One dado to Pattern & location
Dd2	= Two dadoes to Pattern & location, etc.

SPECIAL WORKING:

RSC	= Resaw Centre	SH	= Shape to detail
RS2	= Resaw 2 cuts	Bore:	
RS3	= Resaw 3 cuts	B1H	= Bore 1 hole
		B2H	= Bore 2 holes etc.
		B1HC	= Bore 1 hole & countersink
Ripping:		B2HC	= Bore 2 holes & countersink etc.
RP1	= Rip special 1 cut	DW1	= 1 Dowel.
RP2	= Rip special 2 cuts. etc.	DW2	= 2 Dowels, etc
Bandsaw:		Turn:	
BS	= Bandsaw to detail	TN	= Turn to Pattern
Routing:		Sand:	
RT	= Rout to detail	SD1	= Sand 1 face
Mortise:		SD2	= Sand 2 faces
MTC	= Mortise	PFS1	= Profile Sand 1 Edge
Notch:		PFS2	= Profile Sand 2 Edges, etc.
NH1	= 1 Notch		
NH2	= 2 Notches etc.		
Shaping:			
CLP1	= Clip 1 end		
CLP2	= Clip 2 ends, etc.		

NOMENCLATURE AND DEFINITIONS

Bird peck--A small hole or patch of distorted grain resulting from birds pecking through the growing cells of the tree.

Bow--The longitudinal distortion of a board from a true plane or surface (from end to end).

Burl--A swirl or twist in the grain of the wood which occurs near a knot but does not contain a knot over 1/8" in diameter.

Characteristics--Any natural marking or injury which occurs in wood altering the uniformity of its appearance, such as knots, stain, and worm holes.

Check--A lengthwise separation of the wood, the greater part of which occurs across the rings of annual growth. A surface check is a check occurring on the surface of a piece.

Chipped grain--An area where the surface is chipped or broken out in very short particles below the line of cut.

Conditioning in kiln drying--Obtaining the same moisture content in the "shell" or outside surface of the board as there is in the "core" or center of the board.

Crook--The longitudinal distortion along the edge of a board.

Cup--The lateral distortion of a board from a true plane or surface (from edge to edge across the face).

Decay--A disintegration of the wood substance due to the action of wood destroying fungi. Also known as "dote" and "rot".

Defect--Any irregularity occurring in or on wood that may lower its strength, durability or utility values.

Equalizing in kiln drying--Obtaining the same moisture content from board to board in a charge of lumber.

Hardwoods--The botanical group of trees that, with a few exceptions, comprise all the broad-leaved species. The term has no reference to the actual hardness of the wood. Angiosperms is the botanical name for hardwoods.

Heart center--The small soft core (pith) occurring in the structural center of the log.

Moisture content of wood--Weight of the water contained in the wood expressed in percentage of the weight of the oven dry woods.

Sapwood--The layers of wood next to the bark, usually lighter in colour than the heartwood.

Sound knot--A knot which is solid across its face, as hard as the surrounding woods, and shows no indication of decay.

Split--A lengthwise separation of the wood by reason of the tearing apart of the wood cells.

Stain--A discolouration, occurring on or in woods, of any colour other than the natural colour of the piece on which it appears.

Streak--Streak is a discolouration caused by an accumulation of mineral-like substance or chemical change within the wood.

Tight knot--A knot which is so fixed by growth or position as to firmly retain its place in the piece.

Torn grain--A part of the wood that is torn out in dressing.

Twist--A combination of cup, bow, and crook.

Warp--Any variation from a true or plane surface.

Worm Holes--Voids in the wood caused by the burrowing action of certain wood-infesting worms, which do not survive the kiln-drying process.



"Solid American Oak looks magnificent in this renovated home"

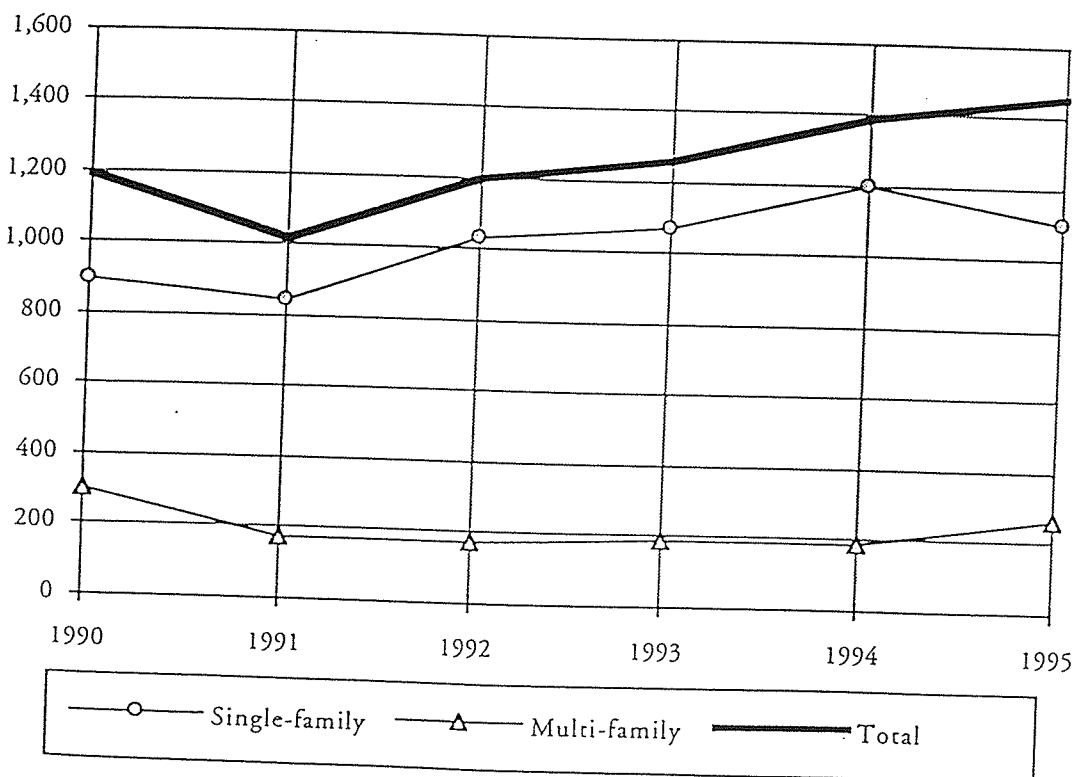
HARDWOOD FLOORING MARKETS

MARKETS AND MARKET GROWTH

The hardwood flooring market in the USA is undergoing a growth phase that is expected to continue to at least the year 2000. The domestic housing market in the U.S. is very volatile much like Australia's however, the base is of course substantially larger. In 1992 new housing starts were 1.16 million and are estimated to grow at a rate of approximately 10% per year for the next few years.

FIGURE 1.2—US housing starts, 1990-1995 (000)

	1990	1991	1992	1993	1994	1995 (est.)
Single-family	895	840	1,030	1,071	1,197	1,040
Multi-family	298	174	170	189	259	260
Total	1,193	1,014	1,200	1,260	1,455	1,300



SOURCE: US Census Bureau.

FORECAST: National Assn. of Home Builders, WOOD TECHNOLOGY staff.

Until the 1970's timber floor systems dominated the single dwelling housing market. Since that time concrete slab floor construction has been making steady inroads into new housing markets. The strongest growth corridors for new housing are forecast in regions which are more suited to concrete slab construction.

Growth trends in Hardwood Flooring - USA

Year	Estimated shipments Million Board Feet	% Annual Change
1982	75	
1987	174	+132
1988	193	+10.91
1989	206	+6.73
1990	205	-0.485
1991	199	-2.92
*1992	220	+10.55

NB 1000 BF = 2.358m³

* 20 year high

Source National Oak Flooring Manufacturers Association

Where is Flooring used?

Thanks to hard wearing finishes that require little care, hardwood flooring enjoyed a tremendous resurgence in popularity from the early 1980's.

A number of factors have contributed to this renaissance including development of new styles and systems and the longevity of polished hardwood floors when compared with other alternative materials.

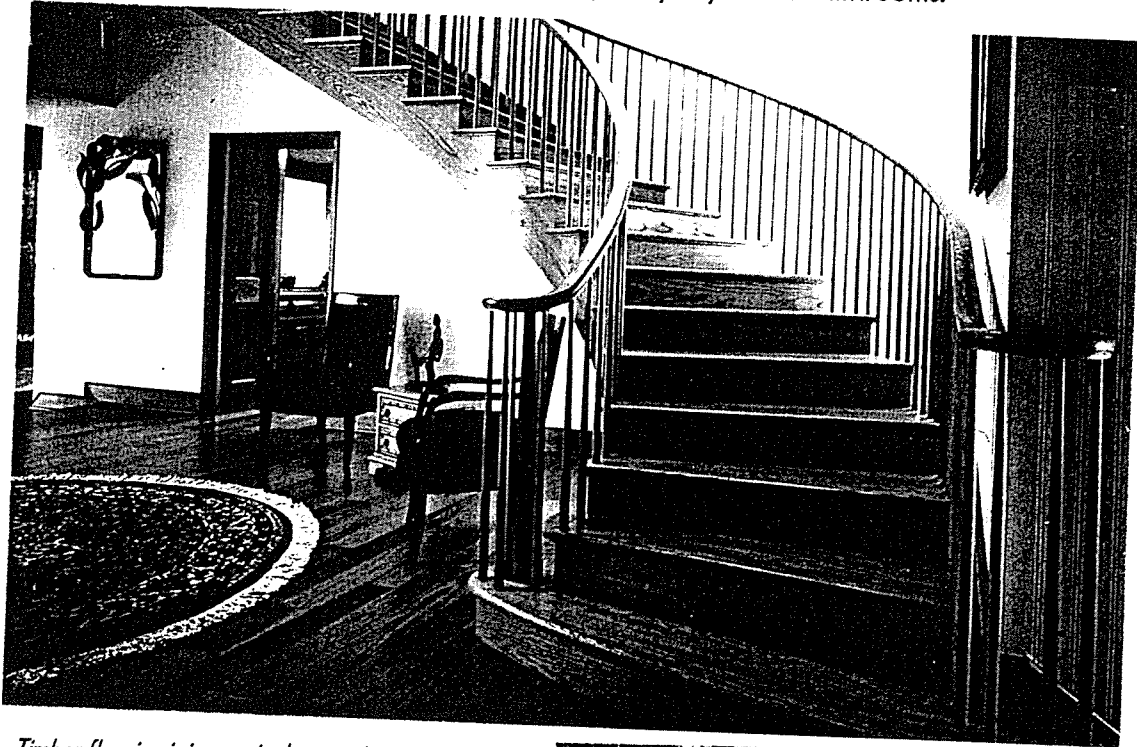
According to data collected by the U.S. Commerce Department, wood floor sales held 3% of the floor covering market in 1983 rising to 5% in 1988, with the total being a staggering 400 million square feet of flooring (approximately 37,160,906 m²).

More recently estimates in a report by National Wood Flooring Manufacturers Association (NWFA) put current market share at 7%. The Association expect penetration to increase to 10% per annum by the year 2000.

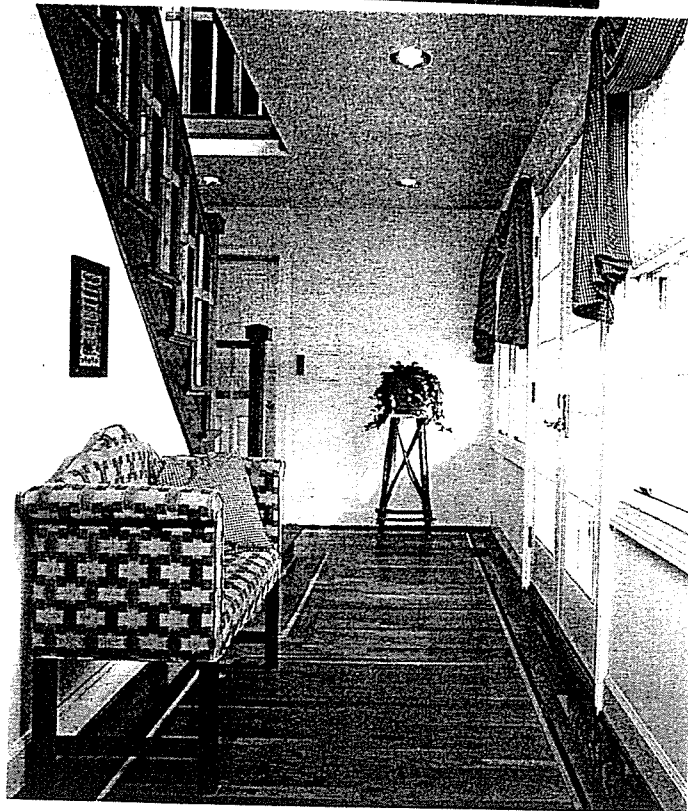
It is estimated that wall to wall carpet usually requires replacing after an average of 7.5 years. Even composite tiles will last only an estimated 18 years.

So consumers and house builders see solid timber flooring as very good value for money. It's intrinsic durability allows the floor to outlast the mortgage and retain its natural beauty long after other floor coverings have been replaced. The Hardwood Flooring Manufacturers Association report an increase in use of timber flooring in areas that traditionally have not used timber.

In kitchens, for example, hardwood flooring is increasingly prominent where nearly a quarter of all new flooring installations are now timber. Other main areas where timber flooring is used in the home include the family room, bedrooms, den, entry foyer and bathrooms.



Timber flooring is increasingly prominent in entry foyers



Cherry floors are bordered by maple and walnut inlays.

Renovation and remodelling markets.

With the cyclical nature of new housing starts and the high proportion of existing housing stock, with those that have timber sub-floor systems installed prior to 1970, a growing market has emerged. The market is expected to grow by around 7% each year through the 90's from a value of \$105 Billion U.S. to \$206 Billion U.S.

Export Markets

The following export market information was obtained from the American Hardwood Export Council. Hardwood flooring in terms of \$ value and volume by country of destination have been extracted.

VALUE OF U.S. EXPORTS OF HARDWOOD FLOORING BY COUNTRY, 1989-1992

Country	1989	1990	1991	1992
———— \$ Thousand F.A.S. Value ————				
Canada	6,446	20,988	22,808	31,358
Korea, Republic of	456	379	661	9,728
United Kingdom	2,606	3,686	4,040	5,301
Japan	4,540	5,419	4,250	3,793
Mexico	400	764	1,172	1,905
Italy	94	190	835	1,609
Hong Kong	197	443	495	880
Taiwan	223	700	834	661
Spain	297	258	571	649
France	170	453	175	376
All Others	1,602	2,562	3,428	3,662
World	17,031	35,842	39,269	59,922

SPECIALISED NICHE MARKETS

Sports floors

The dominant flooring species is Maple. During the late 70's many of the sport and recreation facilities that experimented with synthetic sports floors found that they did not perform as well as hardwood. Issues such as maintenance, long term appearance, cost, resiliency and overall performance lead to a return to hardwood flooring.

With large enclosed facilities having multiple use, timber flooring is ideal. This market includes:

- Squash/Raquetball
- Basketball
- Bowling alleys
- Gymnasiums
- Dance floors
- Indoor general activity zones for schools, etc.

The market size is holding relatively steady at 25 million square feet p.a. approximately 2.3 million square meters.

FLOORING FINISHES

Regulations

The United States Federal Government has introduced a "Clean Air Act" that will progressively be implemented nationwide.

A regulation of this Act, the Volatile Organic Compounds (VOC's) Regulations will have a large impact on the type of wood coatings that are allowed.

The timber floor market with both pre-finished products and site coated raw timber flooring is directly affected.

The VOC regulation limits the amount of solvents that can be contained in all architectural finishes. Traditionally solvent based coatings such as polyurethanes and solvent based stains have been the norm.

Water Based Finishes - The way ahead

One outcome of this VOC regulation is that water based finishes will gain market share. Currently the flooring industry and floor finish manufacturers are developing products which will comply with the new regulations. Some manufacturers are developing high-solids solvent type finishes which don't release any potentially hazardous vapours.

Pre-finished Flooring

The general consensus within the flooring products industry is that water based finishes will gain market share. Increasingly, both solid and laminated flooring will be available pre-finished. Pre-finished flooring is becoming more popular for many reasons, including:

- Factory finishes provide a uniform quality product
- Easy to lay
- Well suited to growing D.I.Y. markets
- Cleaner
- Less labour and trades on site
- No on site environmental considerations
- Direct cost and performance comparisons can be made with other one step flooring products such as carpet, tiles, etc.
- Timber merchant and retailer "friendly"
- Looks immediately appealing
- Reduces risk of moisture content change

To lay a timber floor requires a high level of expertise and knowledge. Accordingly a number of traders have become involved in supply and install operations, employing or sub-contracting specialist floor layers, sanders and finishers.

A timber merchant indicated that the consumer is purchasing a feature floor. Pre-finished flooring enhances the appearance and look of the product, often resulting in instant sales. Alternatively, raw timber flooring forces the consumer to try and "imagine" what the feature floor will ultimately look like.

Factory coated flooring with oil or solvent base sealers are very durable and long wearing. The Memphis Hardwood Flooring Company manufacturer the "chickasaw" brand. Their pre-finished floor uses a baked penetrating oil and stain, plus a durable thermo plastic wax coating. This finish can be easily maintained and restored by fine sanding and re-waxing the affected area using a pre coloured matching wax stick.

At a timber merchant retail outlet, I observed a one metre square cardboard pack of pre-finished stained and coated solid end matched flooring. Its packaging and presentation was specifically marketed to the Do It Yourself Market. The shoulder pack was 4 ft long and included laying and care instructions, as well as a colour matched wax stick for repair of scratches.

Standard factory finishing is a value added process which to a majority of Australian sawmillers would be inappropriate. The average sawmiller knows how to produce quality

wood products and does not have the technological knowhow or facilities to begin a coatings manufacturing process.

Most United States flooring producers are specialist manufacturers of flooring products only. They buy in green or kiln dried timber and run high volume flooring in a dedicated plant. The coating of flooring involves a complex series of high quality controlled procedures. A typical pre-finished flooring process involves:

Steps to produce pre-finished flooring:

- Machining of flooring to profile
- Fine sanding
- Extra fine sanding
- Rolling on stain
- Fine brushing of wet stain
- Oven drying stain finish
- Curing stain finish under ultra violet lamps
- Brush polishing dry stain finish
- Apply first spray coating of urethane
- Curing urethane sealer under ultra violet lamps
- Apply second spray coating of urethane
- Curing second urethane coating under ultra violet lamps
- Ultra fine sanding of second urethane coating
- Apply third spray urethane "Topcoat"
- Apply fourth spray urethane "Topcoat"
- Ultra violet curing of topcoats
- Refrigeration of topcoat to chill harden the surface
- Quality control inspection
- Packaging - vacuum wrapping or protective cardboard boxing
- Bundling to various sizes
- Undercover storage in semi controlled environment
- Distribution

In the U.S. unfinished strip flooring is still the largest single flooring product in the market and, understandably current manufacturers want to continue to produce this product rather than installing pre-finish lines. It is simply that this traditional uncoated flooring product is well positioned in the U.S. market and it is suited to service the large number of specialist installers and finishing trades in the market place that have done an excellent job for a very long time. However those in the pre-finish flooring market are confident that their segment of the market will also expand. There seems to be room in the market for both.

The growth in the pre-finished flooring market in the U.S. will probably be focussed on renovations and as an overlay product on new and existing concrete slab, rather than the new house market.

NEW PRODUCTS

It seems that the new flooring technology available in America is coming from Europe as laminated pre-finished flooring. Durand-Raute of Finland, Junkers of Denmark are two international European companies making inroads into traditional non-finished floor markets.

Prefinished Laminated Flooring (PFLF) has many benefits to the end-user:

- Requires no special installation skill
- You can live on it immediately
- Hard wearing
- Resilient
- East to clean and maintain
- Hygienic

Prefinished Laminated Flooring (PFLF) is glued together using 3 layers of solid timber boards with the top layer of high quality selected species in appearance grades. This layer is generally 3-5mm in thickness. The core and base layer are usually of much lower grade and can be of either hardwood or softwood. The thickness is:

Face	3-4mm
Core	8 mm
Base	2 mm
	<hr/>
	13-14 mm

The layup is in alternative directions providing a stable 'ply' configuration. Other base layers of pre-manufactured sheet products such as plywood and MDF are also being developed.

Finished strips of laminated flooring is available in set lengths of 2090 x 205mm (3 x 65mm), however the look of the floor is one of random length with the face board varying in length from 270-570mm. This utilization of short length product and laying it up into manageable set length, pre-finished planks is a very good way of value adding short length material. All timber used in the process is kiln dried to a moisture content of 7% \pm 1%.

ASSOCIATIONS

There are general Associations involved in the American hardwood flooring products industry. Many of these Associations are species specific in their focus however their activities are often duplicated. Following is a brief description of the activities of one such Association.

NATIONAL OAK FLOORING MANUFACTURERS ASSOCIATION - NOFMA

Based in Memphis, Tennessee this organisation represents manufacturers plants involved in solid wood flooring - often sawmillers. The NOFMA compiles statistics, represents the industry to government and other regulatory groups and participates in research related to production and installation of hardwood floors. Key activities include:

Grading

The NOFMA grading system is the benchmark for hardwood flooring in the U.S. and provides an impartial inspection service report on installed floors. This service is not restricted to grade compliance but also covers installation and other issues which may affect an installed floor. Grade compliance checks are undertaken at mills and plants 6 to 12 times a year.

Education

Since 1979 NOFMA has in conjunction with other flooring associations, recognised a need to educate and train skilled flooring installers. Courses provide hands on activities on grade, timber knowledge, installation finishing and floor care information.

SUBSTRATES FOR STRIP FLOORS

In the U.S. it is important to note that in the majority of cases timber strip flooring is laid over a panel or solid timber boards as a sub-floor base on a bearer and floor joist system. In Australia we tend to lay 19mm strip flooring directly to sub-floor joists.

Some U.S. systems are as follows:

SYSTEM 1

19mm seasoned square edged boards are no wider than 6" (150mm) and are nailed diagonally over seasoned sub-floor joists. This is then overlaid with high grade building paper on asphalt felt. The feature surface appearance flooring is then secret nailed to the substrate using nails that are 8xD (diameter) lengths are 38 or 50ml:

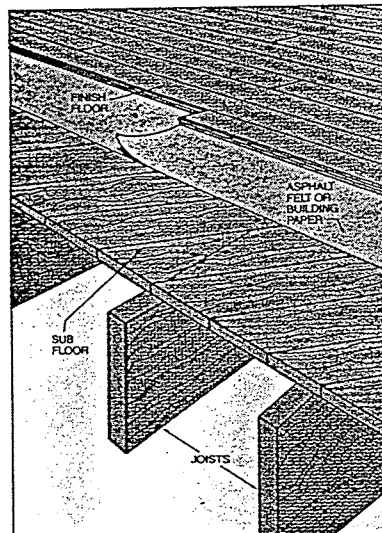


Figure 1

SYSTEM 2 - PANEL FLOOR

Usually plywood or oriented strand board (OSB) in thicknesses of 5/8" or 3/4" are used as the flooring substrate. A plywood 3/4" or thicker is also recommended for laying over concrete slabs in conjunction with an impervious membrane. Hardwood strip flooring is then secret nailed through the side of the tongued edge ensuring that the nail does not penetrate the plywood substrate.

This system has several advantages including:

- A working platform during construction
- Short lengths of flooring can be utilised
- Improved sound insulation properties
- Top floorboards are isolated from moisture related problems that may occur in the sub-floor space
- Flooring may be laid without end jointing over floor joists

- Finished floor heights are compatible with other floor coverings as all the concrete slab or timber sub-floor is covered with the ply substrate

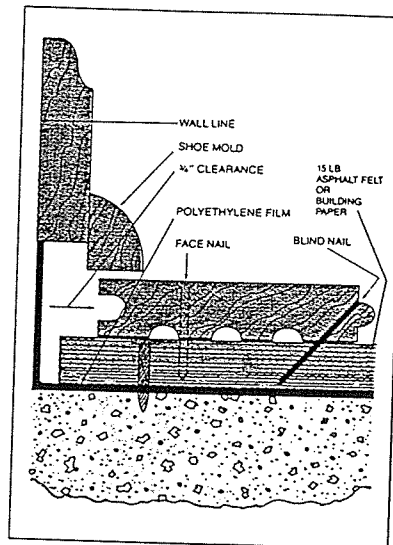


Figure 2

SYSTEM 3

This system uses flat seasoned 2" x 4" battens of varying lengths usually from 18" (450mm) to 48" (1200 mm) spaced at 12" (300mm) centres as a nailing base. Battens are bonded to the slab using mastic and a polythene vapour barrier is laid over the battens. Floor boards are then nail fixed through the membrane into the batten. This system is only recommended for 3/4" thick and strips less than 4" (100mm) in width.

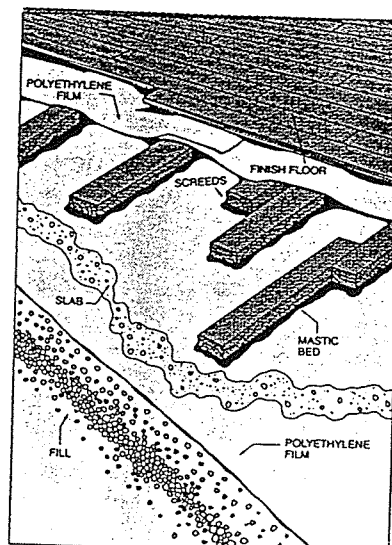


Figure 3

GRADING

For unfinished hardwood flooring all grading is done for appearance alone. The grading system in the U.S. is based on one face only and grading occurs before profiling or machining as flooring has:

- offset tongue and groove
- end matched
- stress relief grooves to underside

There are four basic grades of hardwood flooring which is similar to Australian grading standards for eucalypt hardwoods. The major difference being the acceptance of short length flooring in the U.S.

1. Clear Oak
Very limited character marks
Uniform colour
Average length $3\frac{3}{4}$ ft.

2. Select Oak
Good appearance
Unlimited sound sapwood
Average length $3\frac{3}{4}$ ft.

N.B. Select and Better can also be procured being a combination of clear and select grade.

3. No. 1 Common Oak
Variegated appearance
Sound knots, worm holes allowed
All imperfections are filled
Average length $2\frac{3}{4}$ ft.

4. No. 2 Common Oak
Rustic appearance
All imperfections allowed
All imperfections are filled
Average length $2\frac{1}{4}$ ft.

SHORT GRADES

In addition to these standard grades, there are short grades. The following is a brief description of grade and length requirements.

No 1 Common and better grade - short

Average bundle 1 $\frac{1}{4}$ ft.

This grade allows for a combination of clear select and No. 1 Common timber grading but allows for lengths between 9" and 18". A bundle of this flooring grade will average a nominal 1 $\frac{1}{4}$ ft (15 inches).

No 2 Common - Short

Same as No 2 Common

These short grades are a very good way to upgrade short material. Length is not that important visually in a finished floor and they are often integrated with longer bundles when laying to create a random parquetry look.

PACKAGING

Unfinished flooring is available in graded "bundles" by averaging the length. Tongue and groove flooring strips under 8 ft. (2.4m) are the norm. Bundle lengths start from 1 $\frac{1}{4}$ feet and up to 8 feet.

Nested bundles

These are packs made up of random length flooring bundled up to make 8 ft long packs the shortest piece allowed is down to 9" with the average length from 2 $\frac{1}{4}$ feet to 3 $\frac{1}{4}$ feet depending on grade.

The following table provides a guide to unfinished hardwood flooring grades for three common hardwood species.

GUIDE TO HARDWOOD FLOORING GRADES

UNFINISHED OAK FLOORING (Red & White Separated)	UNFINISHED HARD MAPLE (BEECH & BIRCH*)	UNFINISHED PECAN FLOORING*	PREFINISHED OAK FLOORING (Red & White separated, graded after finishing)
CLEAR PLAIN or CLEAR QUARTERED* Best appearance. Best grade, most uniform color, limited small character marks. Bundles 1 1/4 ft. and up. Average length 3 3/4 ft. **	FIRST GRADE Best appearance. Natural color variation, limited character marks, unlimited sap. Bundles 1 1/4 ft. and up. 1 1/4 ft., 2 ft., & 3 ft. bundles up to 45% footage. 2 ft. bundles up to 25% footage. 1 1/4 ft. bundles up to 5% footage.	FIRST GRADE Excellent appearance. Natural color variation, limited character marks, unlimited sap. Bundles 2 ft. & up. 2 & 3 ft. bundles up to 25% footage. FIRST GRADE RED (Special Order) FIRST GRADE WHITE (Special Order)	PRIME GRADE (Special Order) Excellent appearance. Natural color variation, limited character marks, unlimited sap. Bundles 1 1/4 ft. & up. Average length 3 1/2 ft.
SELECT PLAIN or SELECT QUARTERED* Excellent appearance. Limited character marks, unlimited sound sap. Bundles 1 1/4 ft. and up. Average length 3 1/4 ft. ** SELECT & BETTER* A combination of Clear and Select grades.	SECOND GRADE Variegated appearance. Varying sound wood characteristics of species. Bundles 1 1/4 ft. and up. 1 1/4 ft., 2 ft., & 3 ft. bundles up to 55% footage. 2 ft. bundles up to 27% footage. 1 1/4 ft. bundles up to 10% footage.	SECOND GRADE Variegated appearance. Varying sound wood characteristics of species. Bundles 1 1/4 ft. and up. 1 1/4 ft. to 3 ft. bundles as produced up to 40% footage. SECOND & BETTER GRADE A combination of First and Second Grades.	STANDARD GRADE Variegated appearance. Varying sound wood characteristics of species. A sound floor. Bundles 1 1/4 ft. & up. Average length 2 3/4 ft. STANDARD & BETTER GRADE Combination of STANDARD and PRIME. Bundles 1 1/4 ft. & up. Average length 3 ft.
NO. 1 COMMON Variegated appearance. Light and dark colors; knots, flags, worm holes and other character marks allowed to provide a variegated appearance after imperfections are filled and finished. Bundles 1 1/4 ft. and up. Average length 2 3/4 ft. **	SECOND & BETTER GRADE A combination of First & Second Grades. Lengths equivalent to Second Grade.	THIRD GRADE Rustic appearance. All wood characteristics of species. A serviceable, economical floor after filling. Bundles 1 1/4 ft. and up. 1 1/4 ft. to 3 ft. bundles as produced up to 75% footage. 1 1/4 ft. bundles up to 45% footage.	TAVERN GRADE Rustic appearance. All wood characteristics of species. A serviceable, economical floor. Bundles 1 1/4 ft. & up. Average length 2 1/4 ft. TAVERN & BETTER GRADE (Special Order) Combination of PRIME, STANDARD and TAVERN. All wood characteristics of species. Bundles 1 1/4 ft. & up. Average length 3 ft.
NO. 2 COMMON Rustic appearance. All wood characteristics of species. A serviceable economical floor after knot holes, worm holes, checks and other imperfections are filled and finished. Bundles 1 1/4 ft. and up. Average length 2 1/4 ft. ** Red and White may be mixed.	THIRD & BETTER GRADE A combination of First, Second & Third Grades. Bundles 1 1/4 ft. and up. 1 1/4 ft. to 3 ft. bundles as produced up to 60% of footage.	THIRD GRADE Rustic appearance. All wood characteristics of species. A serviceable, economical floor after filling. Bundles 1 1/4 ft. and up. 1 1/4 ft. to 3 ft. bundles as produced up to 60% footage. THIRD & BETTER GRADE A combination of FIRST, SECOND and THIRD GRADES.	PREFINISHED BEECH & PECAN FLOORING TAVERN & BETTER GRADE (Special Order) Combination of PRIME, STANDARD and TAVERN. All wood characteristics of species. Bundles 1 1/4 ft. & up. Average length 3 ft.
1 1/4' SHORTS Pieces 9 to 18 inches. Bundles average nominal 1 1/4 ft. NO. 1 COMMON & BETTER SHORTS A combination grade of CLEAR, SELECT, & NO. 1 COMMON NO. 2 COMMON SHORTS Same as No. 2 Common.	A brief grade description, for comparison only. NOFMA flooring is bundled by averaging the lengths. A bundle may include pieces from 6 inches under to 6 inches over the nominal length of the bundle. No piece shorter than 9 inches admitted. The percentages under 4 ft. referred to apply on total footage in any one shipment of the item. 1/4 inch added to face length when measuring length of each piece. NESTED FLOORING is random length flooring bundled end to end continuously in 8 ft. long (nominal) bundles. OAK regular grade requirements apply. PECAN 9-18 inch pieces will be admitted in 3/4x2 1/4" as follows: First Grade = 4 pcs. Second Grade = 8 pcs. Third Grade = as develops. Average Lengths: First Grade = 42 inches. Second Grade = 33 inches. Third Grade = 30 inches. BEECH, BIRCH & HARD MAPLE 9-18 inch pieces will be admitted in 25/32"x2 1/4" as follows: First Grade = 4 pcs. Second & Better Grade = 8 pcs. Third Grade = 35 pcs.		

(NOTE: Flooring specified "QUARTERED" shall contain Quartered only. Flooring specified "PLAIN" may contain both Plain and Quartered.)
 *Check for availability.

**The average lengths for 7' and shorter packages, nested or otherwise, are as follows:

	3 1/4'	11 COMMON	2 1/4'
CLEAR	3 1/4'	11 COMMON	2 1/4'
SELECT	3'	12 COMMON	2'

STANDARD SIZES

Nominal	Actual
Tongue & Groove—End Matched	
3/4x2 1/4 in.	3/4x2 1/4 in.
3/4x1 1/2 in.	3/4x1 1/2 in.
1/2x2 in.	15/32x2 in.
1/2x1 1/2 in.	15/32x1 1/2 in.
PLANK SIZES	
3/4x3, 4, 5, 6, 7, 8 in.	
MAPLE STANDARD SIZES	
3/4x2 1/4, 1 1/2 in.	
25/32x2 1/4, 1 1/2 in.	
33/32x2 1/4, 1 1/2 in.	
LIMITED PRODUCTION	
3/4x3 3/4 in.	3/4x3 3/4 in.

SPECIAL ORDER SIZES

Nominal	Actual
Tongue & Groove—End Matched	
3/4x2 in.	3/4x2 in.
3/8x2 in.	11/32x2 in.
3/8x1 1/2 in.	11/32x1 1/2 in.
Square Edge	
5/16x2 in.	5/16x2 in.
5/16x1 1/2 in.	5/16x1 1/2 in.

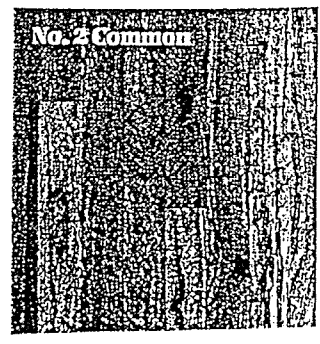
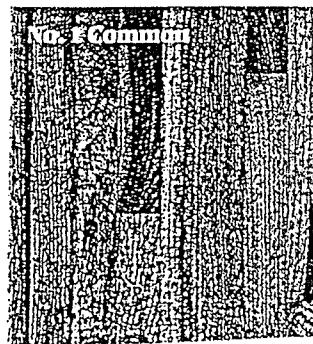
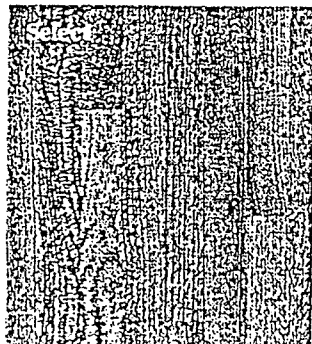
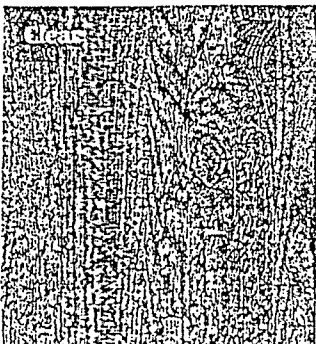
NAILING SCHEDULE

NOFMA Hardwood Flooring Must be installed over a Proper Subfloor
 Tongue & Groove MUST be Blind Nailed Square Edge must be Face Nailed

A slab with screeds 12" o.c. does not always require a subfloor.

STRIP T & G	Size Flooring	Size Nail to be Used	Blind Nail Spacing along the length of strips. Minimum 2 nails per piece near the ends. (1"-3")
3/4 x 1 1/2", 2 1/4", & 3 1/4"	2" serrated edge barbed fastener, 7d or 8d screw or cut nail, 2" 15 gauge staples with 1/2" crown. On slab with 3/4" plywood subfloor use 1 1/2" barbed fastener.		In addition - 10-12" apart - 8-10" preferred. 1/2" plywood subfloor with joints a Maximum 16" o.c., fasten into each joint with additional fastening between; or 8" apart
MUST install on a Subfloor			
1/2 x 1 1/2" & 2"	1 1/2" serrated edge barbed fastener, 5d screw, cut steel, or wire casing nail.		10" apart. 1/2" flooring must be installed over a MINIMUM 3/8" thick plywood subfloor.
3/8 x 1 1/4" & 2"	1 1/4" serrated edge barbed fastener 4d bright wire casing nail.		8" apart
SQUARE-EDGE FLOORING			
5/16 x 1 1/2" & 2"	1" 15 gauge fully barbed flooring brad.		2 nails every 7"
5/16 x 1 1/4"	1" 15 gauge fully barbed flooring brad.		1 nail every 5" on alternate sides of strip.
PLANK			
3/4 x 3" to 8"	2" serrated edge barbed fastener, 7d or 8d screw, or cut nail. Use 1 1/2" length with 3/4" plywood subfloor on slab.		8" apart
FOLLOW Manufacturer's Instructions for installing Plank Flooring			
Widths 4" and over must be installed on a Subfloor of 5/8" or thicker plywood or 1/2" board. On slab use 1/2" or thicker plywood.			

Oak Flooring grades shown



SIZES

General production of flooring is available normally in narrow width boards and is generally end matched. $2\frac{1}{4}$ " is by far the most common width accounting for about 90% of production.

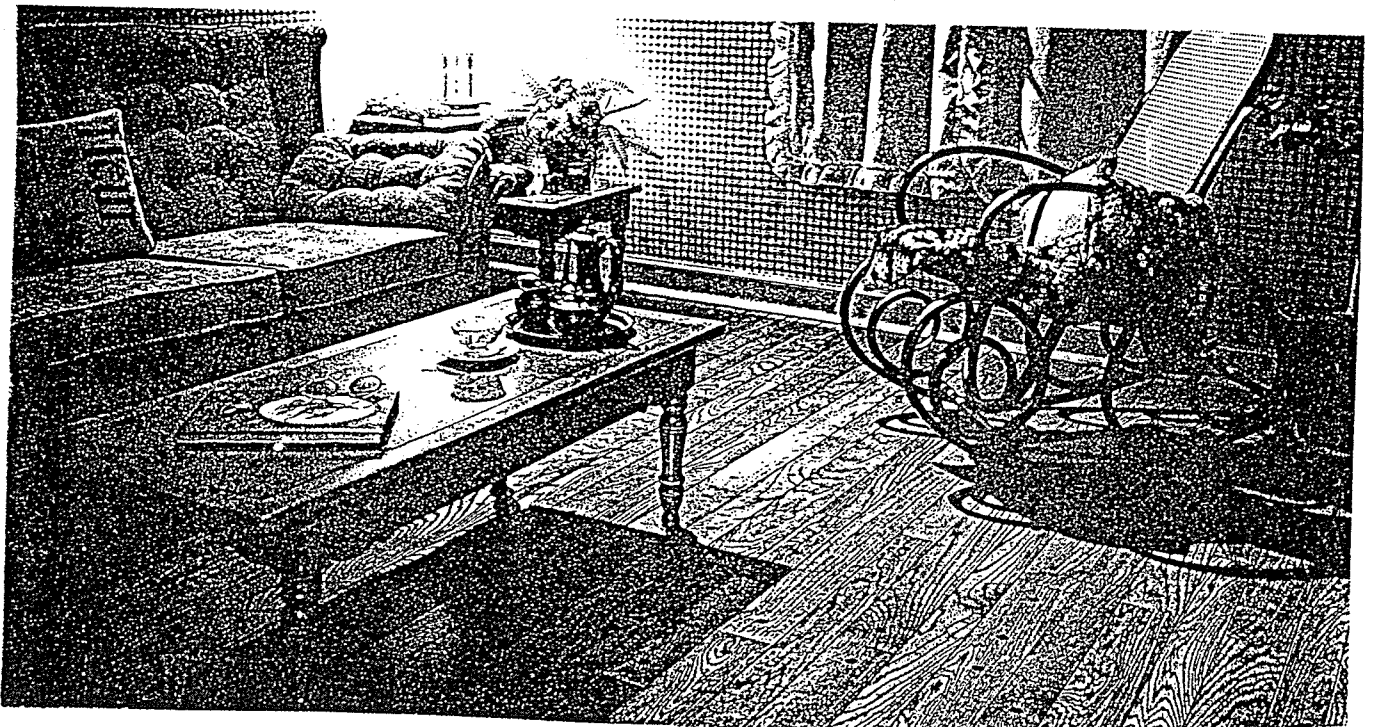
Width		Thickness	
Inch	MM	Inch	MM
$1\frac{1}{2}$	38	$\frac{3}{4}$	19
2	50	$\frac{3}{4}$	19
$2\frac{1}{4}$	57	$\frac{3}{4}$	19

* $3\frac{1}{4}$ " available on special order

PLANK FLOORING

Boards wider than $2\frac{1}{4}$ " standard boards are known as plank flooring and range from 3" to 8" in width and are available in one inch increments. Plank flooring is installed in the same manner as strip flooring i.e. over a timber substrate and is generally $\frac{3}{4}$ " thick. The fixing requirements vary to eliminate cupping and expected additional movement in service associated with wider, often back sawn boards.

Plank floors are secret nailed in the standard position (i.e. through the tongue and groove) and in addition they are face screwed (No 9 or 12 screws) into countersunk holes often pre-drilled into the planks at ends and at intervals along each plank to hold it securely. Countersunk holes are then filled using wooden plugs supplied with the flooring.



Plank Flooring is available in widths 3" to 8"



HERITAGE PLANK

Family-room favorite

True colonial flavor captured in full 3" and 4" pegged planks, available in either Natural or Antique prefinish. Pegs are genuine end grain Walnut, and full-size 3/4" diameter. With heavy side bevels emphasizing the widths, Heritage Plank leaves the impression of wider boards. Install with blind-nailing directly over screeds, wood subfloors, plywood-on-slab or old wood floors. Full 3/4" thick, Select and Better grade Oak. Not available unfinished.

Chickasaw heritage wide board plank floors with timber pegs concealing screw fixings

TRAINING AND EDUCATION

A Hardwood Flooring Installation School has been operated by the following flooring manufacturers associations since 1979:-

- American Parquet Association
- N.O.F.M.A. - National Oak Flooring Manufacturing Association
- Maple Floor Manufacturing Association
- National Wood Flooring Association

The training covers all technical aspects of flooring production, installation, specification, furnishing and is aimed at Government departments, manufacturers, resellers, installers, finishers and specifiers.

FIXINGS

The following nailing schedule has been produced by N.O.F.M.A. for hardwood flooring

NAILING SCHEDULE

NOFMA Hardwood Flooring Must be installed over a Proper Subfloor
Tongue & Grooved **MUST** be Blind Nailed
Square Edge must be Face Nailed

A slab with screeds 12" o.c. does not always require a subfloor.

STRIP T & G

Blind Nail Spacing
along the length of strips.
Minimum 2 nails per piece
near the ends. (1"-3")

Size Flooring

Size Nail to be Used

$\frac{3}{4}$ "x1 $\frac{1}{2}$ ", 2 $\frac{1}{4}$ ", & 3 $\frac{1}{4}$ "

2" serrated edge barbed fastener,
7d or 8d screw or cut nail,
2" 15 gauge staples with
 $\frac{1}{2}$ " crown.
On slab with $\frac{3}{4}$ " plywood
subfloor use 1 $\frac{1}{2}$ " barbed
fastener.

In addition – 10-12"
apart – 8-10"
preferred.

 $\frac{1}{2}$ " plywood subfloor
with joists a Maximum 16"
o.c., fasten into each joist
with additional fastening
between, or 8" apart

MUST install on a Subfloor

$\frac{1}{2}$ "x1 $\frac{1}{2}$ " & 2"

1 $\frac{1}{2}$ " serrated edge barbed fastener,
5d screw, cut steel, or wire
casing nail.

10" apart

 $\frac{1}{2}$ " flooring must be
installed over a MINIMUM
 $\frac{5}{8}$ " thick plywood subfloor.

$\frac{3}{8}$ "x1 $\frac{1}{2}$ " & 2"

1 $\frac{1}{4}$ " serrated edge barbed fastener
4d bright wire casing nail.

8" apart

SQUARE-EDGE FLOORING

$\frac{5}{16}$ "x1 $\frac{1}{2}$ " & 2"

1" 15 gauge fully barbed
flooring brad.

2 nails every 7"

$\frac{5}{16}$ "x1 $\frac{1}{3}$ "

1" 15 gauge fully barbed
flooring brad.

1 nail every 5" on
alternate sides of strip.

PLANK

$\frac{3}{4}$ "x3" to 8"

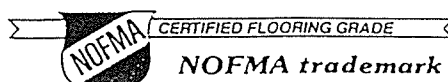
2" serrated edge barbed fastener,
7d or 8d screw, or cut nail,
Use 1 $\frac{1}{2}$ " length with $\frac{3}{4}$ " plywood
subfloor on slab.

8" apart

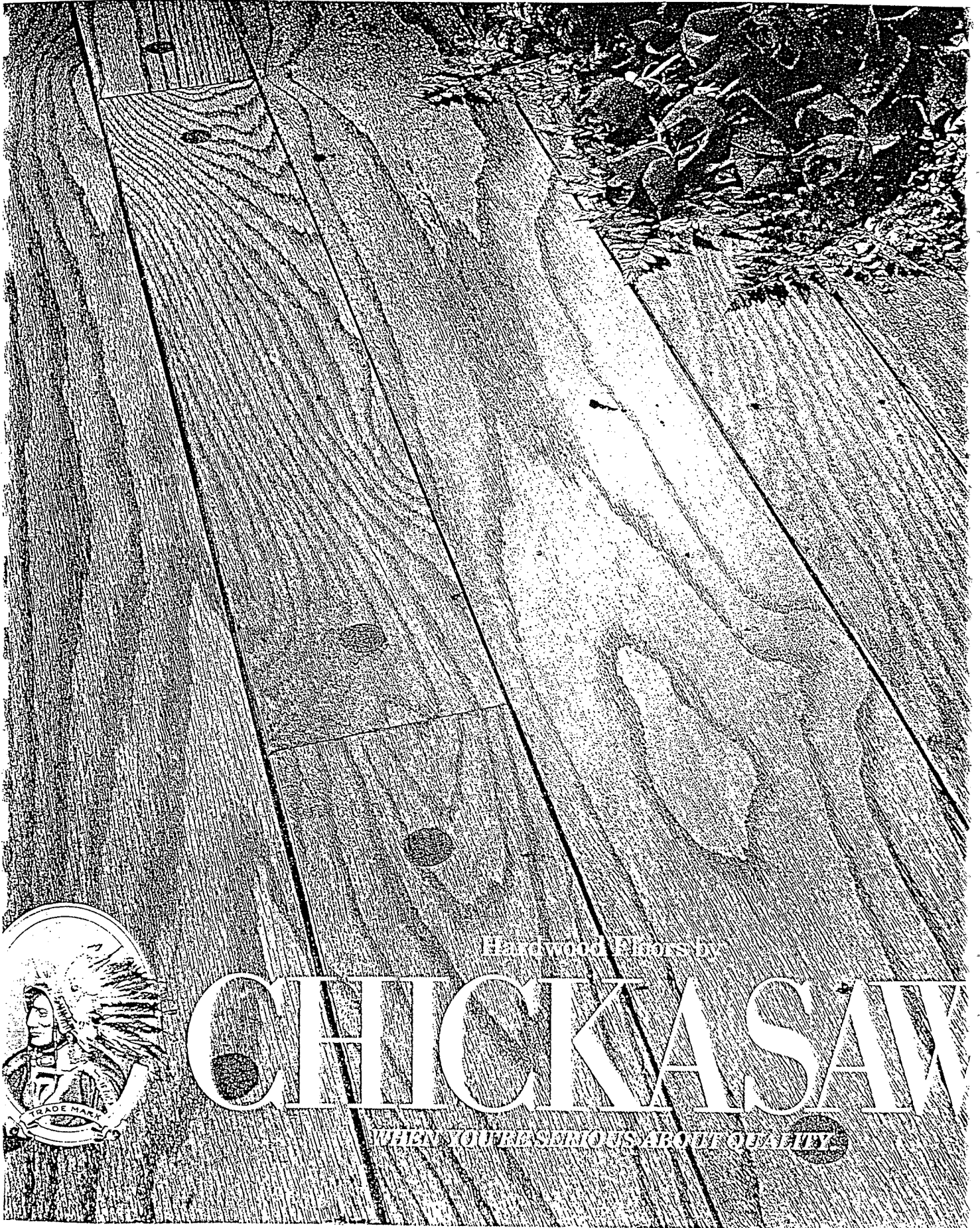
FOLLOW Manufacturer's instructions for installing Plank Flooring

Widths 4" and over must be installed on a Subfloor of $\frac{5}{8}$ " or thicker
plywood or $\frac{3}{4}$ " boards. On slab use $\frac{3}{4}$ " or thicker plywood.

For additional information — write to:
National Oak Flooring Manufacturers Ass'n.
P.O. Box 3009, Memphis, TN 38173-0009




NOFMA trademark assures quality.

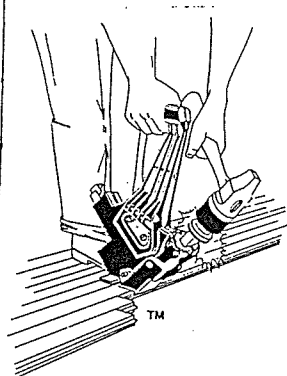
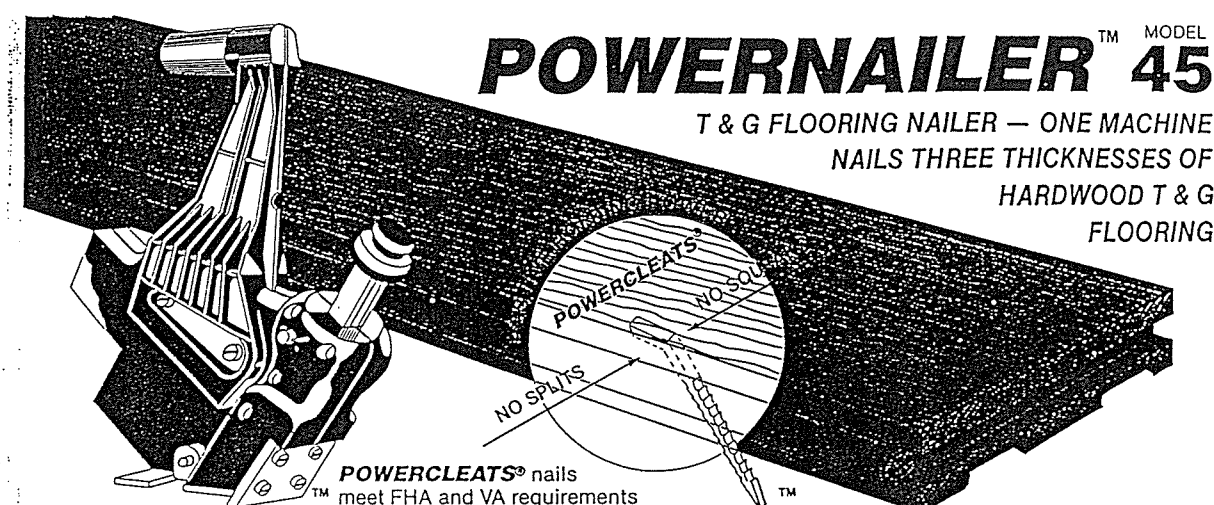


Hardwood Floors by

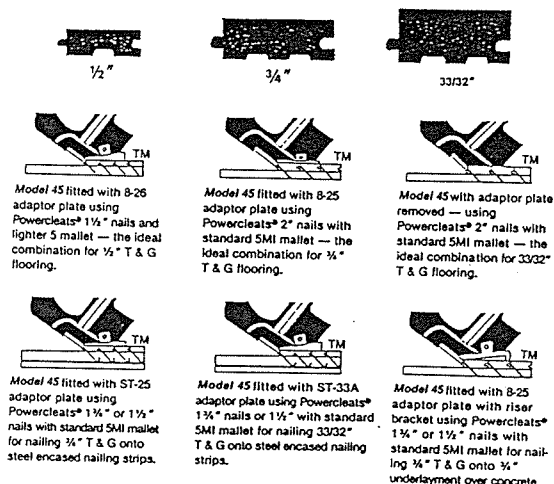
CHICKASAW

WHEN YOU'RE SERIOUS ABOUT QUALITY

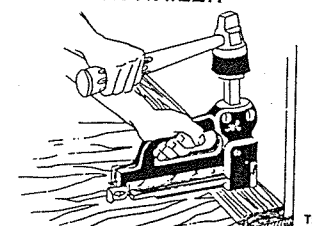




- Nail and set in one blow
- Draw flooring strips tight
- Drive all nails at 45° angle
- Decrease cost
- Increase job production



POWERNAILER™ MODEL 101 SURFACE NAILER



The Model 101 flat nailer is used instead of hand nailing when starting next to a wall. After the first few boards have been nailed, continue with your Model 45. Follow this same procedure at finish of the flooring job.
Use SMI mallet

"Secret and face nail power nailing tools"

PROMOTIONS

Promotion is conducted at all levels of activity in the flooring industry from manufacturers to Associations. Two major promotion programmes that have broad appeal across all species and generic appeal to construction and specification markets are as follows:-

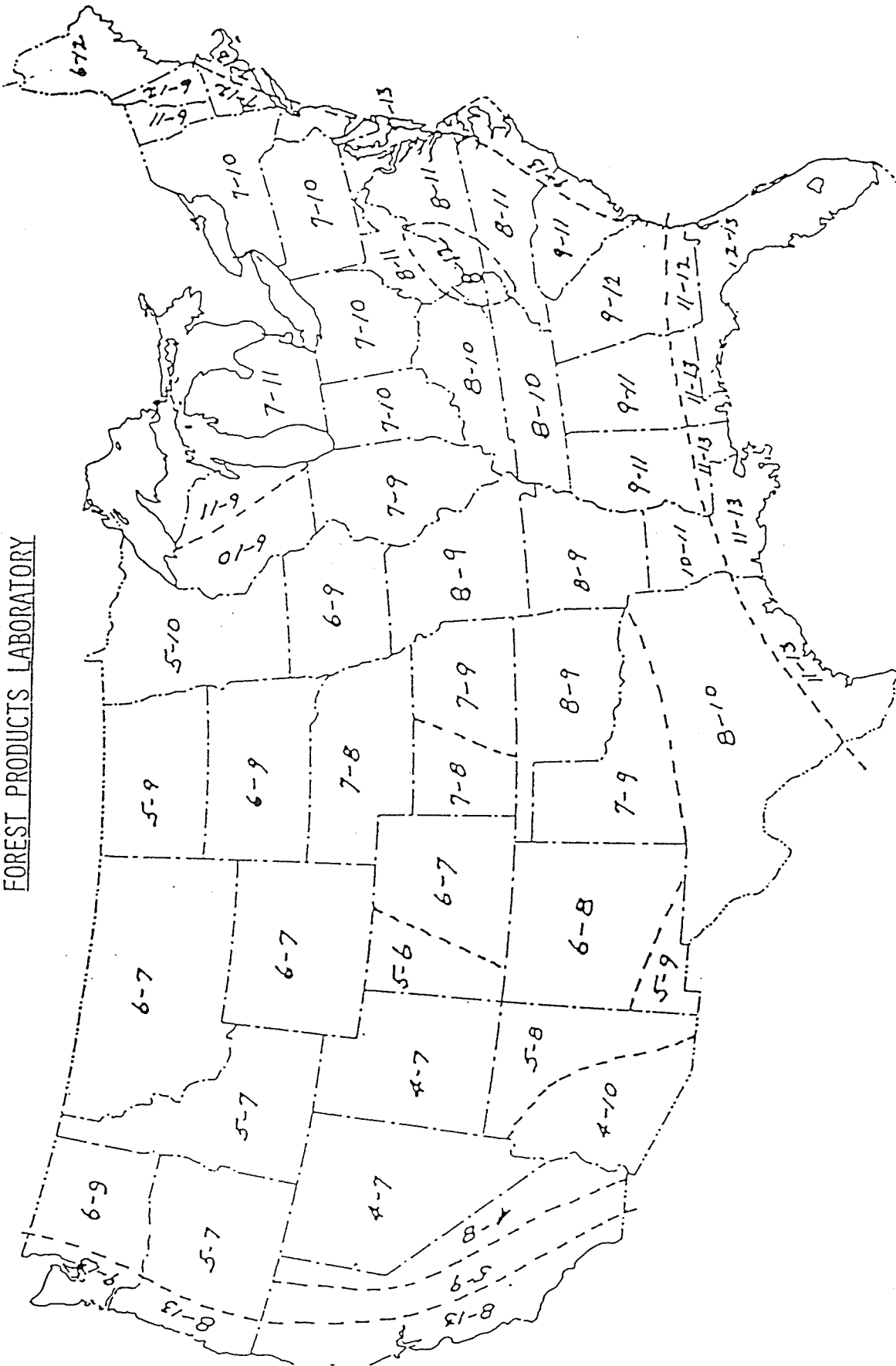
Builder Showcase Programme

Suppliers discount flooring products to local builders constructing display homes. These homes featured flooring showcases within the home to thousands of potential homebuyers.

Floor of the Year Contest

Established in 1990 this programme is focused on specifiers and installers promoting domestic and commercial projects. Winning projects are profiled in flooring and architectural magazines.

FROM THE
US DEPARTMENT OF AGRICULTURE
FOREST PRODUCTS LABORATORY



Variation of average moisture content. In each pair of figures, the first is average moisture content during January and the second is average moisture content during July for wood used in floors.

U.S. FURNITURE INDUSTRY

INTRODUCTION

The U.S. Wooden Furniture Industry is a very large and active manufacturing industry. According to the U.S. Department of Commerce there were 2630 furniture manufacturers in 1992. The number has been remained relatively stable for 15 years. Of these, large establishments of 250 plus workers accounted for 60% of employees. Of all establishments, plants with 10 or less employees accounted for 34%.

LOCATION

Being a labour intensive industry characterised by high transport and material costs manufacturers have tended to set up in regions close to the resource and also with relatively good access to transport facilities (both road and rail). The principle hardwood growing regions are east of the Mississippi river and the states of Virginia and North Carolina with access to an inexpensive and plentiful labour supply is the hub of hardwood furniture manufacture in the USA. Pennsylvania is the major supplier of hardwood but has lost furniture manufacturing jobs to cheaper labour states.

Of the total wooden domestic furniture produced in the U.S.A. in 1982, North Carolina produced 30% and Virginia 14%.

RETAILING AND SALES

Speciality furniture stores are the major outlets for furniture in the U.S. with approximately 62% of sales. Department stores with mainly name brand furniture account for 31%. It is estimated that the furniture retail sales in 1988 was worth 29.4 Billion U.S. Dollars.

The top 10 U.S. Furniture retailers by sales in 1989 and 1996 are ranked in the tables below.

Top 10 U.S. Furniture Retailers - 1989

Rank	Company	Homebase	Sales (\$ millions)
1	Levitz	Baca Raton, Florida	921.0
2	Seaman Furniture	Uniondale, New York	268.1
3	Pier 1 Imports	Fort Worth Texas	257.3
4	Rhodes	Atlanta, Georgia	228.0
5	Haverty's	Atlanta, Georgia	228.0
6	Wickes Furniture	Wheeling, Illinois	216.0
7	Heilig-Meyers	Richmond, Virginia	195.6
8	Value City	Columbus, Ohio	185.0
9	W.S. Babcock	Mulberry, Florida	182.8
10	Art Van	Warren, Michigan	180.0

Note: Ranked sales of furniture, bedding and decorative accessories only

Source: Furniture/Today May 8, 1989 p.38

Levitz the top retailer in 1989 is a quality furniture discounter with sales of almost \$US 1 Billion. The top 10 accounted for 11.3% of all furniture sales and were worth \$3.3. U.S. Billion.

Top 10 U.S. Furniture Retailers - 1996

Rank	Company	Homebase	Sales (\$ millions)
1	Levitz	Baca Raton, Florida	1,008.4
2	Heilig-Meyers	Richmond, Virginia	844.2
3	Pier 1 Imports	Fort Worth Texas	459.2
4	Rhodes	Atlanta, Georgia	430.2
5	Value City	Columbus, Ohio	415.0
6	Art Van	Warren, Michigan	396.0
7	Haverty's	Atlanta, Georgia	395.5
8	Ikea	Plymouth Meeting, Pa.	388.5
9	The Bombay Company	Forth Worth, Texas	309.4
10	Rooms To Go	Seffner, Florida	182.8

Source: Furniture/Today May 1996 p.34

Levitz were still the top retailer in 1996. A publicly held company with a chain of 70 warehouse showrooms and 65 satellite stores in 26 states. Average floor selling space of 48,700 ft².

MATERIALS TRENDS

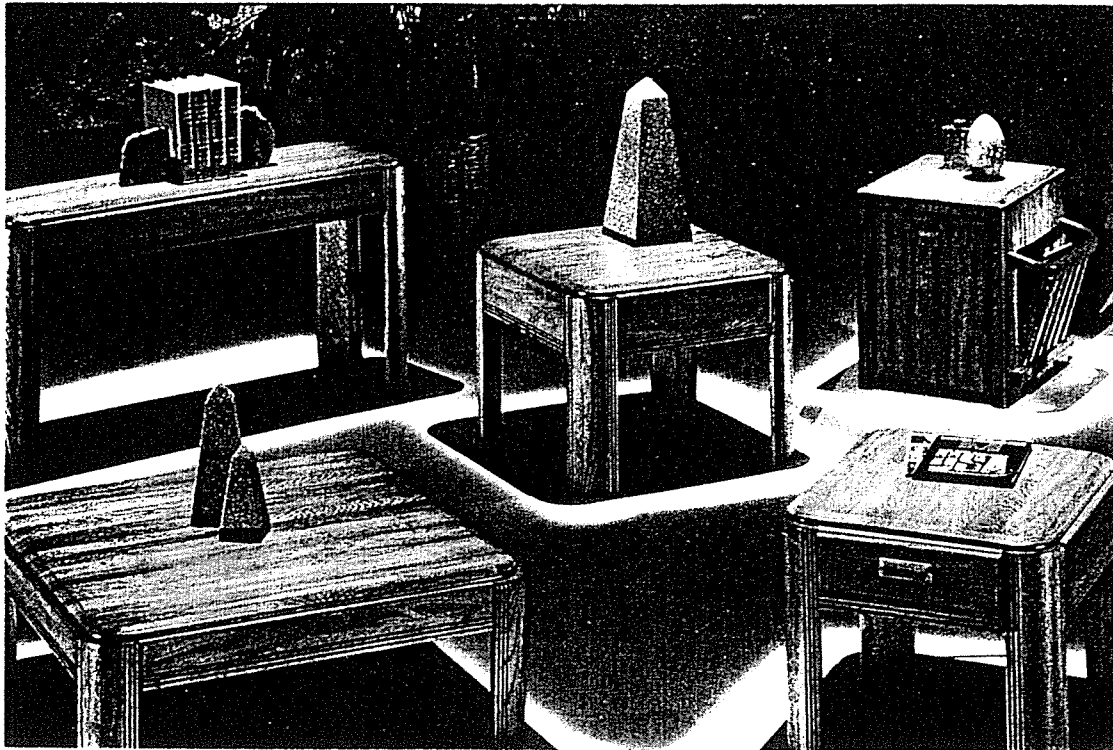
Traditionally the major raw material used in furniture manufacturing is high grade hardwood such as American Oak and hardwood veneer. This material is generally a 'select' grade. In addition softwoods and composite materials such as particleboard plywood and customwood have made significant inroads and substituted for 'solid' timber over the past 30 years. This is a worldwide trend however there are many specialists manufacturing from solid timber to meet the high demand.

FURNITURE MARKETS

America is the land of choice. An enormous range and variety to suit every taste and style is manufactured and consumed in the USA. Major timber furniture categories are no surprise and include:

- Living
- Family
- Dining
- Bedroom
- other categories

These top categories account for 71% of all sales. One significant change over the past 10 years has been the introduction of ready to assemble (RTA) furniture. Panel products high production, add on mouldings and low profit margin have found RTA a niche in low priced disposable furniture.



"Laminated solid wood furniture"

Shipments of Wood Household Furniture by U.S. Producers by Major Project Group

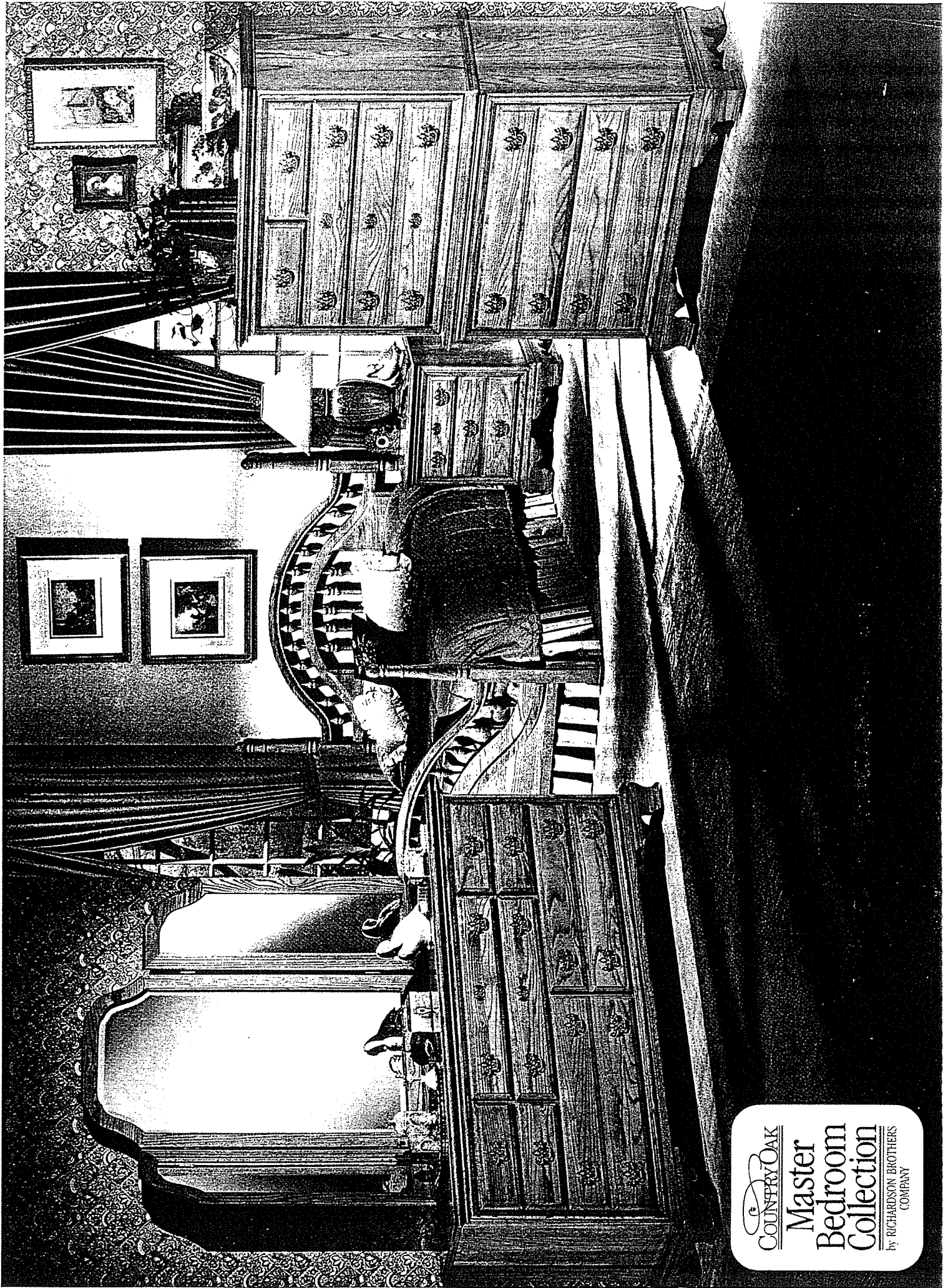
Wood Household Furniture	Product Shipments — \$ Millions		
	1992	1987	1982
Living room/family room furniture	1,620.8	1,499.7	1,221.7
Cabinets	182.1	148.9	129.2
Rockers	70.3	25.2	37.1
Tables	499.2	545.4	499.5
Desks	132.9	140.7	137.7
Credenzas, bookcases, etc	86.7	71.8	71.7
Wall units (desk & storage type)	266.6	258.6	123.5
Other seating	54.5	69.8	*
Other wood living room	263.9	175.5	160.3
Dining room & Kitchen furniture	1,587.6	1,477.4	1,014.7
Tables, 30 x 40 inches or greater	379.8	355.7	250.7
Chairs, dining room	581.6	546.4	378.8
Buffets & servers	142.9	147.3	107.8
China & corner cabinets	309.4	258.7	156.4
Other dining & kitchen seating	19.8	19.7	*
Other dining room	164.1	149.6	126.1
Bedroom furniture	2,478.3	2,271.2	1,557.0
Conventional beds	217.7	214.8	188.1
Headboards	299.2	273.9	188.2
Bunk beds	50.6	46.2	48.7
Water beds	97.4	52.2	41.3
Dressers, vanities, dressing tables	487.2	500.1	325.8
Wardrobes	137.3	117.5	76.8
Chest of drawers	391.3	422.9	257.6
Cedar chests	29.2	37.8	34.9
Night tables & stands	250.3	224.7	161.2
Other bedroom furniture	518.2	381.0	234.6
Infants & children furniture	316.2	272.7	158.8
Outdoor, unpainted & RTA furniture	1,082.2	810.1	249.9
Porch & lawn furniture	57.1	41.2	109.9
Unpainted furniture	74.8	61.1	88.4
Ready to assemble (RTA) furniture	922.6	670.1	49.2
Other	27.8	37.8	12.5
Other wood household furniture	891.2	1,123.0	685.4
TOTAL	7,976.4	7,454.2	4,887.4

Source U.S. Department of Commerce Bureau of the census "1992 Census of Manufacturers, Industry Series for Household Furniture" and "1992 Census of Manufacturers, Industry Series for Household Furniture".

NOTES:

* 1987 and 1992 values are based on the harmonized system of product classification therefore some product categories in 1982 which did not directly translate into the harmonized system were included within "other" categories

May not add to total due to rounding errors.



COUNTRY OAK
Master
Bedroom
Collection
by RICHARDSON BROTHERS
COMPANY

IMPORTS

One of the most surprising aspects of the furniture products industry is the amount of furniture imports. Almost 30% of the wood household furniture consumed in the U.S. is imported and often sold under the name of a U.S. manufacturer. This situation is not new with imports selling around 25-30% since 1985.

Where does it come from?

As the following table indicates the majority by far is imported from Asia which has taken market share from Europe (down 9%). The leading Asian country is Taiwan with 26% of the market share.

**U.S. Wood Household Furniture Imports by Region and Leading Importers
1989-1992 (millions US \$)**

REGION/Country	1989	1990	1991	1992	1993	1994	1995
ASIA	1320.7	1213.4	1271.6	1412.0	1751.7	1993.4	2076.3
China	92.4	100.3	131.4	180.0	278.8	426.5	551.2
Indonesia	42.7	69.5	88.3	107.0	166.7	210.2	250.5
S. Korea	42.8	41.4	23.4	11.9	10.0	11.0	10.7
Malaysia	29.1	40.0	61.6	107.8	203.0	319.1	332.4
Philippines	148.5	129.5	105.9	101.1	109.5	122.1	130.4
Singapore	56.8	48.5	42.3	38.3	44.8	41.4	38.8
Taiwan	759.4	642.9	681.7	698.8	716.2	637.3	548.4
Thailand	82.2	86.5	95.7	130.4	181.3	176.1	165.1
EUROPE	1001.6	1034.7	833.2	780.4	755.1	941.1	1041.1
Denmark	129.2	136.1	97.8	106.5	99.6	120.7	116.4
Germany	82.3	89.0	67.0	45.7	43.3	48.8	58.5
Italy	423.3	447.5	382.7	368.3	372.7	500.3	571.4
United Kingdom	55.4	58.0	53.1	53.3	55.4	67.0	73.1
Yugoslavia	140.2	128.4	93.4	85.2	--	--	--
N. AMERICA	497.6	529.9	530.4	595.9	764.8	975.8	1154.4
Canada	361.2	355.6	344.2	412.9	561.4	748.7	898.0
Mexico	136.4	174.3	186.2	185.0	203.4	227.1	256.4
S. AMERICA	74.2	70.4	70.6	84.4	98.0	120.6	153.1
Brazil	30.3	28.3	24.7	34.4	38.1	56.3	77.0
Chile	6.9	9.1	15.5	16.0	20.2	23.2	27.7
WORLD	2895.9	2854.1	2712.6	2884.3	3381.0	4050.3	4441.8

¹ Estimate for 1995

Source: U.S. Commerce Department, Bureau of Census

STYLES AND TRENDS

Oak and Cherry are the most popular furniture timber and are used in almost every imaginable application. Oak tends to be aimed at mid range price points and Cherry is seen more often in higher priced furniture.

All styles are popular with no noticeable dominance. The country look has been around for many decades and is a strong influence on the market still.

FUTURE MARKET TRENDS

Home entertainment and Home office products, while still a small part of the market are showing strong growth (10% p.a). Consumer electronics, computer videos large screen home theatre TV's have created a new market niche with excellent growth potential as more and more businesses can be run from home. Another interesting reason raised by a manufacturer was that parents wanted their children to entertain from home avoiding the growing rate of street crime all over the USA.

CHARACTER MARKED FURNITURE

A recent addition to the furniture market is product containing natural features similar to that currently being developed in Victoria. Wood containing knots, borer holes etc, is now a feature of the furniture. Sawmillers see this market as an opportunity to increase the yield at the sawmill by 5-10%. The aim in Victoria is much more aggressive to value add to all the logs, increasing the value to the community and create a unique furniture product in international markets.

The natural trend is expected to grow with other minor species being introduced and is suited to both large and smaller volume furniture manufactures. Consumers are responding well to this emerging trend and find the furniture both aesthetically and environmentally satisfying.

MATERIAL USAGE IN FURNITURE

According to the Centre for Forest Products Marketing of Virginia Tech a mass survey was conducted in 1991 'Wood and wood based material use in the wood furniture Industry' by Forbes PUNCHES Sinclair and Cuppold. The survey reports wood and wood based material purchase for 1990, 2183 firms were surveyed to measure the use of wood in household office and upholstered furniture markets.

The tabulated outcomes are listed below:

1990 Material Use by Furniture Industry Category

Materials	Wood Household	Upholstered	Wood Office	Total
Hardwood Lumber (MMBF) ¹	1,196	1,108	121	2,425 ± 2%
Softwood Lumber (MMBF)	744	64	31	839 ± 4%
Particleboard(MMSF) ²	1,129	50	80	1,259 ± 8%
MDF(MMSF)	212	19	17	248 ± 3%
Hardboard(MMSF)	74	10	41	125 ± 8%
OSB/Softwood Plywood (MMSF)	69	245	4	318 ± 5%

¹ All measurements are in million board feet.

² Measure is million square feet.

The volume of hardwood wood purchased in 1990 was estimated to exceed 2.4 billion board feet and 839 million board feet of softwood (approx. 1/3 of hardwood). Particleboard was the dominant sheet product by far with 1.2 million square feet.

The same survey estimated that hardwood usage would increase in household furniture markets by a projected 11% p.a. - a significant amount given the large base figure from 1991 to 1992.

HARDWOOD SPECIES USED IN FURNITURE

Red Oak dominates in the furniture industry and represents 30% of the hardwood used in furniture in 1990. White Oak follows at 16% with 2% increases expected in each specie by 1992.

Market Share of Various Species of Hardwood Timber for 1990 and 1992 in Furniture Manufacture

Species	1990% of Total	1992 of Total
Red Oak	30%	32%
White Oak	16%	18%
Yellow Poplar	11%	10%
Soft Maple	9%	7%
Black Cherry	7%	7%
Hard Maple	6%	5%
Ash	3%	3%
Beech	3%	3%
Sap Gum	2%	2%
Mahogany	2%	2%
Hickory/Pecan	2%	2%
Yellow Birch	1%	2%
Alder	1%	2%
Elm	<1%	1%
Black Walnut	<1%	<1%
Hackberry	<1%	<1%
Other	4%	4%

Solid Oak furniture incorporating 'dimensioned' product. Oak is aimed at mid range price points.

OAK

Lexington®

Lexington Furniture Industries

DISTRIBUTION SYSTEMS

CONCENTRATION YARDS

Concentration yards for the distribution of timber in the U.S. are quite common. They act in a similar capacity to a wholesale distribution network for producers and timber merchants that is seen in Australia. However there the similarities finish. U.S. distribution or concentration yards often play an important role in value adding by further processing and upgrading timber.

The evolution of concentration yards is associated with the population, migration in the U.S.A. Distribution yards are strategically located along major transport routes or hubs. Timber products can be shipped to all parts of the U.S. continent and to international shipping points more efficiently by such yards than by smaller individual producers.

The major advantages perceived by purchasers of timber through concentration yards are service and quality. The size and set up of concentration yards varies considerably but they have a common attitude - that is to further prepare timber to particular market specifications both domestically and internationally. An obvious wide range of specifications can be met more readily through this system than for a small sawmill trying to service a number of diverse markets for reasons of geographical location, marketable volumes, grade quality and species. Additionally sawn blanks can be processed to suit a particular order e.g. flooring.

CASE STUDY

The American Lumber Company has four concentration yards located in different regions in the eastern half of the U.S.A. The concentration yard I visited was located just outside Memphis, Tennessee.

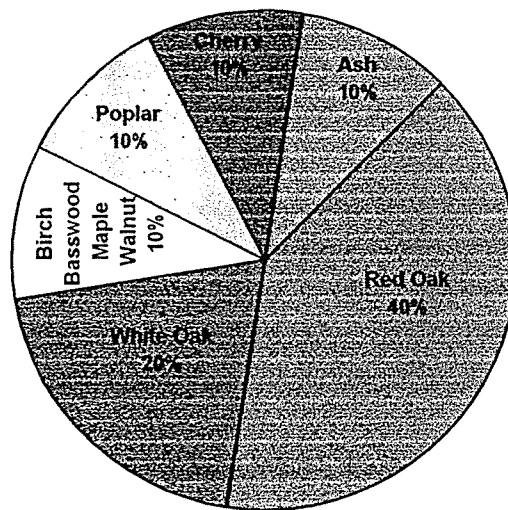
Each location has value adding facilities which include:

- Pre-driers
- Kilns
- Straightline ripaws
- Moulders
- Planers
- Grading expertise

Specialising in U.S. hardwoods they market 60 million board feet annually (141,600m³). Domestic distribution accounts for approximately 50% (30 mbf) and the remainder is destined for export markets.

The species range is a good representation of commercially available timbers which are readily available and able to be regularly sourced from most eastern states sawmills.

SPECIES MIX THROUGH CONCENTRATION YARD



Purchase

Timber is predominantly sourced green from regional hardwood sawmills in standard sizes as set down by the National Hardwood Lumber Association (NHLA). This ensures that all mills can provide a standard range of grades. This is important as upon receipt of the material it is immediately thoroughly inspected for grade. Any below grade stock is then tallied and the sawmill notified so that price can be adjusted and the sawmill can then take the appropriate steps to eliminate the problem. This load by load analysis soon establishes which sawmills are consistent in quality and means the customer gets the quality they deserve.

All acceptable green timber is then end grain sealed (with a wax) to minimise end checking or splits and racked on sticks at 300mm centres by species and thickness. The most common thickness for these non-structural grades of hardwood are:

4/4	(1")	25 mm
5/4	(1 1/4")	32 mm
6/4	(1 1/2")	38 mm
8/4	(2")	50 mm

DRYING

These are two elements to the drying process in this concentration yard, pre-drying and airdrying. Material 1.1/2" and thicker requires greater care in drying to reduce the degree of checking as a high proportion of material is back sawn (rift).

This thicker material is put straight into large pre-driers. Pre-driers have been commonplace in America since the 1980's as a measure to largely reduce the incidence of surface checking. There would be very few American export companies air drying their timber.

The American Lumber Company has pre-drier capacity of approximately 3.5 million board feet across the four yards. This average range of a pre-drier is from (small) 1000 m³ to 3000 m³ (large). By controlling initial moisture loss in pre-driers through automatic monitoring and control of temperature and air circulation, timber is less likely to degrade before going directly into a kiln where humidity can be closely controlled.

Thinner 1" material is air dried often in open sided sheds where direct contact with the elements is minimised. The quicker drying stock by-passes the pre-drier and goes directly into the kiln.

Re-grading

Following kiln drying processes the material is unstacked and regraded by a staff of 25 (NHLA) qualified grade inspectors. Material is docked and up graded as appropriate to market specification. Quality audits are also undertaken with detailed records kept of various processes.

Re-processing

Re-graded kiln dried product can be value added through a number of machine processes for particular market requirements such as mouldings or bundles of specific sizes by grade and species.

Distribution

The final link in the chain is getting the goods to the customer. The rail system in America is extensive. Often goods are containerised which allows a flexible range of transport modes without damage to the timber which can incorporate, road, rail and sea travel. To get goods to the West Coast for example may require multiple changes in mode and when packaged this way gives:

- Security - no pilferage
- Little or no damage by fork lifts etc.
- Stable environment - doesn't get wet etc.

Some concentration yards have also diversified into importing, value adding through drying and processing species from other countries and acting as a distribution centre for manufacturers (furniture joinery etc) within the U.S.A.

AUSTRALIA

What can Australia learn from this? We already have an extensive network of merchants who specialise in marketing timber products. However there appears to be a limit to the Australian model in that few distribution networks are actively upgrading and value adding hardwoods in particular.

There are many small family run sawmills in Victoria who, to remain viable in the medium to long term, must invest in value adding to the resource available to them.

To do so is an extremely costly exercise, the mill may often be located in a region that has geographic disadvantage. Sawmills are often a long way from market and transport is limited in Victoria for example green mixed species hardwood sawmillers often have small volumes of up to 12 species and a vast range of wood quality.

It is difficult to develop high value niche markets for small volume speciality species due to the cyclical nature of availability and the lack of equipment, finance and marketing skills.

Perhaps a solution to this is to develop a joint initiative by sawmillers. A central processing facility regionally based would take green, graded boards for further processing. Re-grading, drying and processing products similarly to USA concentration yards will allow niche markets to evolve in species and grades that individually sawmillers cannot process and market in the volumes required. This central processing facility may have an extensive range of advantages. A listing of thought starters is provided below:

- Collation of marketable volumes
- Quality audit and control measures
- Shared costs of value adding facilities:
 - kilns
 - pre-driers
 - machinery and plant equipment
 - laminating equipment
 - marketing
- Reduced overheads
- One point of contact
- Consistent grading
- Services
- Improved and cost effective distribution to major markets

- Standardised sizes of timber in value added kiln dried appearance markets
- Conformance to grade
- Introduction of market specific grades e.g. a natural feature grade, paint grade, staining grade and develop the flexibility to grade for specific international market requirements
- Diversifies the mills market
- Uniform packaging
- Better customer servicing
- Opportunity to develop specialty niche markets through increased volumes of specialty species and their properties e.g.
 - Durability
 - Appearance
 - Strength
 - Hardness
- Allow cheaper diversification into appearance markets from traditional structural markets
- Regional employment opportunities

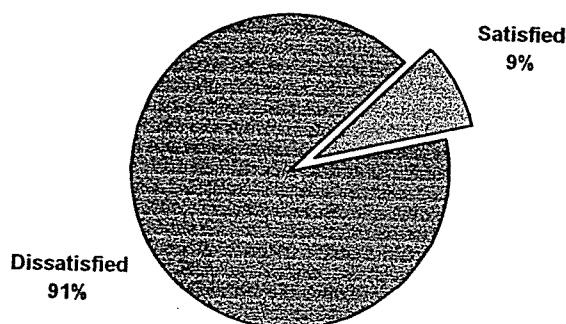
GRADING

QUALITY ISSUES - MARKET NEEDS

The following is extracted from a survey conducted in 1990⁽¹⁾ that sought to identify the amount of dissatisfaction amongst timber buyers relating to quality issues when purchasing U.S. hardwoods. Timber purchasers interviewed represented 5 key market segments:

- Furniture
- Cabinet
- Flooring
- Mouldings
- Dimension industry

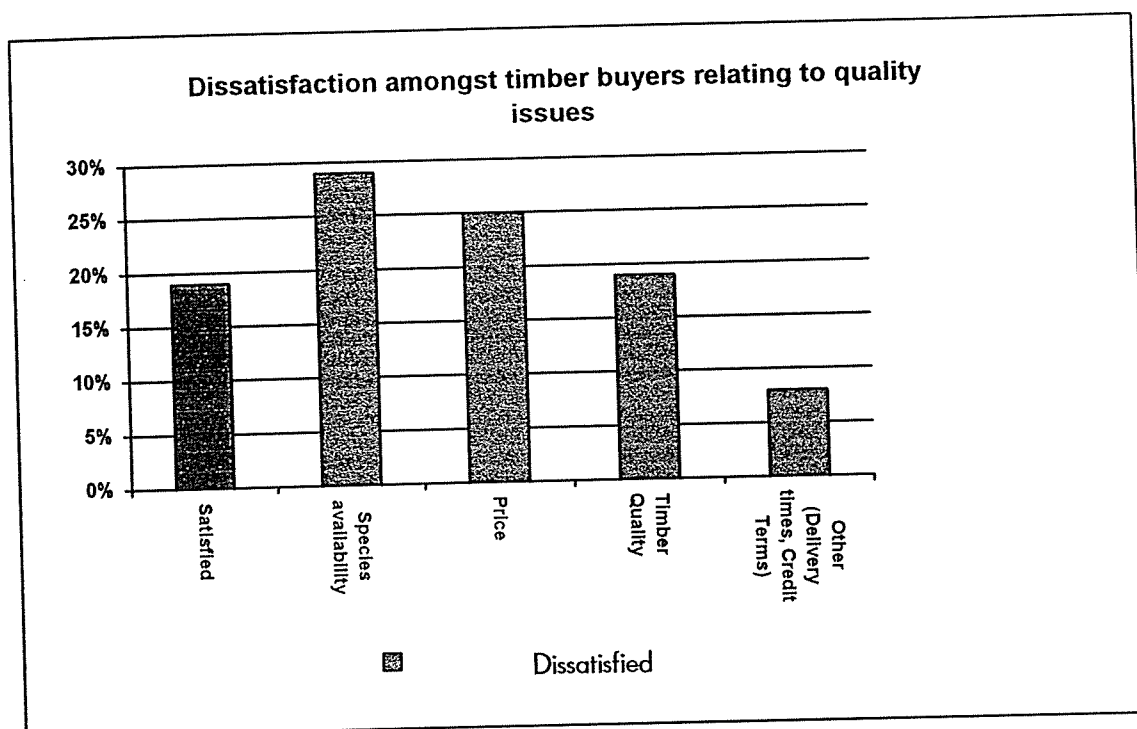
The surprising aspect of this survey was that 91% were dissatisfied when purchasing hardwood timber. The major reason for that dissatisfaction was timber quality - 61%. Other reasons are also indicated in the following pie chart.



As a result of this survey an additional survey was undertaken by Bush, Sinclair and Araman to determine the reasons for this dissatisfaction with timber quality. Timber buyers were asked to rate the importance of characteristics which directly affected timber quality.

Accurate grading was found to be the most important characteristic closely followed by thickness consistency, absence of surface checking, timber straightness along with consistent and accurate moisture content.

(1) Matching your hardwood lumber to market needs - R Bush, A Sinclair, P Araman. Virginia Polytechnic.



Two key recommendations for hardwood timber producers were:

1. Commit your company to producing quality timber - as this is what the market is demanding. One of the best ways was to ensure the sawmillers product is graded accurately and consistently.
2. Have a long term commitment aimed at developing a reputation for quality and service.

To gauge whether hardwood producers understood the buyer dissatisfaction a further survey was undertaken with executives of top 100 lumber producers in the USA. They were asked the main reasons why they felt lumber buyers were dissatisfied. The results above in Table 2 were quite different. 19% indicated that their customers were satisfied. The remaining 81% is rated in the table above shows an almost opposite point of view of customer dissatisfaction. The results do indicate that the timber producers may have underestimated the importance of quality to their customers and overestimated the importance of price. One might argue that this is a typical attitude amongst production rather than market oriented producers - a charge often leveled at Australian sawmillers.

NATIONAL HARDWOOD LUMBER ASSOCIATION

HISTORY

N.H.L.A is a non-profit organisation with 1200 members in USA and Canada, founded in 1898. It's membership base is firms who produce, sell and consume hardwood timber.

TIMBER GRADING SERVICE

Prior to W.W. II, all grading inspectors throughout the U.S. were directly employed by N.H.L.A. That has changed extensively with the bulk of work now being undertaken by individual company inspectors. The NHLA currently has 11 (eleven) inspectors in the U.S. which has reduced from 10 years ago when there were 25 inspectors. These national inspectors, as well as inspecting at point of origin, conduct training workshops. All grading is now conducted by company inspectors and the national inspectors continually review the grading rules and sharpen company inspectors' grading skills.

TIMBER INSPECTION SERVICE

The N.H.L.A. Timber Inspection Service also provides an "impartial expert service" in the case of disputes. These qualified hardwood Inspectors are stationed throughout the United States and Canada. As well as providing impartial expert service they can also be called in by agreement between buyer and seller to either ship the timber initially to prevent claims or inspect timber at its final destination if the purchaser feels that the shipment does not meet specifications. The National Inspector will measure and grade parcels and issue a certificate guaranteeing the quantity and quality. The NHLA then assumes the financial responsibility for the footage and grade as certified. The Association does not take title to or assume a financial interest in the timber, but if there is any further claim regarding footage or grade, the claim is defended by the Association through a specific re-inspection procedure.

If the purchaser wants to claim against the Association, he request a re-inspection (which is undertaken by the Association's Chief Inspector). At first this process appears to put the Chief Inspector in a difficult position whereby he is judging one of his own. It was indicated to me that the system functions well because the NHLA certificate is highly regarded by industry and that the system of original and re-inspection is practical and universally accepted.

These services are essential and are conducted on a fee for service basis that industry believes is effective in ensuring that grade and quality issues are consistent and to a high level that meet customer expectations.

INSPECTION SCHOOL

Extensive Course

N.H.L.A. runs a unique hardwood grading school with an annual intake of 200 students, attending the course which runs for 14 weeks. Classes have an emphasis on the practical application of the rules, with students attending from every state and often from other countries. This course is recognised as being invaluable for those seeking a career within the industry.

Short Course

N.H.L.A. also offer an additional short course (1 week or 3 days) which is geared to familiarize industry personnel with grading. This course is ideal for new industry personnel and sales people.

These short courses are flexible and mobile and may be held anywhere in the country, which are often "sponsored" by NHLA members or Forestry Schools. The sponsor provides a class room and facilities and co-ordinates enrolments.

Continuing Education

A variety of seminars and training programmes on industry related subjects are conducted at their Memphis headquarters. High calibre speakers from industry and research organisations ensure full enrolments.

Students come from all over USA and Canada, encouraging contacts and communications with others in the industry. These continuing education programmes are often conducted with the co-operation of a major university.

EXPORT DEVELOPMENT

With the increased focus on export of U.S. hardwoods, there has been an increased interest in the grading system used by international companies.

The NHLA, a member of the Hardwood Export Council (HEC) has translated the grade rules thus making American hardwoods easier to specify. In addition to the translated material, an export directory for free distribution internationally and an export newsletter for exporting members is also produced. They are currently available in the following languages:

- French
- Spanish
- German
- Chinese
- Japanese

HARDWOOD RESEARCH COUNCIL

The HRC works closely with government and education facilities to secure funding for research and technology development. More efficient use of research funds by better problem identification, project planning and co-ordination provides a strong, balanced and well supported series of programmes looking at hardwood management, marketing and product manufacture.

HARDWOOD GRADING

Hardwood grading is a very important aspect of pricing and quality, and a full explanation of the grades is imperative to fully understand the relatively easy system that is used.

Hardwood is generally graded on the basis of size and number of cuttings (pieces), which can be obtained from a board when it is cut and used in the manufacture of a product such as furniture and flooring. All boards are graded to one face only, however grading to all faces and edges can also be specified.

Grading is based on clear wood, the higher the grade, the larger the area of clear wood in each board. This allows for lower grade boards to yield a higher proportion of clear wood if it is economic to cut it.

The standard grades of hardwood are:

- Firsts
- Seconds
- Selects
- No. 1 Common
- No. 2 A Common
- No. 2 B Common
- No. 3 A Common
- No. 3 B Common

Timber Conversion Table

	STANDARD THICKNESS FOR ROUGH SAWN					
Imperial inches	1	2	3	4	5	6
Metric mm	25	50	75	100	125	150
1/4" Increments	4/4	8/4	12/4	16/4	20/4	24/4

Dressing removes 3/16 (3.5mm)
 Surfaced two sided (S2S)

For explanation and illustration of clear grade percentage requirements for each timber grade, please refer to illustrated NHLA grade rules that follow this section.

PROMOTIONAL ACTIVITIES

The NHLA under the guise of the Hardwood Institute conducts a consumer awareness and public relations programme outsourced through an advertising agency.

Promotion includes television commercials, an ideas booklet and architecture students.

AMERICAN HARDWOOD EXPORT COUNCIL

BACKGROUND

Traditionally the U.S. forest products industry has not considered the international market to be an outlet for its products. It is only since the early 1980's that companies began to seriously consider exports as a long term market for wood products. While export value have doubled since the mid 1980's, wood products still represent a minor portion of U.S. annual wood production.

Total 1989 wood product exports were US\$6 billion, by the year 2000 it is projected to be 50% greater US\$9.0 billion. Ongoing environmental concerns about dwindling tropical hardwood forests, coupled with export bans/restrictions on logs and rough sawn timber from tropical hardwood exporting countries, will increase demand for both U.S. hardwoods and softwoods. The Philippines, Indonesia, New Guinea, Malaysia & Thailand are very recent examples of countries that have either banned or curtailed exports and or commercial logging.

AMERICAN HARDWOOD EXPORT COUNCIL

Based in Washington D.C. the AHEC is an international trade association for the U.S. hardwood industry representing U.S. hardwood export companies and all 13 U.S. hardwood product trade associations.

Hardwood export products represented include:

- lumber
- veneer
- plywood
- flooring
- mouldings
- dimension materials

AHEC provides the international hardwood trade - importers, specifiers, users - with promotional assistance, technical information and sources of supply for U.S. hardwoods. The AHEC is very active internationally and maintains overseas offices in:

- Japan
- Europe
- South East Asia
- Korea
- Taiwan
- Mexico

Each regional office provides a confidential market report to members covering exchange rates, market summary, review of alternative supplies in the region, statistics and current AHEC activities.

PROGRAMS & SERVICES

1. Technical information on U.S. hardwoods

AHEC provides technical information about U.S. hardwood species and products in the following areas:

- application
- variety
- availability
- characteristics
- grading
- speciality species
- alternative grades

This data is provided through written material, audio-visual presentations and seminars, which are translated into a number of languages to suit target markets.

2. Promotion

AHEC promotes American hardwoods to the overseas trade and the consumers, generally through participating in major international trade fairs and exhibitions in Asia, Europe and Mexico.

Literature to support export programmes include:

(a) The Designers Guide to Temperate Hardwoods

- This folder contains veneer samples of the eight most common U.S. hardwood species. A booklet on decorative and practical applications is also included.
- A booklet specification guide covers all technical details, working properties, environmental facts and growing regions.
- Individual data sheets on each species listing general characteristics, distribution, a comparison of properties with other timber substitutes.

(b) "A Guide to Wood Design Info"

A bibliography of technical wood design information available from Wood Products Association and other co-operating organisations.

Its purpose is to facilitate the search and selection of pertinent wood design literature and act as a reference source.

(c) "Hardwood Expressions"

An international edition to the original H.M.A. publication. Aimed at Designers, Architects and Editors with striking photographs of a variety of solid U.S. hardwood in many applications. Each issue explores the personality and character of a particular species and environmental issues are reinforced.

3. Trade Delegations

Co-operates and organises trade delegations with the assistance of particular downstream industries such as furniture manufacturers or flooring companies.

4. Membership Directory

This comprehensive directory supplies detailed contacts in the United States for the full range of hardwood species and products available throughout America. Categories of information provided include: annual export sales in dollars, company i.e. Manufacturers, distribution yards, wholesaler and production capacity by species and contact name at each organisation. 17 of the 73 producers listed have annual export sales of over \$10 million.

5. Seven Country and Regional Offices

- Europe - London
- Japan - Tokyo & Osaka
- South East Asia - Hong Kong
- Mexico - Mexico City
- Korea - Seoul
- Taiwan - Taipei

6. Foreign Agriculture Service (FAS)

The F.A.S. a division of the Department of Agriculture and the hardwood industry jointly assist these programmes.

The F.A.S. provides an excellent handbook called "A Guide To Exporting Solid Wood Products" which provides a guide for U.S. wood product producers to develop a successful export marketing strategy. It covers how to obtain accurate and up to date export market information so that the production, scheduling and shipping of U.S. wood products can be done profitably.

Table 1 — Major activities associated with exporting

STEP I	STEP II	STEP III	STEP IV
Management Commitment	Analyze objectives, strengths, and weaknesses 1. Short- and long-term goals 2. Personnel 3. Resources 4. Production 5. Financing 6. Knowledge of export marketing	Develop contacts and collect current market information in the United States 1. U.S. Government and State agencies 2. Banks with international departments 3. Freight forwarders 4. Marine insurance agents 5. U.S. port authorities	Conduct market analysis 1. U.S. export statistics 2. Foreign import statistics 3. Current market developments and trends 4. Import barriers 5. Other factors (political, economic, geographic, and cultural)
STEP V	STEP VI	STEP VII	
Country/market selection 1. Demand potential/trends 2. Product identification 3. Standards and specifications and trends 4. Language requirements 5. Distribution channels 6. Business practices 7. Tariff and nontariff barriers 8. Licensing/phytosanitary requirements 9. Legal considerations 10. Shipping costs	Develop marketing approach targeted to one or two countries 1. Organization of the firm 2. Determine production 3. Contact foreign importers 4. Schedule marketing/sales trip to the country or market	Trade servicing 1. Product development/modification in response to changes in demand 2. Attention to importer's needs/ commitment to the market 3. Periodic visits to the market to maintain good customer relations and develop new contacts 4. Refine marketing approach	

Source: U.S. Department Agriculture - "A guide to exporting solid wood products"

7. **Marketing Programmes**

Areas covered include Market Development programmes, American Marketing and Manufacturing Systems and Market Intelligence.

MAJOR MARKETS

⁽¹⁾The market summaries give a brief overview of the top export markets, examining marketing channels, practices, major end uses for specific products, and recent developments in each market.

Export markets for "speciality products", including items such as barrel staves and pencil slats, are extensive and varied. The best opportunities for foreign sales of these products may be in non traditional U.S. solid wood markets. For example, in 1988 the largest export market for pencil slats was West Germany. However, Mexico was No. 2, and combined exports to Venezuela and Egypt exceeded U.S. Exports of this product to West Germany.

An examination of other U.S. wood products exports provides insight into the diversity of U.S. markets overseas. In 1988, the Bahamas was the No. 1 importer of dowel rods (\$1.1 million). The top four markets for casks, both new and used, were Venezuela, India, Japan and Canada. Such items as coopers products, casks and pencil slats are the types of commodities that succeed in nontraditional markets. Successful exporters will search for the niche that will give them an edge in the marketplace.

Success in exporting is a function of the ability of the company to be flexible and responsive to changes in consumer demand and the willingness to investigate new opportunities. Most important is the commitment by the U.S. exporter to studying and servicing the foreign market to assure that export marketing becomes a vital aspect of planning and profitability for the business.

The top U.S. markets and the leading products exported on a value basis for 1988 are shown in table 4; figures 1 and 2 graphically show distribution of U.S. overseas markets and wood products exported in 1989.

1. United States Department of Agriculture "A guide to exporting solid wood products"

Table 4 — Value of U.S. exports of solid wood products by principal countries, 1989 (\$000)

Product	Japan	Canada	S. Korea	U.K.	Mex	West Germany	China	Taiwan	Italy	Spain	Belgium	Iraq	Neth.	Algeria	Denmark	Jamaica	Total	
																	Other	World
SW Logs	1,598,963	74,761	254,861	751	1,152	378	174,200	24,986	1,472	1,786	0	0	68	0	0	41	2,133,930	2,146,155
HW Logs	50,128	17,638	17,219	3,251	3,722	46,831	355	25,395	18,489	5,072	8,245	0	1,124	0	179	8	198,764	227,473
Poles, Pilcs. & Post	128	12,400	5	4	1,104	18	0	112	0	10	0	0	10	0	0	2,098	15,960	25,464
Wood Chips	353,033	1,241	11,441	71	7,414	5	0	14,504	0	0	0	0	0	0	0	0	388,024	388,154
SW Lumber	559,645	161,587	11,258	28,068	98,868	21,879	359	5,381	99,949	61,610	10,234	53,375	4,818	36,316	1,683	11,508	1,265,361	1,391,171
HW Lumber	133,414	115,555	11,988	55,678	27,022	37,107	148	58,994	37,292	28,590	42,783	0	18,055	0	2,791	488	572,413	644,593
Flooring	7,118	7,630	477	2,642	614	227	37	526	112	363	14	0	184	0	0	95	20,190	22,200
Siding	920	6,259	0	2	59	0	0	43	74	0	0	0	12	0	0	20	7,389	7,880
Molding	1,280	22,147	0	290	819	0	0	7	102	1,058	4	0	0	0	0	5	26,378	27,072
Treated Lumber	1,140	2,720	39	11	103	20	69	41	117	22	0	0	36	0	0	1,455	5,794	13,012
Railroad Ties	0	15,520	0	51	97	207	3,600	75	0	0	0	0	0	0	0	772	21,558	10,407
HW Veneer	10,770	4,737	10,435	11,211	1,821	60,611	1,020	11,704	7,462	3,433	3,434	0	473	0	931	180	128,250	157,294
SW Veneer	6,586	7,804	36	109	528	577	10	74	316	4	151	0	0	0	0	88	16,482	14,874
HW Plywood	374	28,882	171	493	6,619	623	2	166	75	122	859	0	11	0	0	1,412	39,877	24,156
SW Plywood	3,699	20,894	350	87,438	4,843	19,817	0	61	8,428	274	33,560	2,055	21,796	0	25,308	939	231,721	267,892
Hardboard	141	20,234	3,424	2,378	1,325	104	12	3,559	22	434	237	0	105	0	383	90	32,637	39,710
Particleboard	3,595	20,149	4,285	288	16,511	31	40	11,232	44	4	49	1,242	241	0	171	238	58,868	63,612
Misc Panel Products ¹	32,951	35,744	15,111	6,788	4,923	2,289	608	18,384	235	530	802	0	538	0	460	2,282	122,693	170,033
Misc Wood Products ²	77,831	88,001	12,903	33,808	46,593	17,711	1,259	5,582	4,527	4,439	2,920	106	3,743	294	1,067	10,851	317,537	389,247
Total	2,841,697	645,265	354,001	233,332	224,135	208,435	181,719	180,828	178,716	107,752	103,291	56,787	51,214	36,609	33,019	32,571	5,585,577	6,030,398

Note: Totals may not add due to rounding.

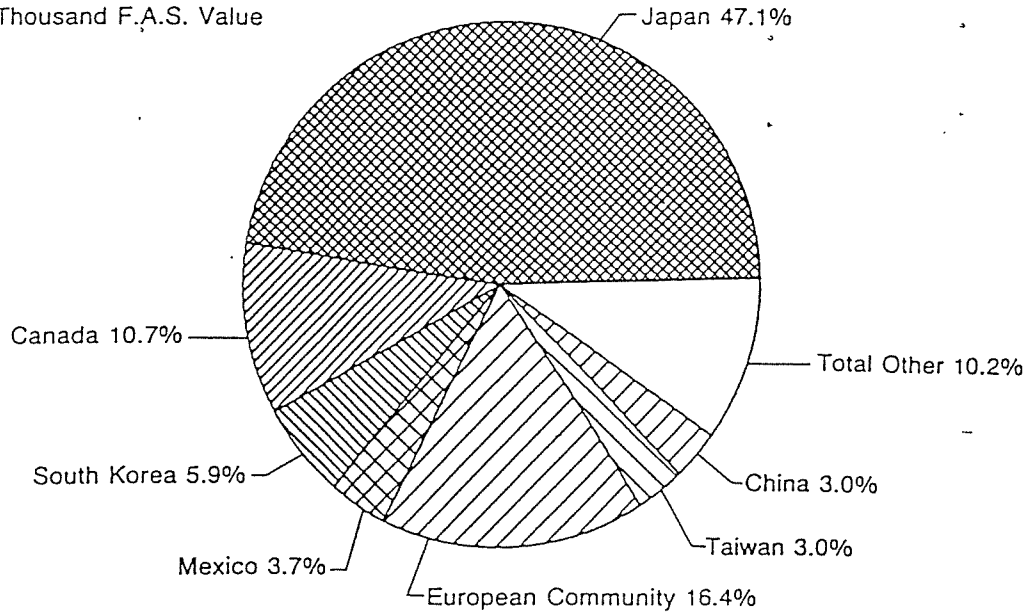
¹Includes such panel products as insulation board, and laminated boards.²Such products as wood waste, pulpwood, building components, containers, and small industrial and household woodware.

Source: Official statistics of the U.S. Department of Commerce.

U.S. Wood Export Markets

1989

\$ Thousand F.A.S. Value

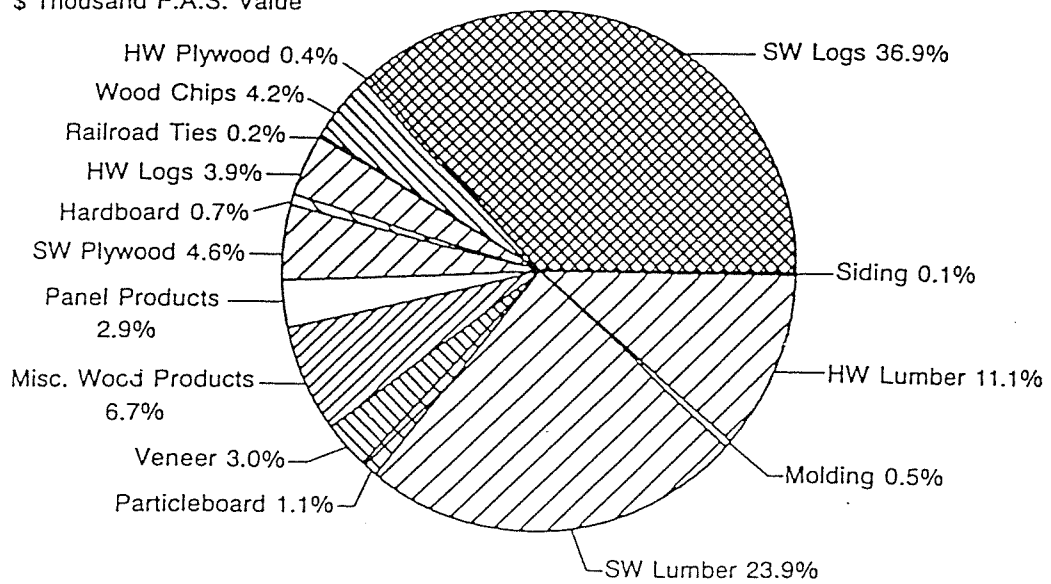


Source: U.S. Department of Commerce

Value of U.S. Wood Products by Commodity

1989

\$ Thousand F.A.S. Value



Source: U.S. Department of Commerce

AMERICAN HARDWOOD EXPORT MARKETS - EUROPE

MARKETING NATURAL FEATURE

A recent initiative by the American Hardwood Export Council (AHEC) is to encourage wider market acceptance of the natural features found in U.S. hardwoods. This message is in conjunction with another European goal of fostering a demand for a wider range of hardwoods.

Non traditional export species are now improving market share. Red Alder, Sapgum and tulipwood accounted for over a third of U.S. hardwood exports, in 1994 whereas in 1989 these accounted for 18% of U.S. hardwood exports.

The programmes are aimed at specifiers, particularly architects, with the message that accepting more of the natural characteristics of hardwood and using a more diverse range of species makes sound ecological sense. Hardwood forestry practices and management have to be matched by less wasteful use of wood. Responsibility in the ecological debate lies with both producers and users.

To get the message across the AHEC has introduced an "illustrated guide to hardwood lumber grades". (I have been unable to obtain a copy). The guide defines a range of grades which allow for knots, wider colour variation inclusion of sapwood in its aim to improve forest utilization.

A designers guide to U.S. temperate hardwoods is also being made available to European architects.

A further initiative is a mobile unit which travels throughout Europe, which in conjunction with producers and European agents, conducts presentations to designers and architects. Other activities including furniture fairs and designer/architectural shows for U.S. hardwoods are planned.

CONVENTIONS

The AHEC has initiated an annual European-American Hardwood Convention the first being conducted in London in 1994 which provides a transfer of information and speakers on various aspects of European markets.

Visitors to the 30' long custom built mobile unit can obtain literature (as described), posters promoting the environmental link, audio visual examples of architectural projects featuring U.S. hardwoods.

HARDWOOD MANUFACTURERS ASSOCIATION (HMA)

The HMA is North America's largest association exclusively for hardwood sawmills.

This national marketing and promotional body's principal goal is to "spread the good news about solid hardwood (SHP) products, building demand and business for all hardwood producers. It has 108 members which operate 218 Sawmills, concentrated (distribution) yards and dimension mills in 25 states, producing and processing nearly 2 Billion board feet (4,720,000 m³)

TRADE SHOWS

Promoting solid hardwood and species range combined with an Environmental Awareness Package.

This program is conducted around the country often in conjunction with other relevant associations, promoting to industry trade representatives in areas such as, architects & builders, kitchen manufactures and furniture and dimension industries.

Themes covered include: environmental issues, solid hardwood, unique renewable products and generally supporting industry by disseminating the range of literature previously discussed.

It is interesting to note that some of this literature has a price of \$1 or \$2 clearly identified on its cover, with the view to ensuring that consumers keep and refer to this point of sale literature. Members purchase this literature at 10c per copy and give them away to their client base who in turn pass them on to consumers.

As most hardwood products are used in the house in appearance applications, the HMA marketing and promotion programmes are orientated directly to consumers.

Two exciting special marketing programmes that have been recently undertaken is: (1) THE HARDWOOD BUILDERS (1993) PROGRAMME and (2) THE SOLID HARDWOOD PROMOTION PROGRAMME (1992).

HARDWOOD BUILDERS PROGRAMME

The HBP is a joint project by six hardwood trade associations under the banner of the Hardwood Council. This programme targets builders of single dwellings in the \$150,000+ range representing approximately 34% of the expected 1.1 million housing starts in 1993.

In part, the HBP is designed to compliment current industry efforts by providing additional avenues for existing promotional literature. According to their HMA the Hardwood Council is the beginning of a new era of co-operation among the many Hardwood Industry Groups, and have focused on builders for the following reasons:

- enormous influence on customer purchasing decisions
- builders are natural salesmen for the hardwood industry and have the consumer's ear at the critical time when buying decisions are made.
- builders are an important audience for hardwood manufacturers in such areas as flooring, cabinets, staircases, veneer, mill work and mouldings.

The programme will recruit leading home builders to feature more hardwood products in display and spec houses.

The Hardwood Council is providing participating builders with a comprehensive range of award winning sales support literature free of charge, including design and decorating ideas that illustrate the hardwood advantage. Materials supplied includes:

- **Hardwood Expressions**
A 20 pp booklet featuring creative suggestions for cabinets flooring, millwork (mouldings etc) for every room in the house. Each issue includes "how to" articles on decorating, care and repair tips.
- **Imagination with Wood**

64pp ideas book based on hardwood appearance applications within the home.
- **Booklets** - a series of booklets has been produced on selecting and caring for hardwood products, including.
 - At home with Hardwoods
 - The heart of the house
 - The finished home
 - U.S. Hardwoods - Today, Tomorrow, Forever.
 - Beautiful Abundant Hardwoods.

JOIN THE HARDWOOD BUILDERS PROGRAM AND DISCOVER THE BENEFITS OF BUILDING WITH HARDWOODS

As a builder of fine homes, you know that the emphasis today is on quality — in architecture and design, in craftsmanship, and in the materials you and your customers select. Your guidance contributes to customer satisfaction — and can give you a competitive edge.

The Hardwood Builders Program was created by the Hardwood Council to enhance your position as a leader in quality home construction. Participation is simple, and membership is free. Just feature cabinetry, flooring and millwork made of North American hardwoods — oak, maple, cherry, walnut, ash, alder, hickory, poplar and other species — in your model and spec homes.

Cherry flooring and staircase



Dave Rowland

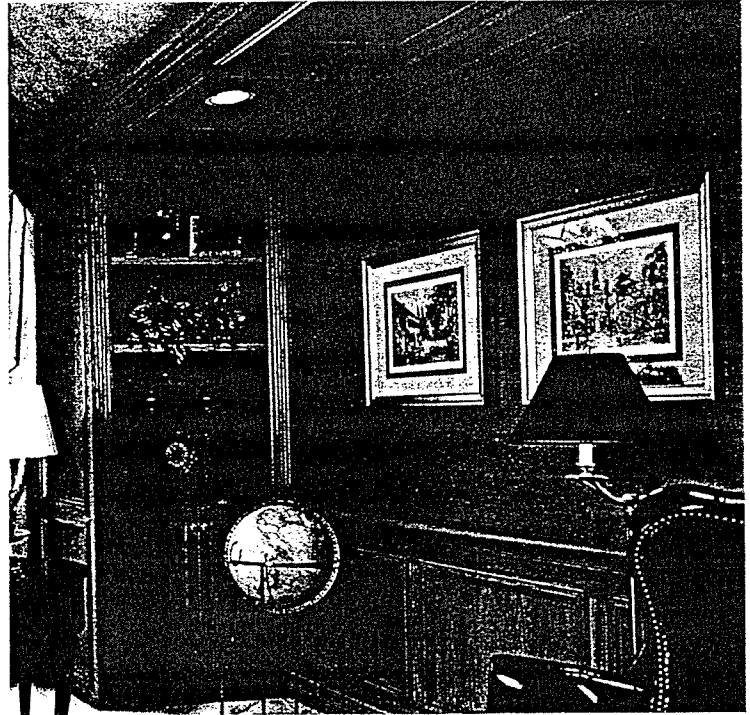
The Hardwood Builders Program takes care of the rest. We show how you can use hardwood products to increase customer traffic, boost sales and improve profits. We back your marketing efforts with a variety of creative, fact-filled literature that helps you guide your customers through design and materials selection. And we support you with publicity that spreads the word about the homes you build with fine hardwoods.

Read on to learn how the Hardwood Builders Program — and authentic hardwood products — can build your business.



Oak bookcase, paneling and ceiling

Wood-Mode Inc.



Wood Moulding & Millwork Producers Association

PUBLICITY

A series of articles have been generated to support the programme by getting features into - local newspapers,

- home-maker magazines,
- regional trade magazines
- real estate publications

MARKETING

The Hardwood Builders Programme provides builders with a market advantage in the highly competitive house building market.

Builders have reported that having hardwood featured in these homes has generated higher customer traffic and faster sales. Often buyers are requesting (add-ons) such as floors, cabinetry, windows, kitchens etc. Other functions that are endorsed to builders are hardwoods ability to satisfy a broad range of aesthetic and practical performance requirements that reflect the lifestyles of busy American families.

Builders are seeing a network of customer referrals - increased resale value.

CUSTOMERS

Customers report that:

- Hardwoods make a compelling first impression
- that the materials are genuine and natural (not imitations)
- As each piece of wood is unique, each house featuring hardwoods has its own personality, a distinctive advantage.

SOLID HARDWOOD PROMOTION PROGRAMME

HMA believes that demand for hardwoods originates with consumers and by reaching this important audience is the key to increasing the market for solid hardwood products in ways that benefit the entire industry.

The programme costs \$650,000 each year to increase consumer demand for solid hardwood products in furniture, flooring, cabinetry and residential woodwork.

Survey

A Survey was conducted by the H.M.A. targeting consumers through furniture retailers. The retailers represented annual sales of \$1.9 billion US (1991). The Survey reported that 91.3% of consumers looking for solid wood furniture bought generic solid wood while only 8.7% asked for a manufacturer by name. 78% of retailers indicated that consumers will pay a premium for solid hardwood furniture products which incorporated all facets of the make-up of the piece, including Dining room tables, case fronts, interior drawer finishes, drawer guides, mouldings, bed panels.

According to the survey, consumers purchasing solid wood furniture were looking for:

- The generic term "solid wood"
- Longevity/an heirloom
- Durability
- Repairability
- Safe designs that will last for a generation
- Simple, functional designs

Despite the popularity of solid wood, the survey reported that there was more resistance from retailers than from their customers. This is due in large part to retailers not wanting to pay a premium for solid wood construction over similar designs manufactured with veneer. However, it should be noted that solid wood furniture weathered the 1988/91 recession far better than veneered products, with over 60% of retailers indicating that solid wood was a better seller.

Hardwood in furniture

A consumer booklet has been produced by the H.M.A. titled "The Solid Guide to Hardwood Furniture" (14pp). This booklet is aimed at consumers and retailers as well as being an active marketing tool for furniture and component manufacturers.

The booklet also offers detailed descriptions of identifying solid hardwood, asking the reader to closely examine furniture in the showroom, providing a quality checklist for materials and workmanship in exposed timber furniture and chairs as well as upholstered pieces.

Information contained within the booklet reinforced attitudes found within the survey, including:

- Lasting value - A solid hardwood furniture investment offers enduring value (and beauty) from one generation to the next.
- Resale value - Solid Timber in Furniture is of superior quality and can significantly increase in value.
- Durability - screw and nail holding, shocks and abrasions, strength and stability

TWO DOLLARS

H A R D W O O D

Expressions

IN FURNITURE

**A Guide to
Decorating, Selecting
and Caring for
Hardwood Furniture**

- Variety - Species, designs, carrying bending and turning.
- The Real Thing - Every piece of hardwood furniture is unique, as its made from non man made material.
- Timber is a Renewable Resource
- Hardwood Furniture - You know what your buying with detailed, illustrated guide to construction methods.
- Tradition of Excellence - lifetime utility, easy to repair.
- Quality - Quality checklist
- Finishes - A guide to various furniture finishes.
- Hardwood Furniture Care - indicates wood's sensitivity to dampness, heat and direct sunlight.

CONSUMERS

The programme focuses on consumers through articles and features inserted into hundreds of daily, weekly newspapers and home-maker magazines.

One article for example 16 pps reached 750,000 readers through a Womans Day Home Decorating Magazine. This feature copy was then sent to newspapers across the country where editors produced their own articles on solid hardwood applications.

This effective method of disseminating information is only a fraction of the cost to similar quantities of paid advertising/the 16 page story in Woman's Day alone would have cost several hundred thousand dollars if placed as an advertisement.

Of equal importance this avenue of publicity provides third party credibility unmatched by advertising. According to HMA, nearly 9 million consumers read about the advantages of solid hardwood in furniture cabinets, flooring and mill work. Support for these articles is provided by in house produced consumer publications such as "**Hardwood Expressions**" which is published 3-4 times a year with each issue focussed on an individual topic/furniture, kitchens and baths, decorative woodwork.

MANUFACTURERS & RETAILERS

Other support publications are provided to manufacturers and retailers to be used to educate sales staff and customers.

HMA believe that consumers in the 90's are spending their money more wisely often researching before making a purchase. These publications are a great source of consumer education and reinforce purchasing decisions based on the value of solid hardwood products - the quality, uniqueness and lasting value.

Overall a total of more than 130,000 pieces of promotional literature ended up in consumers hands in 1993.

One interesting example is the Furniture Swing Tag which is attached to every piece of furniture manufactured from Solid Hardwoods to the U.S.A. The Swing Tag reinforces quality material from a renewable resource and emphasises that so piece of wood looks exactly like another and that distinctive grains, character marks and colour variations are the purest expressions of nature. Over 285,000 tags were distributed in 1992 reaching through more than 400 furniture and retail marketing partners.



'A range of HMA support publications that educate sales staff and customers'

THE NEXT GENERATION.

Hardwood Education Kit - this kit is aimed at Junior and High School levels providing teachers with a fact-filled, instructive lesson plan for teaching students the ins and outs of species identification, selection and care of solid hardwood home products:

- background on environmental issues
- Forestry practices.

The kit uses HMA literature and video tape allowing students to be more knowledgeable consumers.

HOME SHOWS

A travelling solid hardwood display travels to major home shows around the country with support provided by regional supporters of the programme.

INDUSTRY INTELLIGENCE

A number of activities are undertaken to ensure members are aware of significant issues that will effect their business and cost saving benefits, through belonging to an industry association.

Surveys

Surveys are conducted on a number of fronts including:

1. an annual wage and benefit survey and
2. manufacturing cost survey.

This survey breaks down manufacturing costs by function within the sawmill enabling hourly labour costs and production per hour of timber at the mill gate.

Other areas include insurance programs and safety programs.

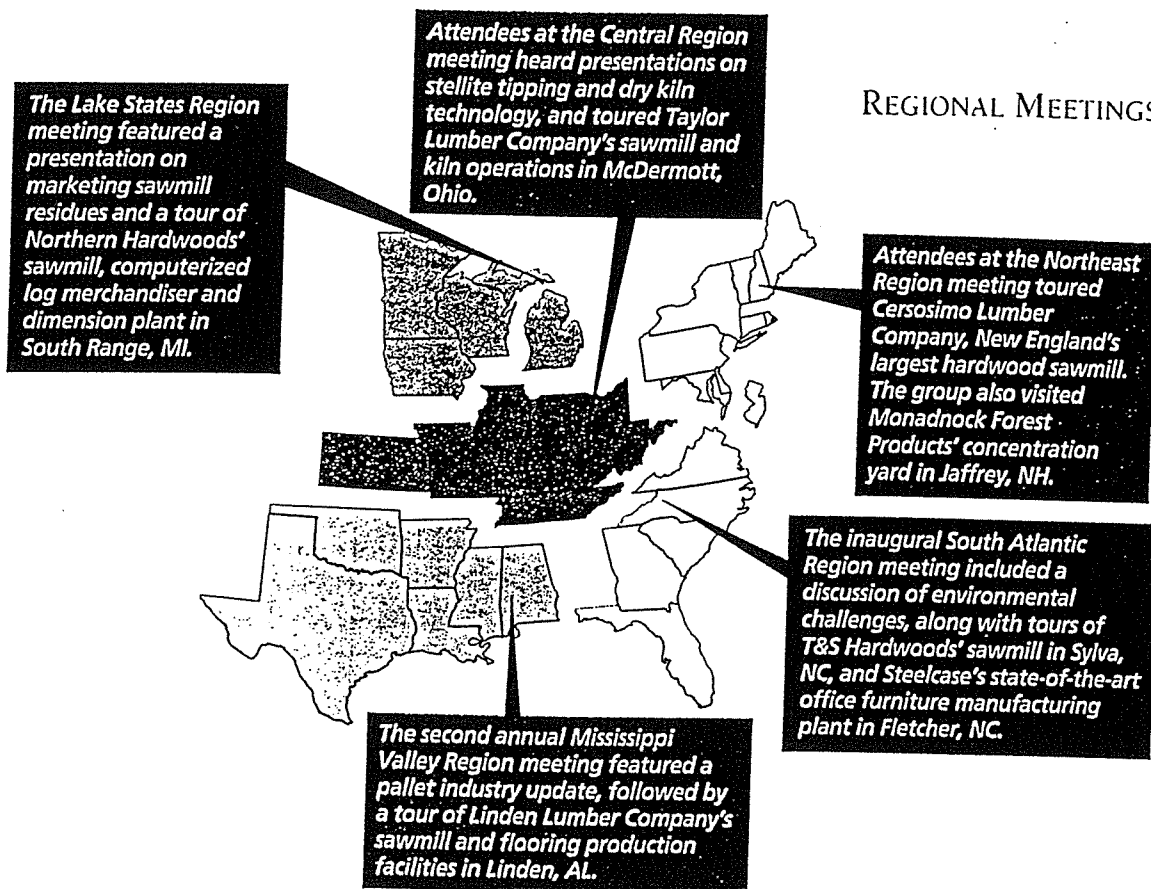
REGIONAL MEETINGS

A decision was made in 1991 to hold regional meetings at five (5) regional throughout the East Coast of the USA.

*Include regional meetings map breakup from page 2 of the HMA Annual Report

These meetings have been highly successful and one of the main reasons for this success is that sawmillers have allowed tours of their plant and sawmills to other members. This is a significant achievement in that members are now contributing and discussing production and marketing issues

REGIONAL MEETINGS



and the development of sawmill technology. By networking in this fashion, it has the effect of "growing the relevant markets" for all concerned by developing and improving standards for continued success in both domestic and export markets.

Other growth areas from these regional network meetings has also included tours of specialist manufacturers, for example, dimension plants, and State-of-the-Art furniture manufacturing. This has the effect of bringing lively discussion closer to the producer from the wide and varied end users of their timber products.

Allied to this strategic plan to meet the challenges facing these producers in the future, is the technical contributions of the *University Forestry Extension Services* who provides sound technical advice and information on such things as:

- kiln drying technology
- pros and cons of predrying
- computerised cutting techniques
- log grading
- sawn timber grading



Hardwood in a kitchen setting gives interesting textural contrasts with tiles and fabrics for a look that can be as traditional or contemporary as you choose. Here, the solid drawers and cabinets look clean and bright in the freshly-scrubbed yet mellow look of maple.

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HARDWOOD LUMBER GRADES

APPENDIX 1

Hardwood lumber grades are a means of measuring the quality of lumber. This is extremely important to both buyers and sellers since most often, the price of hardwood lumber is directly related to the quality and therefore, the grade.

With some exceptions, hardwood lumber is graded on the basis of the size and number of cuttings (pieces) which can be obtained from a board when it is cut up and used in the manufacture of a hardwood product such as furniture, flooring, or interior house trim (architectural millwork). Common usage generally requires that the cuttings be clear wood so that undesirable defects, such as splits, rot, bark pockets and knots do not appear in the finished product. Generally speaking, the higher the grade, the larger the area of clear material contained in an individual board. When cut up for remanufacture the upper grades will yield a larger proportion of the board in a few large-sized cuttings, while lower grade boards will yield a smaller proportion of the board in a larger number of smaller-sized cuttings.

The standard grades of hardwood lumber are Firsts, Seconds, Selects, No. 1 Common, No. 2A Common, No. 2B Common, Sound Wormy, No. 3A Common and No. 3B Common.

Today, not all standard grades find equal usage in commercial trade. The grade of Sound Wormy is rarely used in practice. Furthermore, the special grade of Firsts and Seconds One Face (FAS1F) is more commonly used in

some regions, often being substituted for Selects. Lumber may be sold separately by each grade or in combination of grades. Some common examples are:

FAS—(Firsts and Seconds) are combined as one grade.

No. 1 Common and Better—The full run of the logs (includes Selects) with all grades below No. 1 Common excluded.

No. 2A Common and 2B Common may be combined as No. 2 Common and when so combined and specified shall be understood to include all the No. 2A Common that the logs produce.

FAS1F--(Firsts and Seconds One Face) A special grade that will grade not below FAS on one face for the particular species; and not below No. 1 Common on the reverse side. The reverse side of the cuttings in both FAS and No. 1 Com do not have to be sound. Wane on the No. 1 Com side cannot exceed 1/3 the width of the board, nor is either edge of the board allowed to have wane exceeding 1/2 the length.

Refer to the official Rule Book for other groupings and grades.

Hardwood Grading Terms

Lumber grading cannot be understood or practiced until the individual knows and understands the terminol-

ogy. The following are some basic definitions.

Surface Measure—(SM) The surface area of a board in square feet. To determine surface measure multiply the width of the board in inches and fractions by the length in feet, and divide the product by 12, rounding off to the nearest whole number.

Some examples of surface measure calculations are as follows:

Examples

$$6\frac{1}{2}" \times 8' + 12 = 4\frac{1}{3} \approx 4 \text{ SM}$$

$$8" \times 12' + 12 = 8 \text{ SM}$$

$$10" \times 13' + 12 = 10\frac{10}{12} \approx 11 \text{ SM}$$

Most board rules today, (lumber scaling sticks) take this averaging into account automatically. The graduations on the board rule measure from the half-foot mark to the next half-foot mark, therefore all boards falling into the range are shown as a whole number.

Board Foot—bd. ft. or BF. A board foot is the unit of measurement of lumber. A board foot is one foot long, one foot wide and one inch thick, or its equivalent. The formula for determining board feet in a board is:

(Width in inches and fractions X length in feet X thickness in inches) + 12 = BF

Examples

$$(12" \text{w} \times 12' \text{L} \times 1" \text{t}) + 12 = 12 \text{ bd. ft.}$$

$$(6" \text{w} \times 16' \text{L} \times 5/4" \text{t}) + 12 = 10 \text{ bd. ft.}$$

$$(8" \text{w} \times 6' \text{L} \times 2" \text{t}) + 12 = 8 \text{ bd. ft.}$$

The board foot measure of 1" thick boards is equal to the surface measure (note rounding convention):

Examples

$$(9" \times 9' \times 1") + 12 = 6\frac{3}{4} \approx 7 \text{ bd. ft.}$$

$$(10" \times 10' \times 1") + 12 = 8\frac{1}{3} \approx 8 \text{ bd. ft.}$$

$$(7" \times 11' \times 1") + 12 = 6.42 \approx 6 \text{ bd. ft.}$$

Lengths: Fractional lengths in standard grades shall be measured as the next lower standard length. Standard lengths are 4' through 16' in 1 foot increments.

Thickness: The standard thickness for rough lumber 1" and thicker may be expressed in quarter inches such as 1" —4/4; 1-1/4" —5/4; 1-1/2" —6/4, etc.

Surfaced thickness: Standard surfaced thickness for lumber surfaced two sides (S2S) is as follows:

Rough 4/4" S2S to 13/16"

Rough 5/4" S2S to 1-1/16"

Rough 6/4" S2S to 1-5/16"

Rough 7/4" S2S to 1-1/2"

Rough 8/4" S2S to 1-3/4"

Cutting: A portion of a board or plank that would be obtained by cross-cutting, ripping, or both. Diagonal cuttings are not permitted. Cuttings in the Common grades shall be flat enough to surface two sides to standard surfaced thickness after they have been removed from the board. In the grades FAS and Selects, the board as a whole must be flat enough to permit surfacing to standard surfaced thickness.

Clear Face Cutting: A cutting having one clear face (ordinary season checks are admitted), and the reverse side sound as defined in Sound Cutting. The clear face of the cutting shall be on the poor side of the board, except when otherwise specified.

Sound Cutting: A cutting free from rot, pith, shake, and wane. Texture is not considered. It will admit sound knots, bird pecks, stain, streaks, or their equivalent, season checks not materially impairing the strength of the cutting, pin, shot, and spot wormholes. Other holes 1/4" or larger are admitted, but are limited as follows: One 1/4" hole in average diameter in each cutting less than 12 units (144 square inches); two 1/4" holes or one 1/2" hole to each 12 units (144 square inches) and on one side only of a cutting.

Cutting Unit: A cutting unit is 1" wide and 1' long. A square foot (144 sq. in.) of surface area contains 12 cutting units. To calculate the number of available cutting units in a board, multiply the width of each cutting in inches and fractions by its length in feet and fractions (of feet), then add the products obtained for each cutting together.

There are also certain physical characteristics of wood which occur during the growth process of the tree or while lumber is drying, which must be recognized and taken into consideration during grading.

Sapwood: The light colored living wood near the outside of the tree.

Heartwood: The central part of the tree from the center to the sapwood, generally darker colored in hardwoods.

Note: Unlimited sapwood or heartwood is admitted except as otherwise specified. Contracts for special grades under a heartwood or sapwood specification shall state the maximum or minimum percentage desired and how it shall be calculated.

Season Checks: Ordinary season checks are admitted in clear-face cuttings. An ordinary season check can be thought of as one which is a result of the natural drying process and will not proceed deep enough into the board to be visible in the finished product. When the board is surfaced to standard surfaced thickness, no ordinary season checks are to be present in the clear-face cuttings. Season checks that do not impair the strength of the cuttings are admitted in Sound Cuttings.

Stain: Stain shall not be admitted in clear face cuttings unless it will dress out in surfacing to standard thickness for surfaced lumber, except in grades for species in which the rules specifically state that stain is admitted.

Mineral Streaks and Spots: Mineral streaks and spots are olive-greenish, black or brown discolorations naturally occurring, but of unknown cause in hardwoods. Mineral streaks and spots are admitted in the clear-face cuttings unless otherwise specified in the grading rules for the respective species.

Sticker marks: Piling sticker marks showing a variation in color but not containing stain are admitted in clear-face cuttings.

Burls: A burl is a swirl or twist in the grain of the wood which usually occurs near a knot but does not contain a knot. Those containing sound centers are admitted in the clear-face cuttings, except when otherwise specified.

Warp: Any variation from a true or plane surface. Warp includes bow, crook, cup, twist or any combination thereof. In the common grades, a cutting must be flat enough to surface two sides to standard surfaced thickness after being removed from the board. In FAS and Selects, the entire board must be flat enough to S2S to standard surfaced thickness.

Shake: A lengthwise separation of the wood which usually occurs between the rings of annual growth. Shake is not permitted in clear or sound cuttings.

Pith: The small, soft core occurring in the structural center of the tree. Pith, whether boxed or on the surface, is not permitted in clear-face or sound cuttings.

Wane: Bark or lack of wood. Wane is found on boards sawn near the outside of a log. Wane is not permitted in clear-face or sound cuttings.

Splits: A lengthwise separation of the wood due to a tearing apart of the

wood cells. Splits are not permitted in clear-face cuttings.

Decay (rot): A disintegration of the wood due to the action of wood destroying fungi. The words "dote" and "rot" mean the same as decay.

Incipient decay is the early stage of decay in which the disintegration has not proceeded far enough to soften or otherwise change the hardness of the wood perceptibly. It is usually accompanied by a slight discoloration or bleaching of the wood.

Advanced (or typical) decay is the later stage of decay in which the disintegration is readily recognized because the wood has become soft and spongy, stringy, pitted or crumbly.

Lumber Manufacture

Lumber should be properly manufactured of good average widths and lengths. Hardwood lumber is usually sawn and edged to random widths. It should be edged and trimmed carefully to produce the best possible appearance while conserving the usable product of the log. Lumber shall be of standard thickness with the exception that the percentage not included in the required cuttings may be scant (just short of the required) thickness, provided the cuttings are of standard thickness and there is no greater variation in the thickness of the board than allowed in the rule describing miscut lumber.

Miscut Lumber Rule: Rough lumber shall be measured for thickness at the thinnest cutting used in establish-

ing the grade. If there is a greater variation in thickness on the entire board than shown in the following table, the board shall be classed miscut.

Variation Allowed

1/8" in thicknesses of 1/2" or less
3/16" in thicknesses of 5/8" and 3/4"
1/4" in thicknesses of 4/4" to 7/4"
3/8" in thicknesses of 2" to 3 1/2"
5/8" in thicknesses of 4" to 6"

Minimum Widths

Each of the standard grades specifies a minimum sized board; for FAS this is 6" W X 8' L. Ninety percent of the minimum widths mentioned in all grades of lumber must be full width. The remaining 10% may be up to 1/4" scant in width. As an example for applying this rule to a load of lumber, in tallying the FAS, for every nine 6" wide FAS boards tallied, one 5-3/4" board is permitted.

Lumber Measurement and Tally

Random width lumber of standard lengths and thicknesses is tallied surface measure and this tally is the number of feet, board measure (BF) of 1" lumber. In lumber thicker than 1" the

tally is multiplied by the thickness as expressed in inches and fractions of an inch. Lumber less than 1" thick is counted surface measure.

In lumber measured with a board rule, random width pieces measuring to the even half foot are alternately counted as of the next higher and lower foot counts; fractions below the half foot are dropped and fractions above the half foot are counted as of the next higher foot.

Tapering lumber in standard lengths shall be measured one-third the length of the piece from the narrow end.

Grading Lumber

Lumber is inspected and graded as the inspector finds it, of full length, width and thickness. No allowance is made for the purpose of raising the grade, except that in rough stock, defects which can be removed by surfacing to standard rough thickness, shall not be considered.

The grade shall be determined from the poor side of the piece, except when otherwise specified.

The grading rules define the poorest piece acceptable in any given grade, and all pieces up to the next higher grade will be included in the grade.

Note: For a step by step description of the hardwood lumber grading process, please refer to page 10. The steps are a simplification of the mental process that the inspector goes through in examining each board. Diagrams of boards to which the cutting unit method has been applied are shown on pages 11 to 15.

CUTTING UNIT METHOD

The Cutting Unit Method is the foundation upon which hardwood grades are based. It is a mathematical representation of the yield of clear wood from the board, which could be used in the manufacture of a secondary product (such as furniture parts), subject to specific limitations as to the size and number of cuttings used to produce the yield.

The basic hardwood lumber grades are based on the yield in clear cuttings (or in some circumstances, sound cuttings) which can be obtained from an individual board, measured in cutting units.

With some exceptions, the standard grades must yield the following proportions of the board in clear cuttings:

Basic Yield to Make Grade

Firsts - $11/12$ or $91\frac{2}{3}\%$
Seconds - $10/12$ or $83\frac{1}{3}\%$
#1 Com - $8/12$ or $66\frac{2}{3}\%$
#2A Com - $6/12$ or 50%
#2B Com - $6/12$ or 50% Sound
#3A Com - $4/12$ or $33\frac{1}{3}\%$
#3B Com - $3/12$ or 25% sound

The convention of specifying the proportions of clear-face yield in fractions of 12ths comes from the fact that the lumber grader is doing the calculations in his head. The numerator of the fraction is used in determining the

number of cutting units required for a grade by multiplying by the SM.

The minimum size of cuttings permitted are specified for each grade. The higher grades require wider and longer cuttings of clear wood. The number of cuttings permitted vary by grade and surface measure of the board. In the higher grades, the required yield must be realized in a smaller number of cuttings. In the lower grades, the larger number of cuttings permitted give more opportunity to cut between defects to realize the yield. In calculating the number of cuttings allowed, fractions are dropped and the lowest whole number is used.

Basic Requirements of the Standard Grades

Firsts and Seconds (FAS)

Minimum Size Board - 6" wide x 8' long
Minimum Cutting Size -- 4" x 5' or
3" x 7'

Clear-Face Yield in Cutting Units--
 $83\frac{1}{3}\%$ or $10/12$ clear
(Calculated by -- $SM \times 10 = \# \text{ units}$)
Cuttings Allowed — Calculated by
 $SM + 4$. Maximum number allowed—
4. Boards of 6' to 15' SM will admit 1 additional cutting if yield can be raised to $91\frac{2}{3}\%$ ($11/12$) in clear-face cuttings. Admits also pieces 6" and wider of 6' to 12' surface measure that will yield 97% in two clear-face cuttings of any length, the full width of the board.

Selects

Minimum Size Board—4" wide x 6' long.

Minimum Cutting Size—

On FAS face -- 4" x 5' or 3" x 7'

On #1 Com face - 4" x 2' or 3" x 3'.

Clear-Face Yield—2' and 3' surface measure that will yield $91\frac{2}{3}\%$ ($11\frac{1}{12}$) clear-face in one cutting with the reverse side of the FAS cuttings sound as defined in sound cutting ("sound-back Selects") or the reverse side of the piece grading not below No. 1 Common ("No. 1 Common-back Selects"); 4' and over surface measure—one face must grade as required for FAS, the reverse side of the FAS cuttings sound as defined in sound cutting ("sound-back Selects") or the reverse side of the piece grading not below No. 1 Common ("No. 1 Common-back Selects"). The reverse side of the cuttings in FAS and No. 1 Common are not required to be sound for "No. 1 Common-back Selects".

Cuttings Allowed—On the good face, boards of 2' and 3' SM—One cutting. Boards 4' SM and over; $SM + 4$. The reverse side No. 1 Common ($SM + 1$) + 3.

No. 1 Common

Minimum Size Board—3" wide x 4' long

Minimum Size Cutting—4" x 2' or 3" x 3'

Clear-Face Yield— $66\frac{2}{3}\%$ or $8\frac{1}{12}$ clear, calculated by $SM \times 8 = \# \text{ units}$
Cuttings Allowed -- $(SM + 1) + 3$.
Maximum number allowed—5.

Boards of 3' to 10' SM will admit 1 additional cutting if yield can be raised to 75% — ($9\frac{1}{12}$) in clear-face cuttings.

No. 2A & B Common

Minimum Size Board—3" wide x 4' long.

Minimum Cutting Size -- 3" x 2'.

Clear-Face Yield -- 50% or $6\frac{1}{12}$ clear, calculated by $SM \times 6 = \# \text{ units}$.

Cuttings Allowed -- S.M. + 2.

Maximum number allowed—7.

Boards of 2'-7' SM will admit 1 additional cutting if yield can be raised to $66\frac{2}{3}\%$ ($8\frac{1}{12}$) in clear-face cuttings.

Note: 2B Common requires the cuttings only to be sound.

No. 3A Common

Minimum Size Board—3" wide x 4' long.

Minimum Size Cutting—3" x 2'

Clear-Face Yield -- $33\frac{1}{3}\%$ or $4\frac{1}{12}$ clear, calculated by $SM \times 4 = \# \text{ units}$.

Cuttings Allowed -- No limit.

Note: Also permits boards that grade No. 2A Common on the better face with the reverse side of the cuttings sound.

Note: The table on pages 8 and 9 summarizes the fundamental requirements of the commonly used grades. A student of the rules must first master the basics by committing this table to memory. It may seem difficult at first, but as you progress, this information will become second nature to the serious student.

Basic Requirements of Hardwood Lumber Grades

	FAS	SELECT	#1 COM	#2A & 2B COM	#3A COM	#3B COM	NOTES:
Minimum Size Board	6" x 8'	4" x 6'	3" x 4'	3" x 4'	3" x 4'	3" x 4'	FAS1FACE (When Specified) Better face to grade FAS for species being inspected. Poor face to grade not below #1 Com. The reverse side of FAS and #1 Com cuttings not required to be sound.
Minimum Size Cutting	4" x 5' 3" x 7'	4" x 5' 3" x 7'	4" x 2' 3" x 3'	3" x 2'	3" x 2'	Not less than 1 1/2" wide containing 36 sq. inches	
Basic Yield	SM x 10 (83 1/3%)	SM x 10 (83 1/3%)	SM x 8 (66 2/3%)	SM x 6 (50%)	SM x 4 (33 1/3%)	SM x 3 (25%)	Wane in FAS1FACE FAS Limitation Applies to the Better face. #1 Com side: 1/3 W x 1/2 L Widest wane added together; Length can be on both edges
Formula to Determine Number of Cuts	$\frac{SM}{4}$ (4 max.)	$\frac{SM}{4}$ (4 max.)	$\frac{SM+1}{3}$ (5 max.)	$\frac{SM}{2}$ (7 max.)	Unlimited	Unlimited Sound Cuttings	
SM Needed to Take Extra Cutting	6 - 15' SM	6 - 15' SM	3 - 10' SM	2 - 7' SM			#1 Common-Back Selects: Must make #1 Com on poor face and make FAS on good face. Check for wane limitation--the reverse of FAS & 1 Com cuttings are not required to be sound
Extra Yield Needed for Extra Cutting	SM x 11 (91 2/3%)	SM x 11 (91 2/3%)	SM x 9 (75%)	SM x 8 (66 2/3%)			Sound-back Selects: Must make FAS on good face and reverse side of FAS cuttings must be sound
Additional Yields	97% Rule - 2 cuts full width any length Pcs. 6" & wider with 6-12' SM SM x 11.64 for Yield	Same as FAS 97% 2' & 3' SM x 11 cutting	1' SM - 100% 2' SM-SM x 9	1' SM - SM x 8 #2A Common - Clear Face Cuttings #2B Common - Sound Cuttings	#2A Com on Btr Face & reverse side of cuttings sound; will also qualify for 3A Com		
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>FAS Limitations: Pith = SM in inches Wane = 1/12 SM (SM x 12 = sq. in.) or 1/2 Length Knot = 1/3 SM or (SM) ÷ 3 Warp = Entire board must be flat enough to S2S to S.S.T.</p> </div> <div style="width: 50%;"> <p>Splits: not to exceed 2 x SM or 12" whichever is greater. Splits shall not diverge 1" in 12". First Lineal Foot Rule: Applies to both ends of Board, to contain not over 25% unsound wood.</p> </div> </div>							
				Wane In Selects			
				Pcs. 6" & Wider	Pcs. 4" & 5" Wide		
				FAS limitation applies to Btr. face #1 Com side: 1/3 W x 1/2 L or 1/4 W x 3/4 L Widest wane added together; Length can be on both edges	1/3 W x 1/2 L applies to both faces Add widest wane together Add total length of wane from both edges		

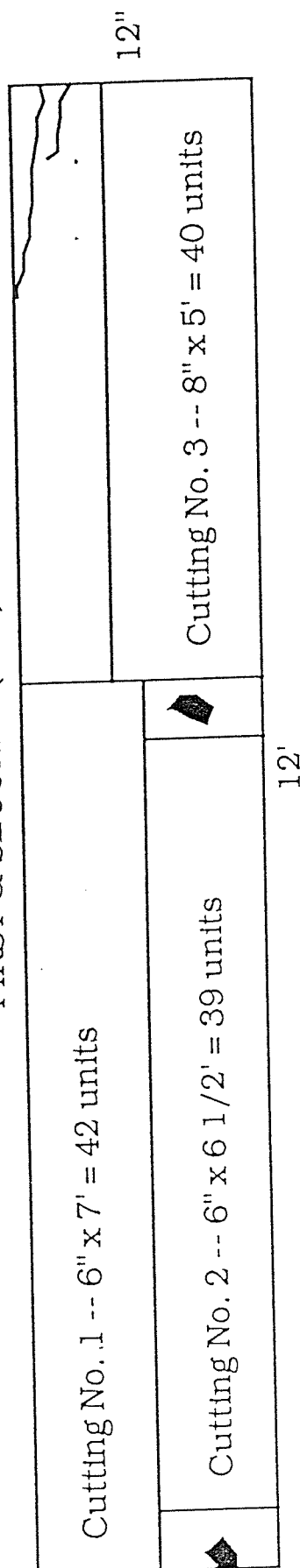
The Steps in Grading Lumber

1. Determine the species.
2. Determine the Surface Measure using a board rule (lumber scaling stick).
3. Determine the poor side of board. The grade is determined from the poor side of the board, except when otherwise specified. The poor side of the board will have the least amount of clear wood or the lower grade.
4. Assign a "trial" grade to the poor face, based on your estimate of the yield of clear wood.
5. Determine number of cuttings permitted in the "trial" grade, keeping in mind the minimum size of cutting required for that grade.
6. Determine the clear-face cutting units needed (SM X the multiplier for that grade).
7. Calculate the total area of clear-face cutting units on the poor face.
8. If the board does not yield sufficient clear-face cutting units of the right size and number of cuttings, try the next lower grade. Remember the reverse side of the clear-face cuttings must be sound.
9. Tally S.M. by grade and thickness on basis of 1" (4/4) lumber.

In lumber thicker than 1" the tally in B.F. is multiplied by the thickness as expressed in inches and fractions of an inch. Lumber less than 1" thick shall be measured and tallied as 1" lumber.

FIRST & SECONDS (FAS) GRADE

FIRST & SECONDS (FAS) GRADE



1. Determine Surface Measure using a board rule, or from the formula:

$$\frac{\text{Width in inches} \times \text{Length in feet}}{12} = \frac{12" \times 12'}{12}$$

$$= 12' \text{ S.M.}$$

2. FAS is the "trial" grade of board. Percent of clear cutting area required for FAS—83 1/3% or 10/12.
3. Determine number of cuttings permitted.

$$\text{For FAS grade} — \text{S.M.} \div 4 = 12 \div 4 = 3 \text{ cuttings}$$

4. Determine minimum size of cuttings.

$$\text{For FAS Grade } 4" \times 5' \text{ or } 3" \times 7'.$$

5. Determine clear face cutting units needed.

$$\text{For FAS grade} — \text{S.M.} \times 10 = 12 \times 10 = 120 \text{ units}$$

6. Determine total area of permitted clear-face cuttings in units.

$$\text{Width in inches and fractions of inches} \times \text{Length in feet and fraction of feet.}$$

$$\text{Cutting \#1} — 6" \times 7' = 42 \text{ units}$$

$$\text{Cutting \#2} — 6" \times 6 \frac{1}{2}' = 39 \text{ units}$$

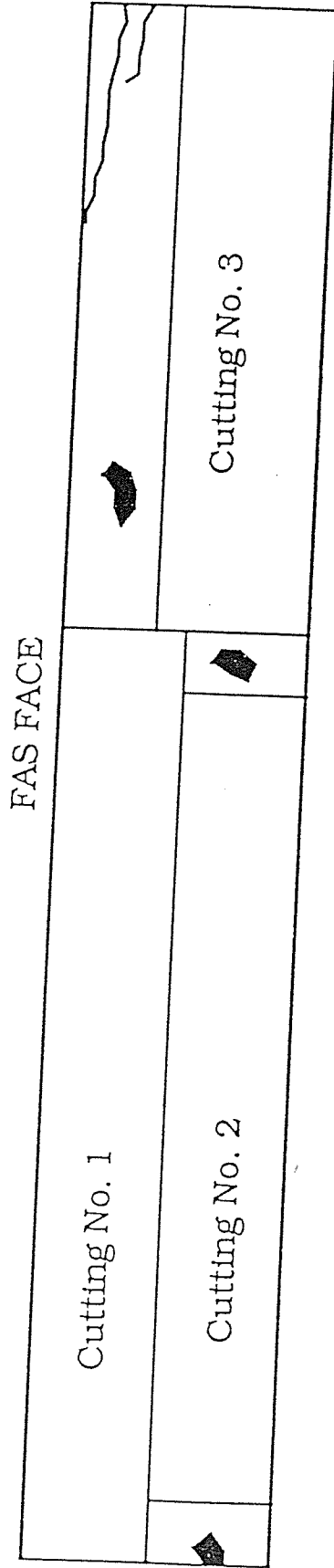
$$\text{Cutting \#3} — 8" \times 5' = 40 \text{ units}$$

$$\text{Total Units} \quad 121$$

$$\text{Units required for FAS} \dots\dots\dots 120$$

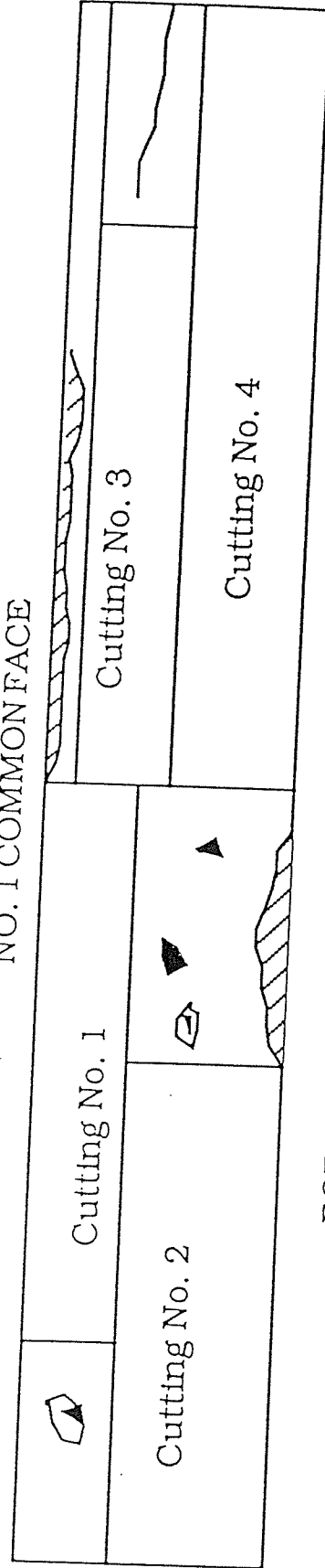
Board meets requirements for FAS grade.

SELECTS GRADE
FAS FACE WITH NO. 1 COMMON BACK



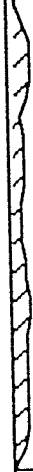





FOR DETAILS SEE FAS EXAMPLE BOARD

NO. 1 COMMON FACE



FOR DETAILS SEE NO. 1 COMMON EXAMPLE BOARD

NO. 1 COMMON GRADE

NO. 1 COMMON GRADE		12"	
			
	Cutting No. 1 - 3 1/2" x 4 1/2' = 15 3/4 units	Cutting No. 3 - 4 1/2" x 4 1/2' = 20 1/4 units	Cutting No. 4 - 6" x 5 2/3" = 34 units
	Cutting No. 2 - 8 1/2" x 4 1/2' = 38 1/4 units		

1. Determine Surface Measure using a board rule, or from the formula:

$$\frac{\text{Width in inches} \times \text{Length in feet}}{12} = \frac{12" \times 12'}{12} = 12' \text{ S. M.}$$

2. No. 1 Common is the "trial" grade of board. Percent of clear-cutting area required for #1 Common — 66 2/3% or 8/12.
3. Determine number of cuttings permitted.

$$\text{For \#1 Common grade (S.M. + 1) + 3} = \frac{(12 + 1)}{3} = \frac{13}{3} = 4\text{-}1/3 \approx 4 \text{ cuttings.}$$

4. Determine minimum size of cuttings.

$$\text{For \#1 Common grade } 4" \times 2' \text{ or } 3" \times 3'.$$

5. Determine clear face cutting units needed.

$$\text{For \#1 Common grade S.M.} \times 8 = 12 \times 8 = 96 \text{ units.}$$

6. Determine total area of permitted clear-face cutting in units.

Width in inches and fractions of inches X
Length in feet and fractions of feet.

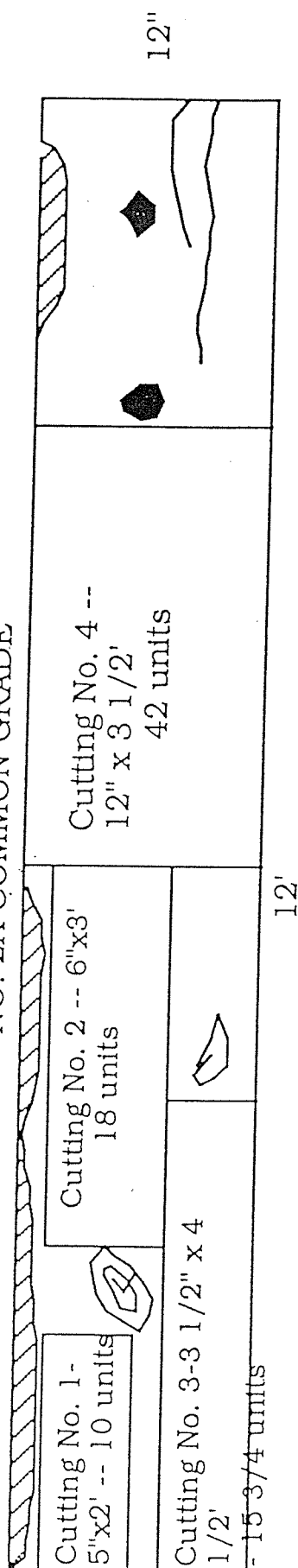
$$\begin{aligned} \text{Cutting \#1} &— 3\frac{1}{2}" \times 4\frac{1}{2}' = 15\frac{3}{4} \text{ units} \\ \text{Cutting \#2} &— 8\frac{1}{2}" \times 4\frac{1}{2}' = 38\frac{1}{4} \text{ units} \\ \text{Cutting \#3} &— 4\frac{1}{2}" \times 4\frac{1}{2}' = 20\frac{1}{4} \text{ units} \\ \text{Cutting \#4} &— 6" \times 5\frac{2}{3}' = 34 \text{ units} \end{aligned}$$

$$\text{Total Units} \qquad 108\frac{1}{4} \text{ units}$$

Units required for #1 Common — 96

Board meets requirements for #1 Common Grade.

NO. 2A COMMON GRADE



NO. 2A COMMON GRADE

1. Determine Surface Measure using a board rule, or from the formula:

$$\frac{\text{Width in inches} \times \text{Length in feet}}{12} = \frac{12'' \times 12'}{12} = 12' \text{ S.M.}$$

2. No. 2A Common is the "trial" grade of board. Percent of clear-cutting area required for #2A Common — 50% or 6/12.
3. Determine number of cuttings permitted.
For #2A Common Grade S.M. + 2 = 12/2 = 6 cuttings.
4. Determine minimum size of cuttings.
For #2A Common Grade 3" X 2'.
5. Determine clear face cutting units needed.
For #2A Common Grade S.M. X 6 = 12 X 6 = 72 units.
6. Determine total area of permitted clear-face cutting in units.
Width in inches and fractions of inches X
Length in feet and fractions of feet.

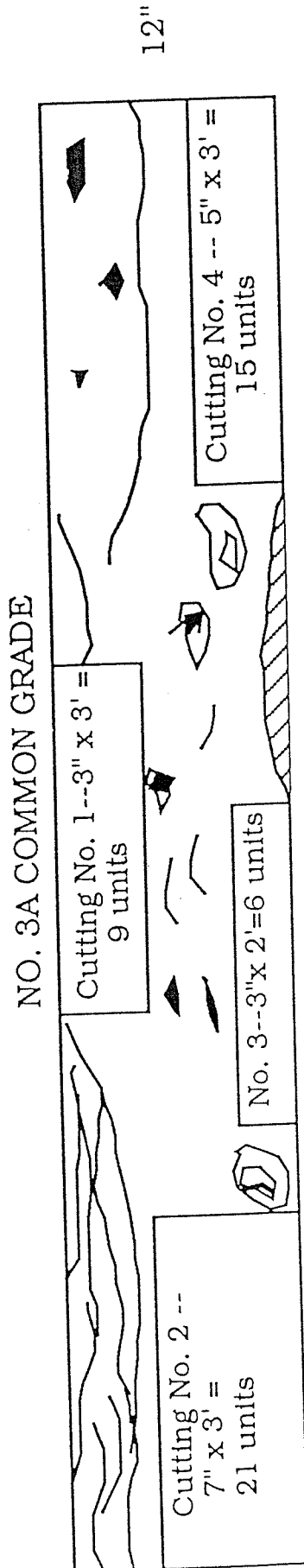
Cutting #1—5"	X 2'	= 10	units
Cutting #2—6"	X 3'	= 18	units
Cutting #3—3 1/2"	X 4 1/2'	= 15 3/4	units
Cutting #4—12"	X 3 1/2'	= 42	units
Total Units		85 3/4	

Units required for #2A Common — 72

Board meets requirements for #2A Common Grade.

#2B Common is a sound cutting grade. All other grading requirements for #2A Common will apply.

NO. 3A COMMON GRADE



1. Determine Surface Measure using board rule, or from the formula:

$$\frac{\text{Width in inches} \times \text{Length in feet}}{12} = \frac{12" \times 12'}{12}$$

$$= 12' \text{ S.M.}$$

2. No. 3A Common is the "trial" grade of board. Percent of clear-cutting area required for #3A Common — 33 1/3% or 4/12.

3. Determine number of cuttings permitted.

For #3A Common — No limit to number of cuttings.

4. Determine minimum size of cuttings.

For #3A Common — 3" X 2'.

5. Determine total clear-face cutting units needed.

For #3A Common grade S.M. X 4 = 12 X 4 = 48 units.

6. Determine area of permitted clear-face cutting in units.

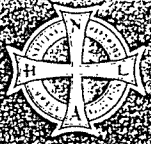
Width in inches and fractions of inches X
Length in feet and fractions of feet.

Cutting #1 — 3" X 3' =	9 units
Cutting #2 — 7" X 3' =	21 units
Cutting #3 — 3" X 2' =	6 units
Cutting #4 — 5" X 3' =	15 units
Total Units	51 units

Units required for #3A Common — 48

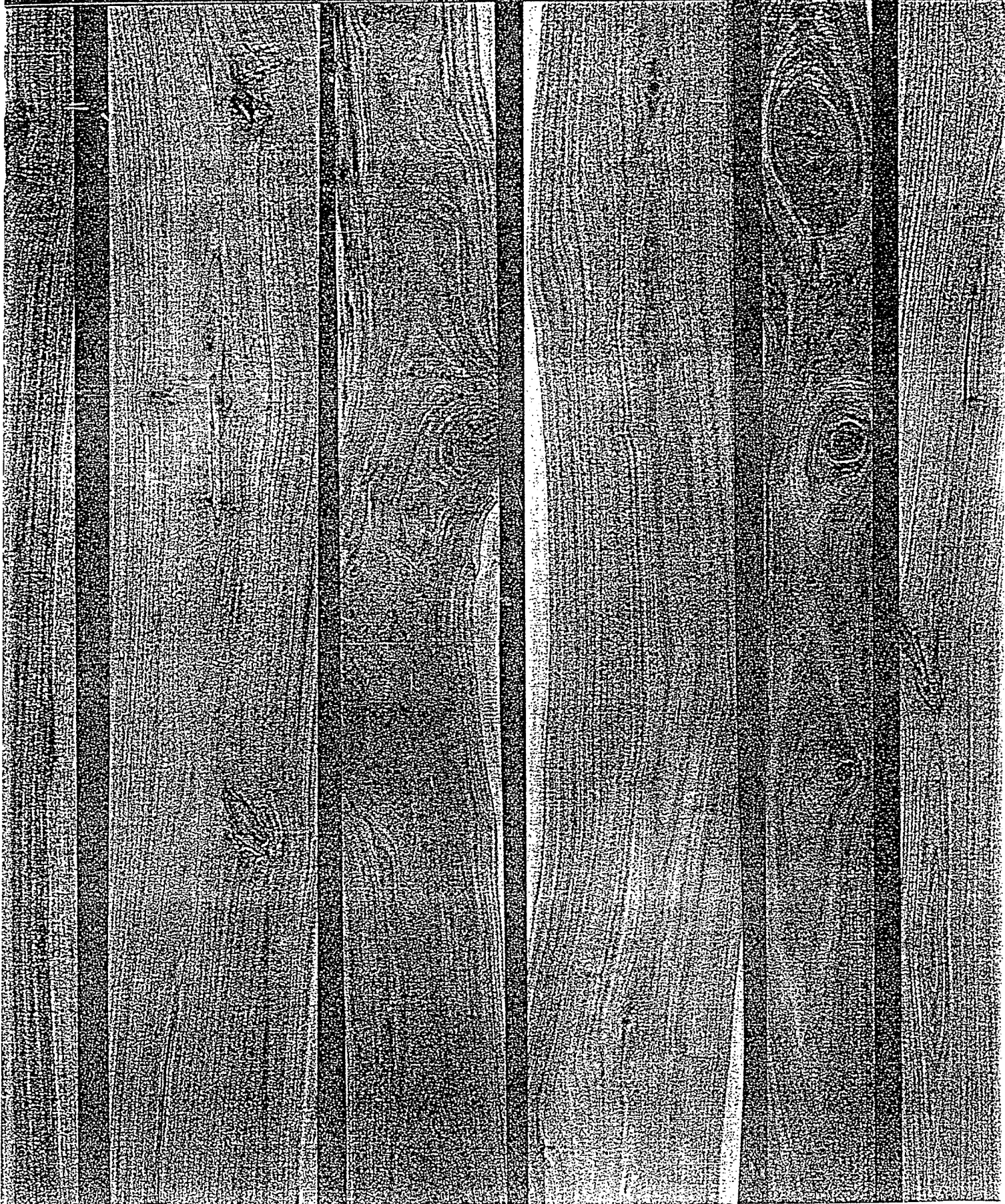
Board meets requirements for #3A Common.

National Hardwood Lumber Association



An Illustrated Guide to Hardwood Lumber Grades

Revised Edition



GENERAL SCOPE

This guide is designed to encourage the reader to become familiar with the grading rules for hardwood lumber established by the National Hardwood Lumber Association. The following photographs are examples of the range in appearance that the buyer may expect to receive when purchasing each grade. An effort was made to show the maximum and minimum clear yield for each grade. Each picture shows the "worst" side of the board since hardwood lumber is graded from the poor face.

INTRODUCTION TO GRADING

With some exceptions, hardwood lumber is graded on the basis of the size and number of cuttings (pieces) which can be obtained from a board when it is cut up and used in the manufacture of a hardwood product such as furniture, flooring, or architectural millwork. Usually the buyer intends to use only the clear (defect free) material in a board, so a higher grade would have a larger area of clear wood.

Because the grading rules are based on the yield of clear wood, many of the beautiful, natural characteristics which appear in a board are not included in the calculation of the yield. Often, the natural beauty and real bargains are not found in the most expensive grade of lumber. The keen buyer who will examine the #1 and #2A grades can discover that they may "yield" the prize pieces. Pages 5 to 18 display photographs of typical boards representing three of the commonly used NHLA standard grades in several species of lumber.

Basic Yield for FAS

FAS (Firsts and Seconds)—The FAS grade will provide the user with long, wide, clear cuttings. Best suited for high quality furniture, interior trim, millwork, and solid wood mouldings. The FAS grade includes a range of boards which yield from $83 \frac{1}{3}\%$ (10/12ths) to 100% clear wood in cuttings at least 3" wide by 7' long or 4" wide by 5' long.

Note: Diagrams show two examples of the minimum clear yield (unshaded area) needed to make each grade. The shaded area contains defects and is not used in calculating the yield, although users may very well crosscut and rip the lumber in a different pattern and use portions of the board in the shaded area.

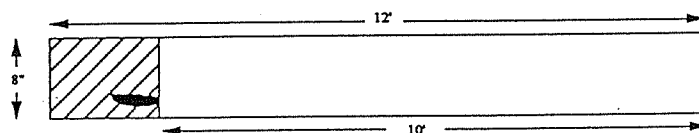


Diagram 1. FAS

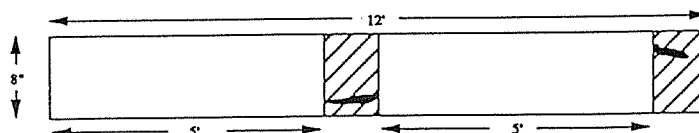
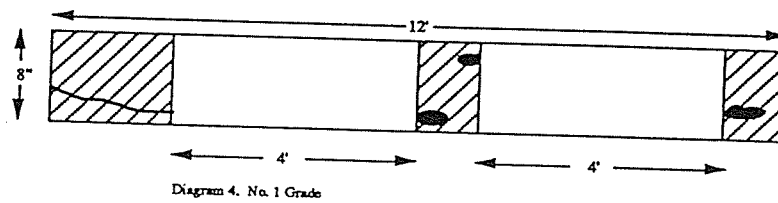
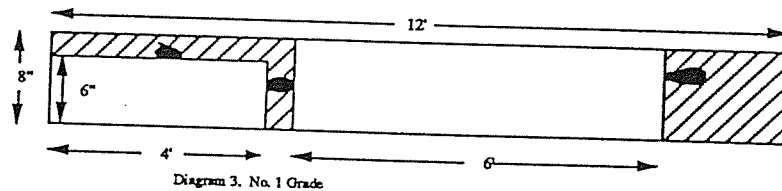


Diagram 2. FAS

FAS1F or Selects—In FAS1F ("FAS one Face") and Selects, the grade is established using both faces of the board. The best face must meet the requirements for FAS, and the reverse side must essentially grade No. 1. FAS1F and Selects are virtually the same grade, except for minimum width and length. The minimum board size for Selects is 4" x 6'; and for FAS1F it is 6" x 8'.

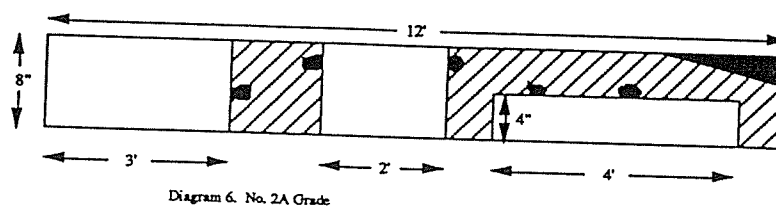
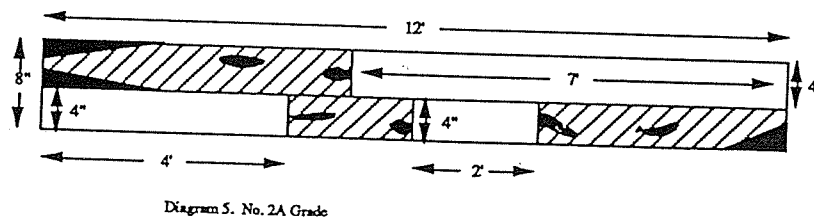
Basic Yield for No. 1 Grade

No. 1—Will provide the user with clear cuttings of medium length and width. Best suited for furniture, cabinets, and a multitude of solid wood manufactured products. The No. 1 grade includes a range of boards which will yield from $66 \frac{2}{3}\%$ ($8/12$ ths) to $83 \frac{1}{3}\%$ ($10/12$ ths) clear wood in cuttings at least 3' wide by 3' long or 4" x 2'.



Basic Yield for No. 2A Grade

No. 2A—Will provide the user with short, narrow clear cuttings economically priced, for use in unexposed furniture frames, picture frames, cabinet rails and frames, parquet or strip flooring, and many other smaller solid wood components. The No. 2A grade includes a range of boards which will yield from 50% ($6/12$ ths) to $66 \frac{2}{3}\%$ ($8/12$ ths) clear wood in cuttings at least 3" wide by 2' long.



MEASURING HARDWOODS (Random Widths & Lengths)

Surface Measure—(SM) The surface area of a board in square feet. To determine surface measure multiply the width of the board in inches and fractions by the length in feet, and divide the product by 12, rounding off to the nearest whole number.

Some examples of surface measure calculations are as follows:

Examples:

$$\begin{aligned} 6\text{-}1/2" \times 8' + 12 &= 4\text{-}1/3 \approx 4 \text{ SM} \\ 8" \times 12' + 12 &= 8 \text{ SM} \\ 10" \times 13' + 12 &= 10\text{-}10/12 \approx 11 \text{ SM} \end{aligned}$$

Most board rules today (lumber scaling sticks), take this averaging into account automatically. The graduations on the board rule measure from the half-foot mark to the next half-foot mark, therefore all boards falling into the range are shown as a whole number.

Board Foot—(bd. ft. or BF) A board foot is the unit of measurement of lumber. A board foot is one foot long, one foot wide and one inch thick, or its equivalent. The formula for determining board feet in a board is:

(Width in inches and fractions \times length in feet \times thickness in inches) $\div 12 = \text{BF}$

Examples:

$$\begin{aligned} (12" \text{w} \times 12' \text{l} \times 1" \text{t}) + 12 &= 12 \text{ bd. ft.} \\ (6" \text{w} \times 16' \text{l} \times 5/4" \text{t}) + 12 &= 10 \text{ bd. ft.} \\ (8" \text{w} \times 6' \text{l} \times 2" \text{t}) + 12 &= 8 \text{ bd. ft.} \end{aligned}$$

The board foot measure of 1" thick boards is equal to the surface measure (note rounding convention):

Examples:

$$\begin{aligned} (9" \times 9' \times 1") + 12 &= 6\text{-}3/4 \approx 7 \text{ bd. ft.} \\ (10" \times 10' \times 1") + 12 &= 8\text{-}1/3 \approx 8 \text{ bd. ft.} \\ (7" \times 11' \times 1") + 12 &= 6.42 \approx 6 \text{ bd. ft.} \end{aligned}$$

Notes

1. Lumber measurement is based on thickness before surfacing.
2. When measuring hardwood lumber, lengths less than a full foot are measured as the next lower foot length. (A board 9' 9" is measured as just 9' long.)

Measuring With A Board Rule

1. Place the flange of the rule on edge of board, 1/3 of the length up from the narrow end.
2. Read to the right edge of the board, on the line indicating the board's length, for board feet in lumber 1" thick and less.

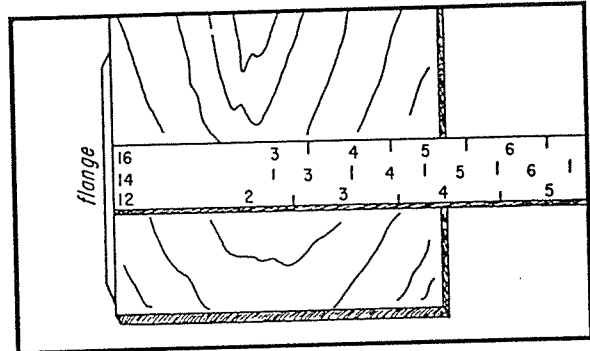


Diagram 7. Using a Board Rule

The board rule reads, for the example above:

$$\begin{aligned} 16' \text{ length} &= 5 \text{ BF} \\ 14' \text{ length} &= 5 \text{ BF} \\ 12' \text{ length} &= 4 \text{ BF} \end{aligned}$$

For 8' lumber, read 1/2 the 16' scale: 8' length = 3 BF

Table 1. Standard Thickness for Surfaced Lumber¹

Rough	Surfaced	Rough	Surfaced
3/8" S2S to	3/16"	1-3/4" S2S to	1-1/2"
1/2" S2S to	5/16"	2" S2S to	1-3/4"
5/8" S2S to	7/16"	2-1/2" S2S to	2-1/4"
3/4" S2S to	9/16"	3" S2S to	2-3/4"
1" S2S to	13/16"	3-1/2" S2S to	3-1/4"
1-1/4" S2S to	1-1/16"	4" S2S to	3-3/4"
1-1/2" S2S to	1-5/16"		

¹ From: NHLA Rule Book page 9 for commercial sales of hardwood lumber.

Kiln-Dried Hardwood Lumber-Measurement

Measurement After Kiln Drying

Sales of hardwood lumber measured after kiln drying shall be quoted, invoiced, and delivered on the basis of net board footage, with no addition of footage for kiln drying shrinkage.

Measurement Before Kiln Drying

Sales of hardwood lumber measured prior to kiln drying shall be quoted, invoiced, and delivered on the basis of net board footage before kiln drying. If the lumber is to be kiln dried at the request of the purchaser, the kiln drying charge shall be clearly shown and identified on the quotation and invoice.

Retail Sales of Stock Width Surfaced Lumber

Sizes for Surfaced (S4S) Hardwood Lumber Manufactured to Stock Widths

Hardwood lumber is normally manufactured in random widths. Stock width boards are a special item manufactured to pre-determined widths, normally for retail sales. The following table shows minimum sizes for the stock widths listed:

Table 2. Minimum Sizes for Surfaced (S4S) Hardwood Lumber²

Normal Size Stock Widths	Inches	Normal Size Stock Widths	Inches
2 x 4	1-1/2 x 3-1/2	1 x 1	3/4 x 3/4
2 x 6	1-1/2 x 5-1/2	1 x 2	3/4 x 1-1/2
2 x 8	1-1/2 x 7-1/4	1 x 3	3/4 x 2-1/2
2 x 10	1-1/2 x 9-1/4	1 x 4	3/4 x 3-1/2
2 x 12	1-1/2 x 11-1/4	1 x 6	3/4 x 5-1/2
		1 x 8	3/4 x 7-1/4
		1 x 10	3/4 x 9-1/4
		1 x 12	3/4 x 11-1/4

Note: The dry thicknesses of nominal 1-1/4" and 1-1/2" hardwood lumber are 1" and 1-3/16" respectively. Widths for these thicknesses are the same as the stock widths shown above.

Estimating Board Feet in a Package of Lumber

To determine the board feet of one board, the procedure is to multiply the surface measure by the thickness. A package of lumber can be estimated in much the same manner. First, figure the "surface measure" of one layer of lumber. Do this by multiplying the width of the package by the length of the package, less gaps (if mixed lengths, use an average of lengths present) and divide by 12. Then, multiply this figure by the thickness of boards in the package. This total will be board feet for one layer, so multiply this by the number of layers to get the total feet in the package.

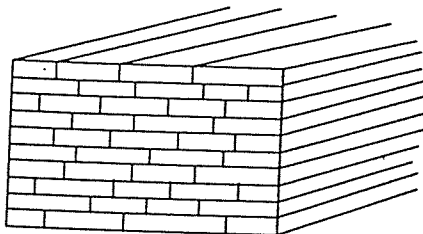


Diagram 8. Estimating package measurement

Average width of unit 40" (lumber only, after allowing for gaps)	
Length of unit 10'	
$40" \times 10' = 400 \div 12 =$	33.33
Thickness of lumber 8/4	$\times \frac{2}{4}$
	66.66
Number of layers	$\times 10$
	666.67
	~667 BF

² From: NHLA Proposal to the National Conference of Weights and Measures, January 14, 1992.

Ash

Species: *Fraxinus americana* (White Ash)

Color: Creamy white to a light brown heartwood with wide light sapwood.

Characteristics: Hard, strong, excellent bending qualities, high shock resistance. Sometime streaked with a light brown fleck.

Texture: Terms such as "tough," "soft," and "medium" texture are used to indicate source of origin. Generally tough Ash is more brown and grows in the Northern/Appalachian Regions where soft/medium texture is whiter/creamier in color and is Southern in origin.

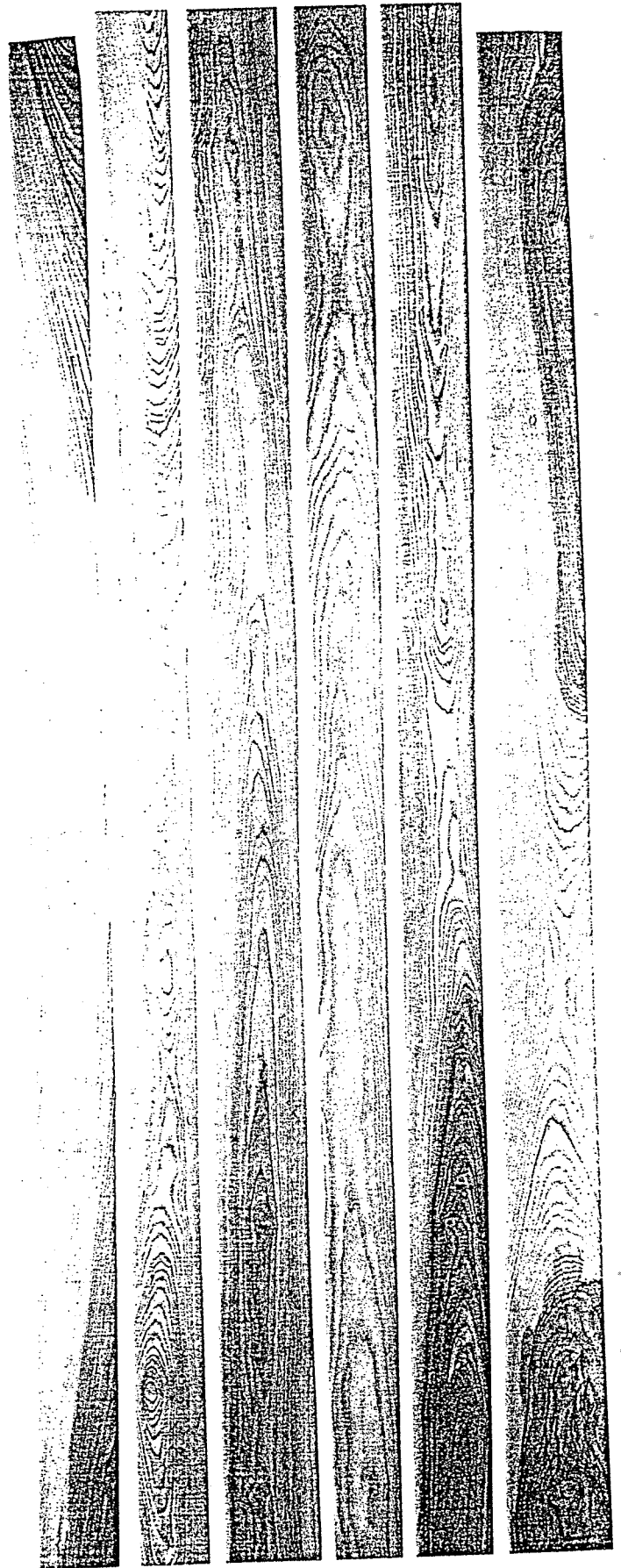
The Wood: Very pronounced grain pattern enables Ash to finish to a bright luster. Ash is excellent for furniture, moulding, athletic equipment, handles for tools, and in applications where strength is required.

White Ash includes a number of species (*F. americana*, *F. pennsylvanica*, *F. quadrangulata*) but does not necessarily signify color. If a particular color is desired, the buyer should make the preference known to the supplier, often times by specifying a percentage of each piece that must be of the desired color. The standard grading rules for Ash do not make any distinction for color. Black Ash (*F. nigra*) is usually sold separately.



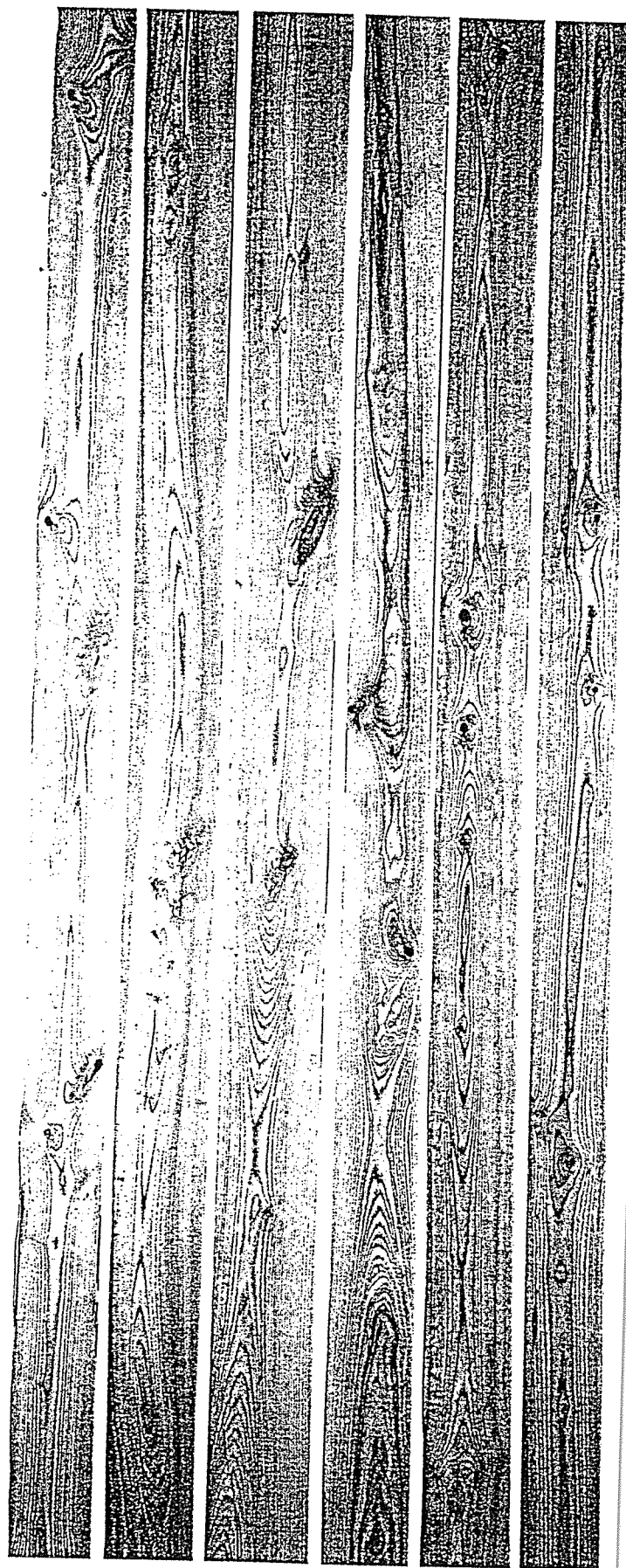
Ash

All boards pictured are 10' lengths.





No. 1



No. 2A

Birch

Species: *Betula alleghaniensis* (Yellow Birch)

Color: Sapwood is creamy-white or yellowish tinged, heartwood is light reddish brown.

Characteristics: While most often sold unselected, or color, some users specify Sap Birch (all sap or white wood cuttings) or Red Birch (all heartwood cuttings), because of the distinct color difference between the sapwood and heartwood. Sometimes birch shows very small pin knots and often shiny burl wood.

Texture: Uniform, fine grain pattern, medium weight, excellent in turnings, machines easily.

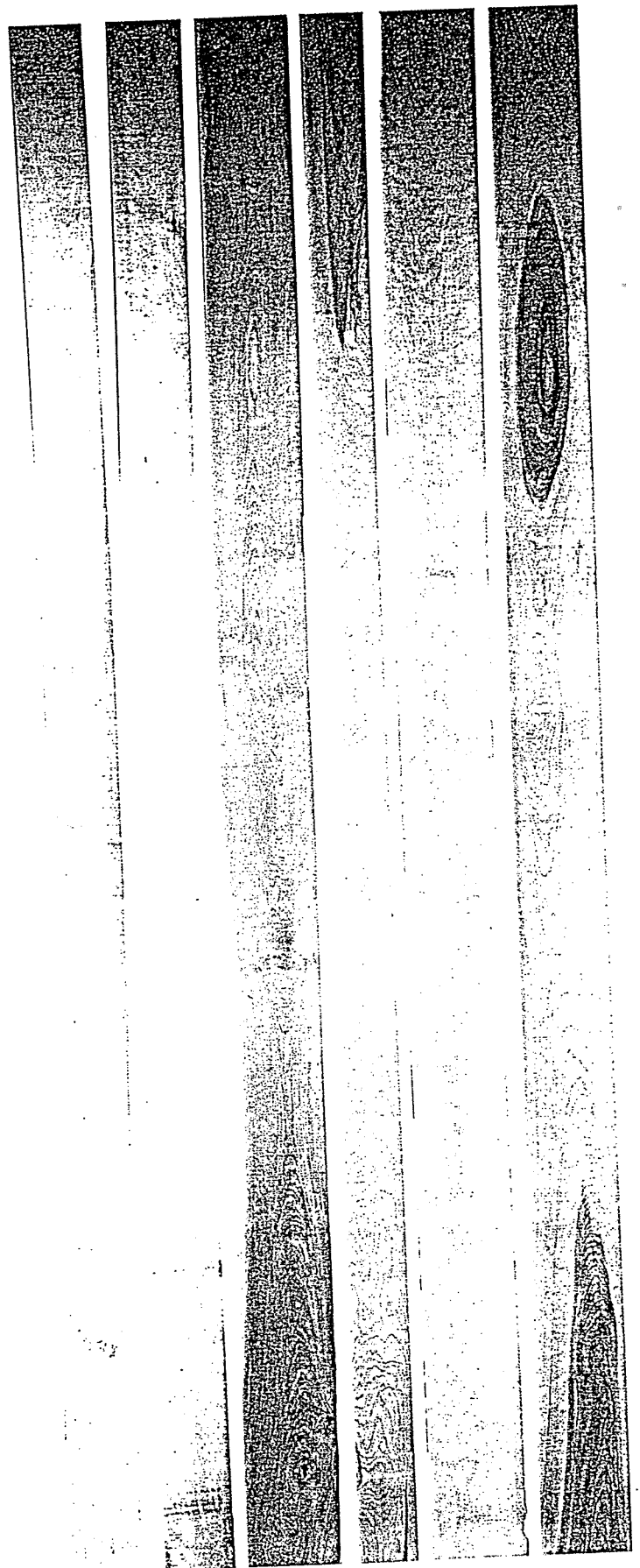
The Wood: Birch has long been used in kitchen cabinets and other carpentry for the home and office. Its fine grain pattern and excellent working qualities suit many woodworking projects. Whether it is the creamy yellow of the sapwood for a light clean look or the rich reddish-brown of the heartwood for a more elegant warmth, Birch provides the user with an opportunity to express his individual style.

It should be noted that both White Birch (*Betula papyrifera*) and Red Birch (*Betula nigra*) are distinct species. To avoid confusion a buyer should specify the species separately, here Yellow Birch, from the additional requirement of Sap Birch (sapwood cuttings) or Red Birch (heartwood cuttings).



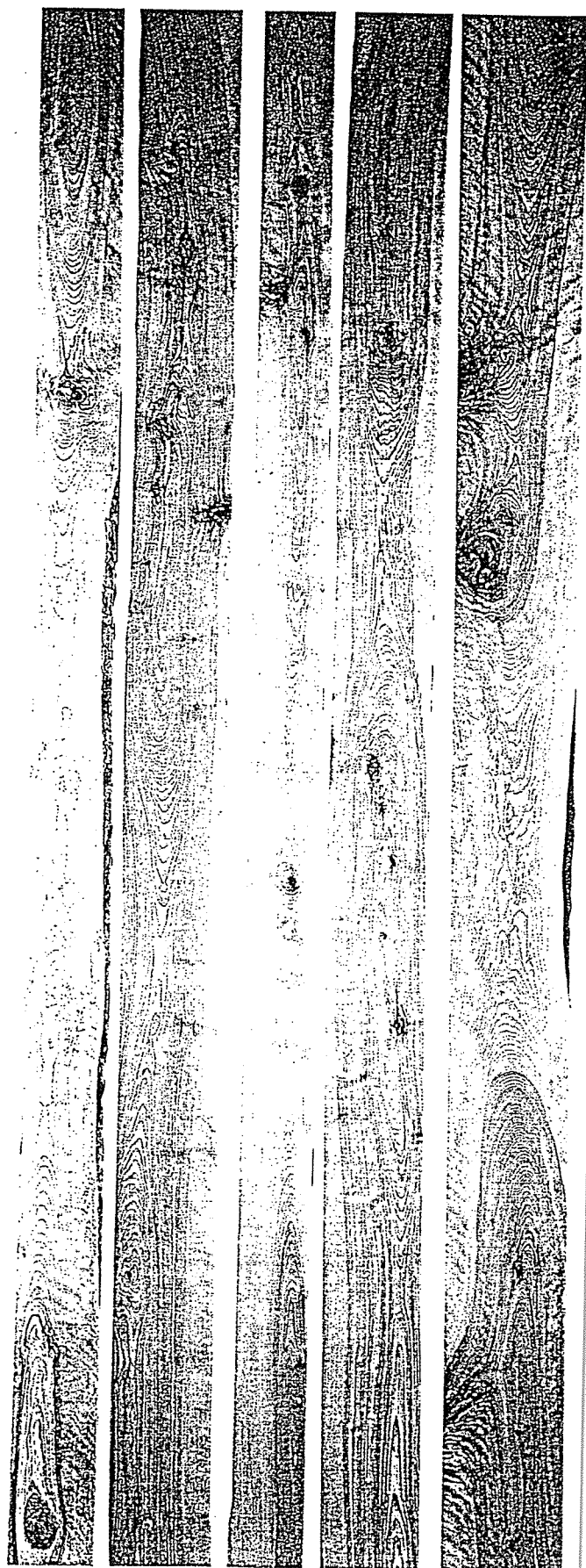
Birch

All boards pictured are 10' lengths.





No. 1



No. 2A

Cherry

Species: *Prunus serotina* (American Black Cherry)

Color: Sapwood-white to yellowish; heartwood deep reddish brown.

Characteristics: Occasionally found with thin, dark gum streaks or small clusters of very small pin knots.

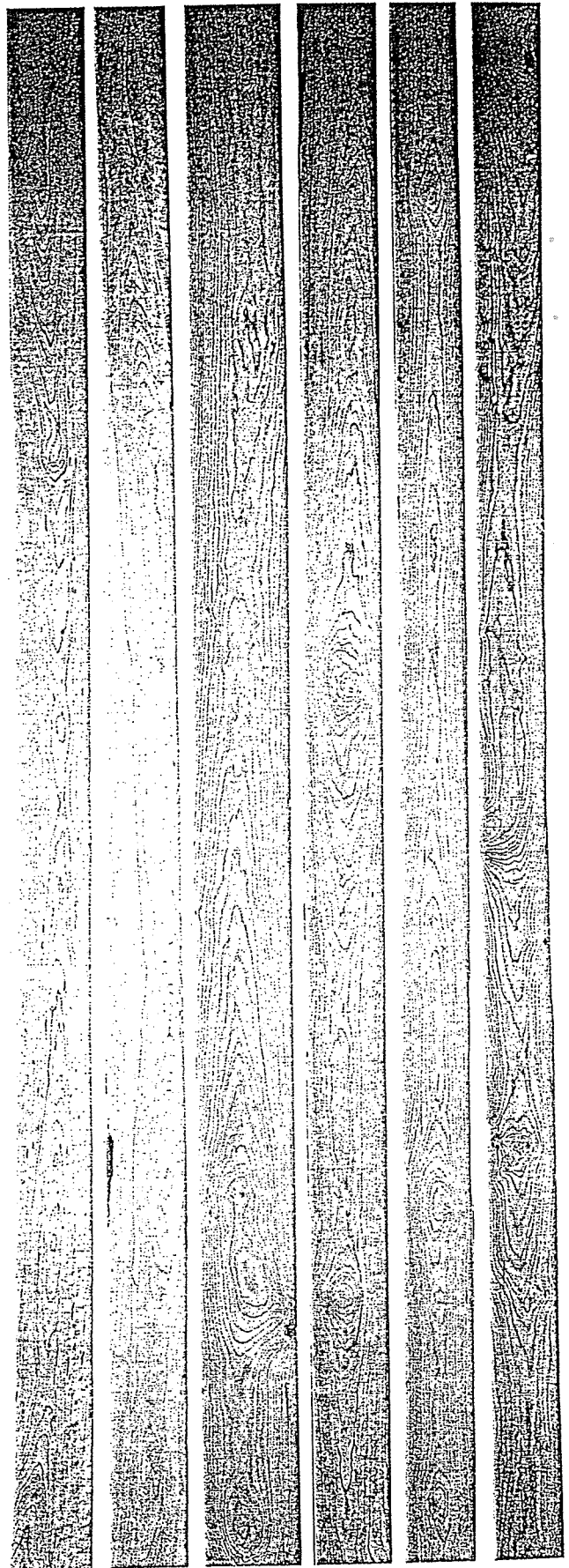
Texture: Medium weight, close fine grain, hard and stable. Finishes to silky luster second only to Walnut.

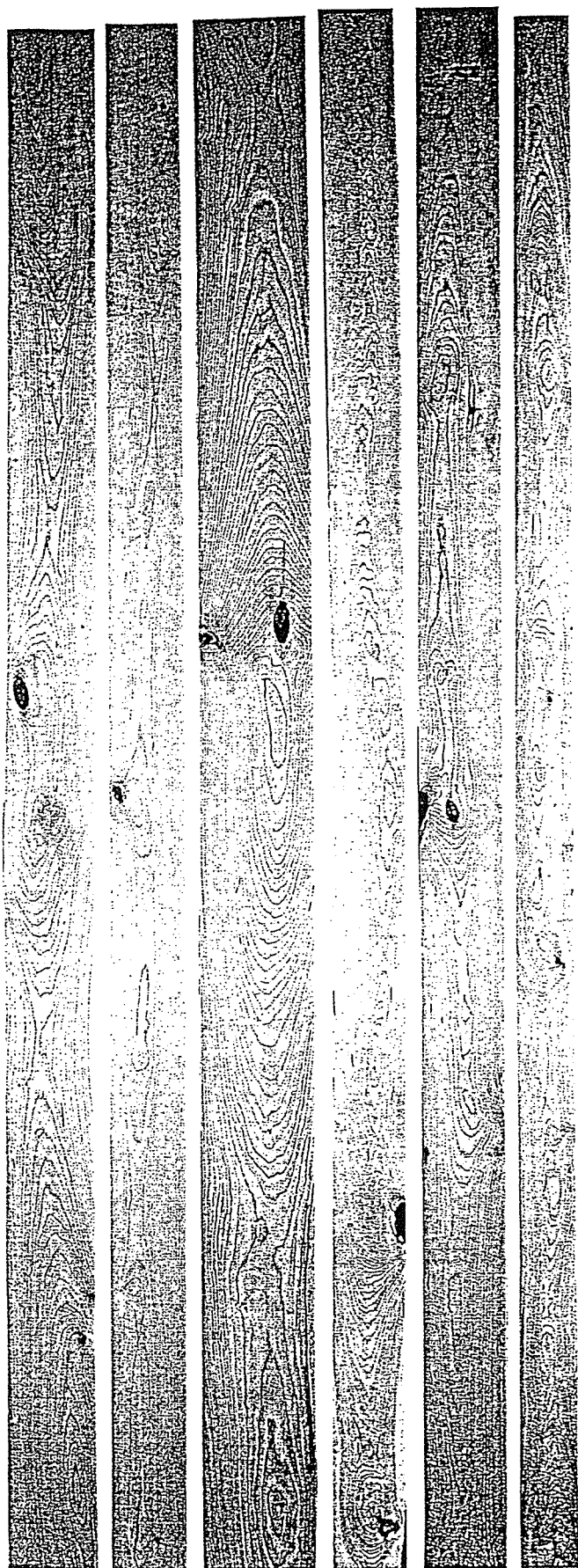
The Wood: The beautiful markings in Cherry have long fascinated wood workers. Occasional clusters of tiny pin knots, or very small, dark streaks of gum set Cherry apart from any other hardwood. Both of these natural characteristics found in Cherry are permitted under the NHLA grading rules for this species, and result in individual pieces which are truly unique.



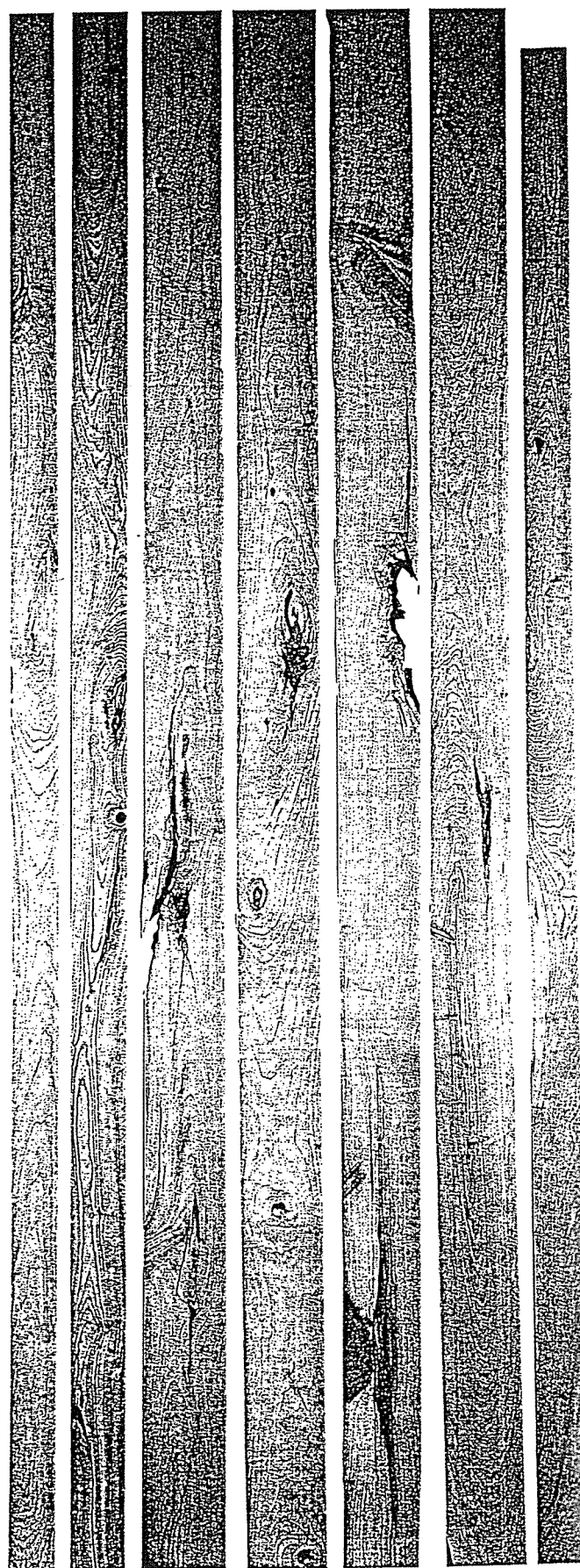
Cherry

All boards pictured are 10' lengths.





No. 1



No. 2A

Maple

Species: *Acer saccharum* (Sugar Maple, Hard Maple)

Color: The sapwood is creamy white to off-white sometimes tinged slightly with reddish brown; tan or very light grayish-brown heartwood sometimes streaked with darker mineral colors.

Characteristics: Hard, heavy and strong, very resistant to shock and abrasive wear; occasional slight green-gray mineral streaks.

Texture: Close-grained, uniform texture, polishes well.

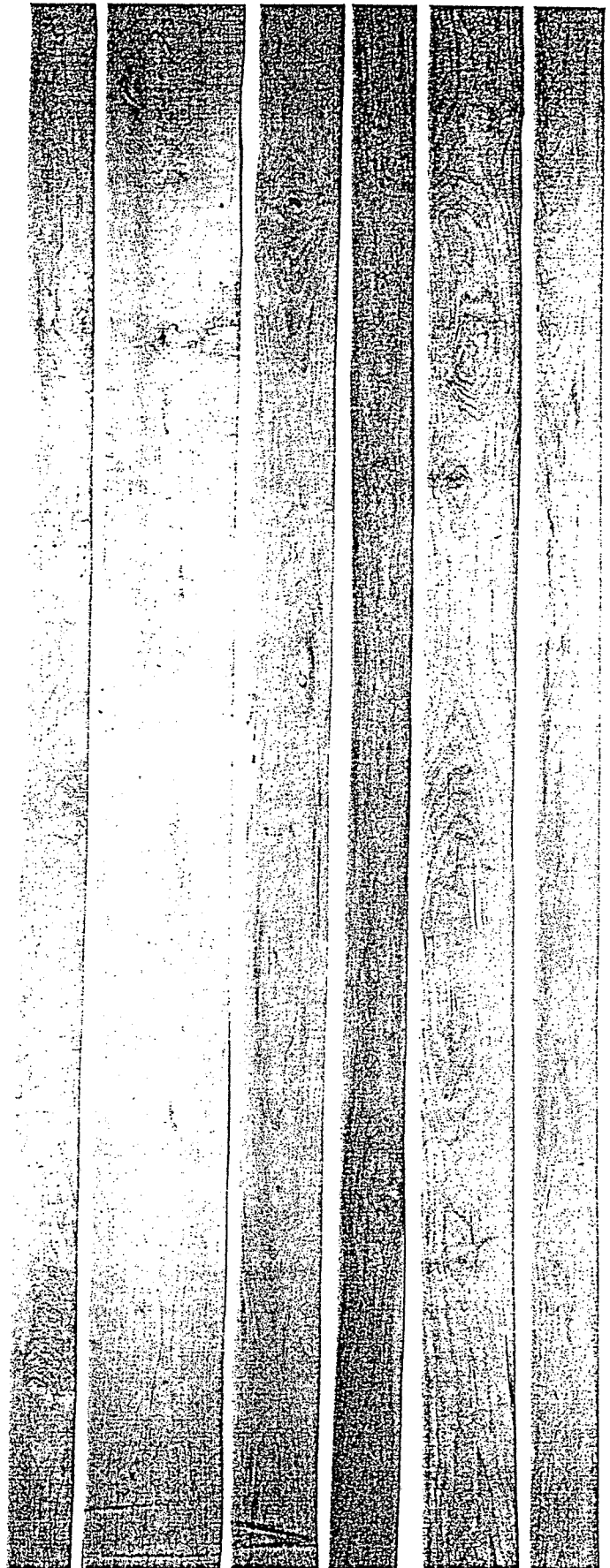
The Wood: The excellent working properties of Hard Maple make it suitable to a wide range of uses. Very popular in flooring applications such as athletic floors and bowling alleys. Standard for cutting boards in packing plants because it is odorless & tasteless. Widely used in furniture, sporting goods and turnings.

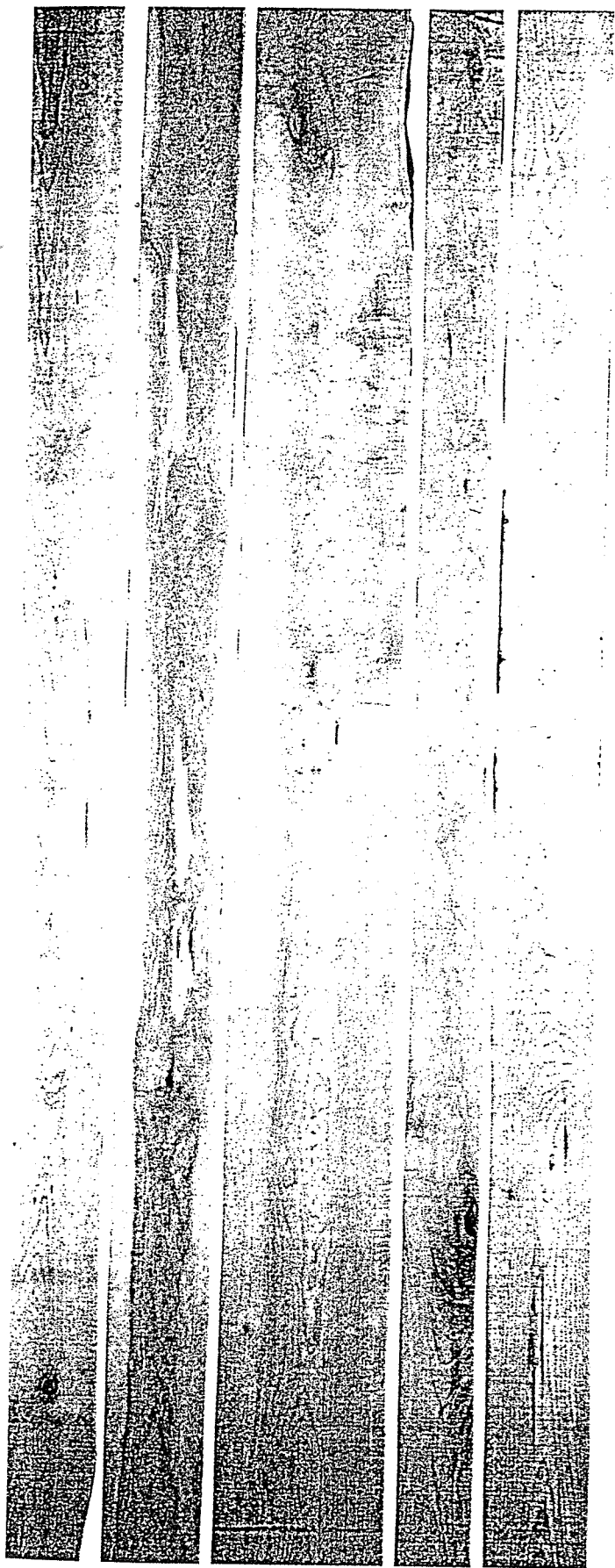
It is worth mentioning, Hard Maple is typically straight grained, but some trees will produce a very unique figure such as birdseye, fiddle back and curly grain patterns that are highly sought after for special applications. Soft Maple (*A. rubrum* and *A. saccharinum*) is less strong than Hard Maple and shows considerable mineral streaks. It is always traded separately.



Maple

All boards pictured are 10' lengths.





No. 1



No. 2A

Red Oak

Species: *Quercus rubra* (Northern Red Oak)

Color: Sapwood is pale white; heartwood varies from a light pink to a dark reddish brown.

Characteristics: Oaks are open-pored and produce dramatic grain patterns in sawn lumber. Some boards may have dark mineral streaks, produced during the natural growth of the tree, which are permitted in the cuttings. Occasionally, very small, pink pin knots will be present.

Texture: Very hard and strong. Easy to turn, sands well, excellent in bending. Very pronounced, coarse grain pattern, high shock resistance.

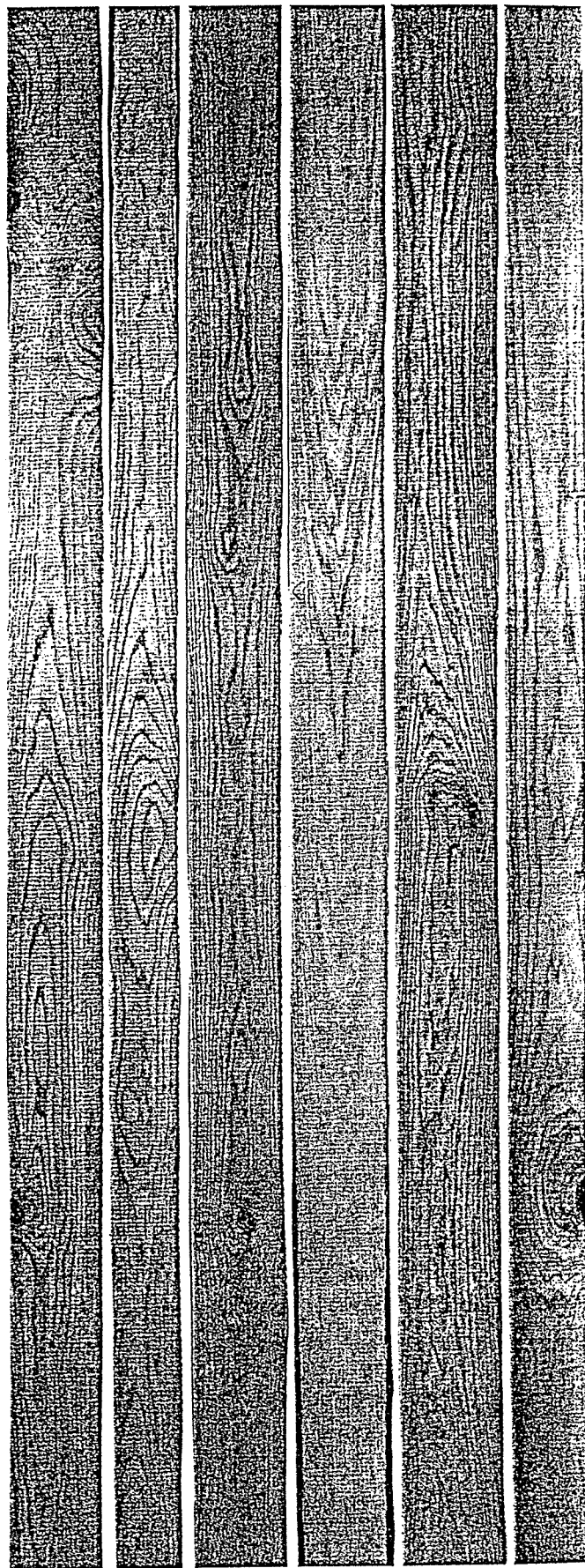
The Wood: The Oaks remain the most popular hardwood for woodworker and consumer alike. The pronounced grain catches the eye and distinguishes the wood from all others. From flooring to furniture to cabinetry, the Oaks are at home in any application. The "red oak group" encompasses several commercially important species including northern red, southern red, black, Shumard, cherrybark, scarlet, pin, and Nuttall oak.

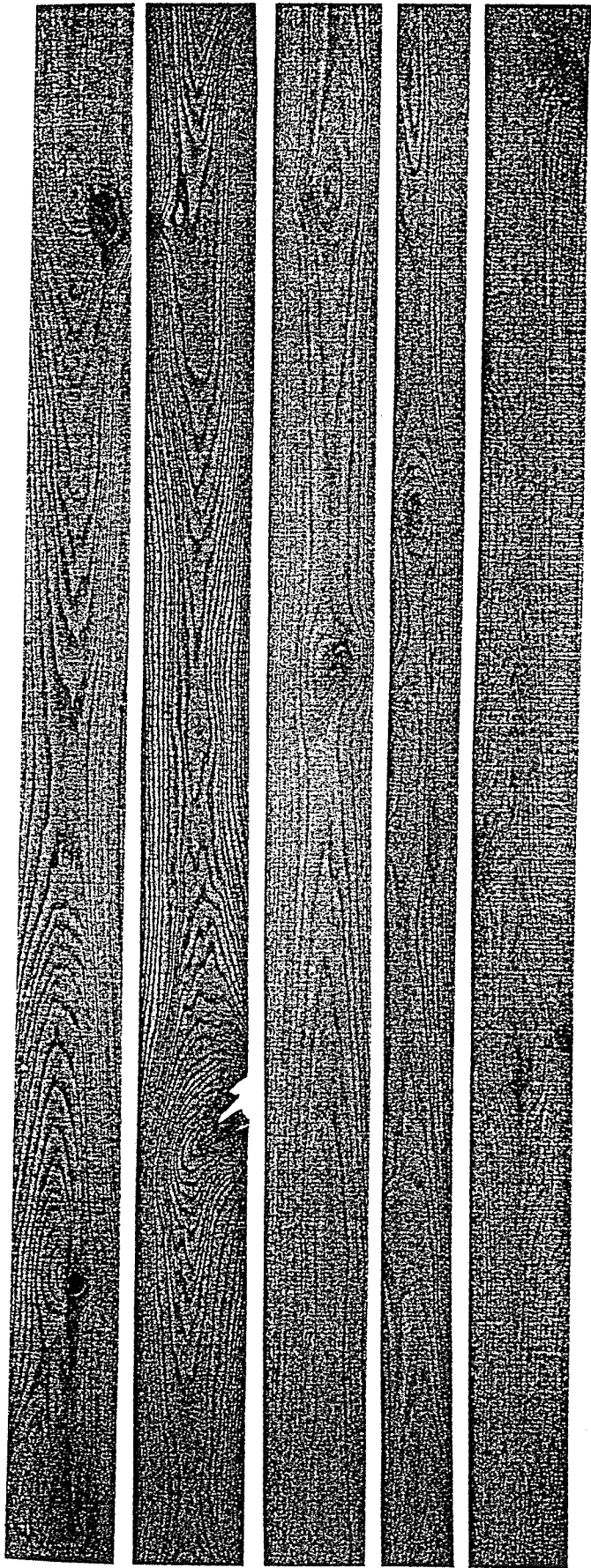
White Oak (not shown) is characteristically more fine grained, and displays a more gray-brown color. The "white oak group" encompasses several important species including white, swamp white, chestnut, swamp chestnut, chinkapin, bur, overcup, and post oak.



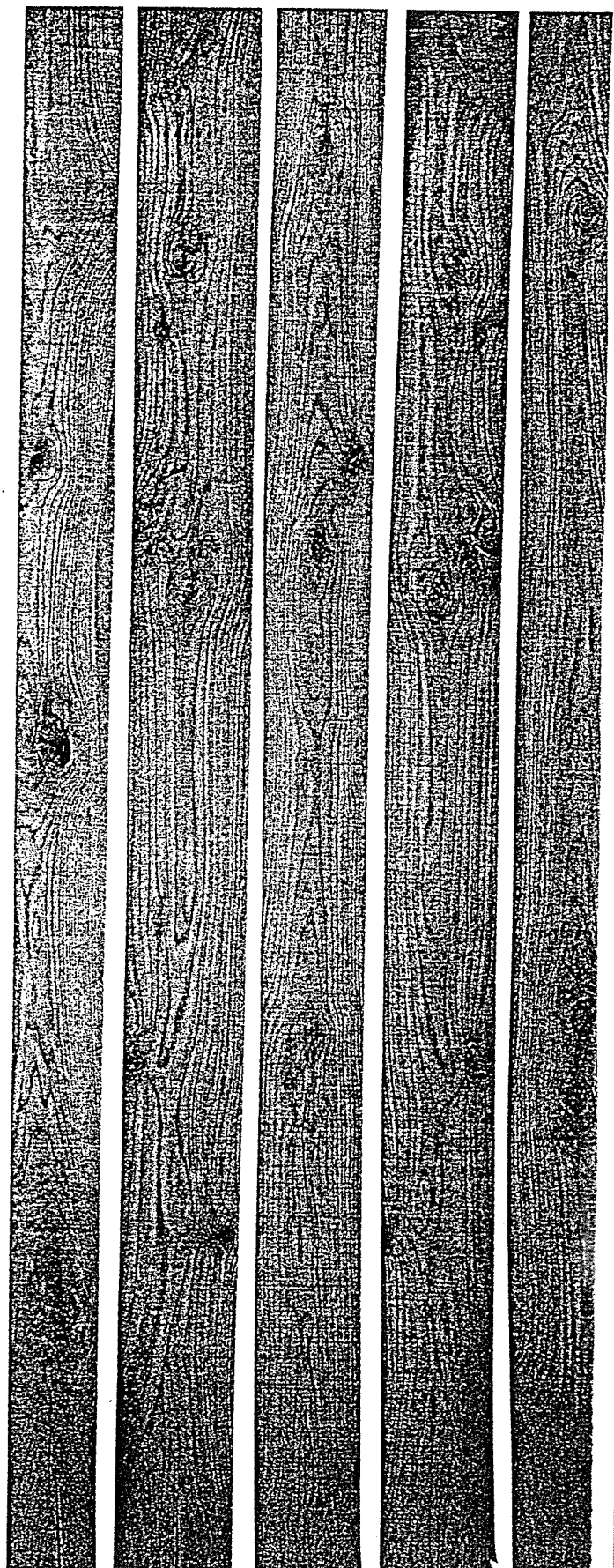
Oak

All boards pictured are 10' lengths.





No. 1



No. 2A

American Tulipwood

Species: *Liriodendron tulipifera* (American Tulipwood, Yellow Poplar)

Color: White to yellowish cast sapwood; straw-brown to slightly greenish heartwood sometimes streaked with purple.

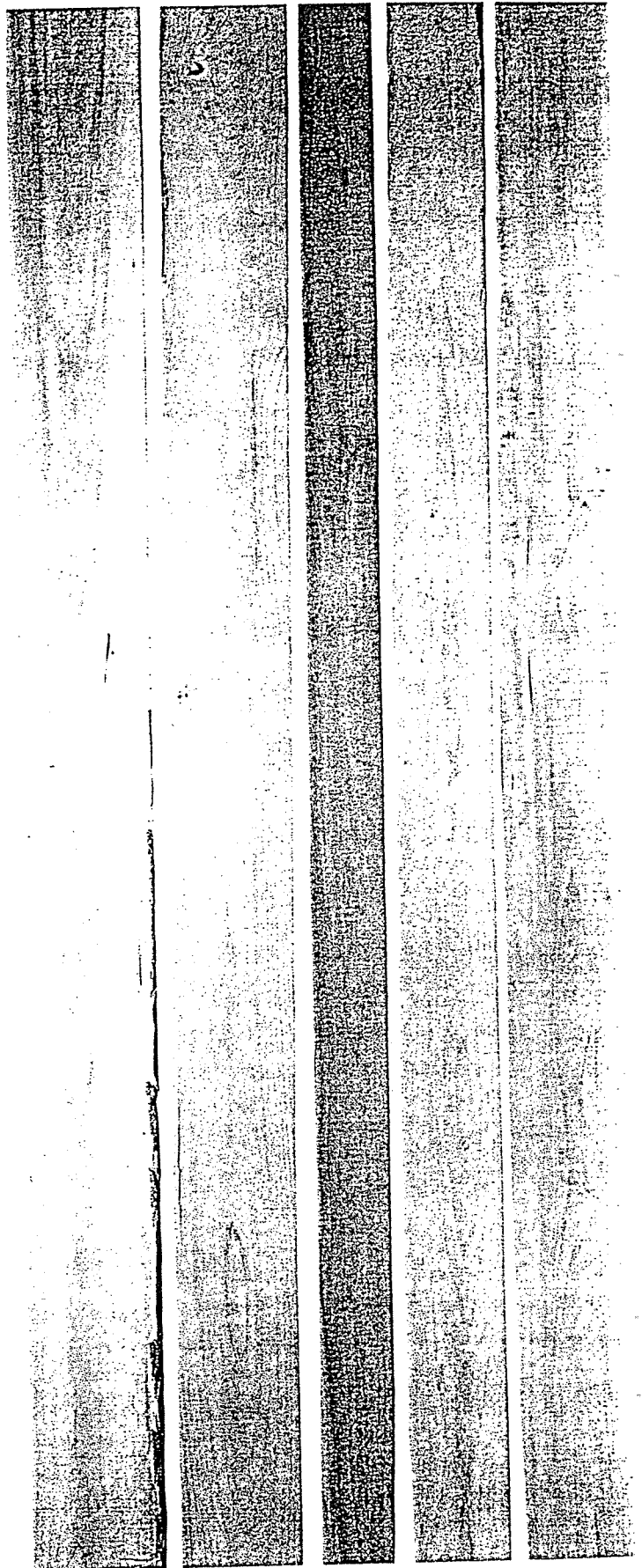
Characteristics: Basically straight-grained, light in weight, excellent strength and moderately stiff and very stable when dried.

Texture: Very uniform, the softness and evenness of the grain make it excellent for moulding, machining and gluing.

The Wood: One of the most abundant hardwoods growing in the Eastern U.S., the Tulipwood grows fast and straight and has excellent woodworking properties. Takes paints and stains well, very easily sanded and worked. Tasteless, can be used for food packaging. Widely used for interior trim, furniture, picture frames, toys and is adaptable to any hardwood application.

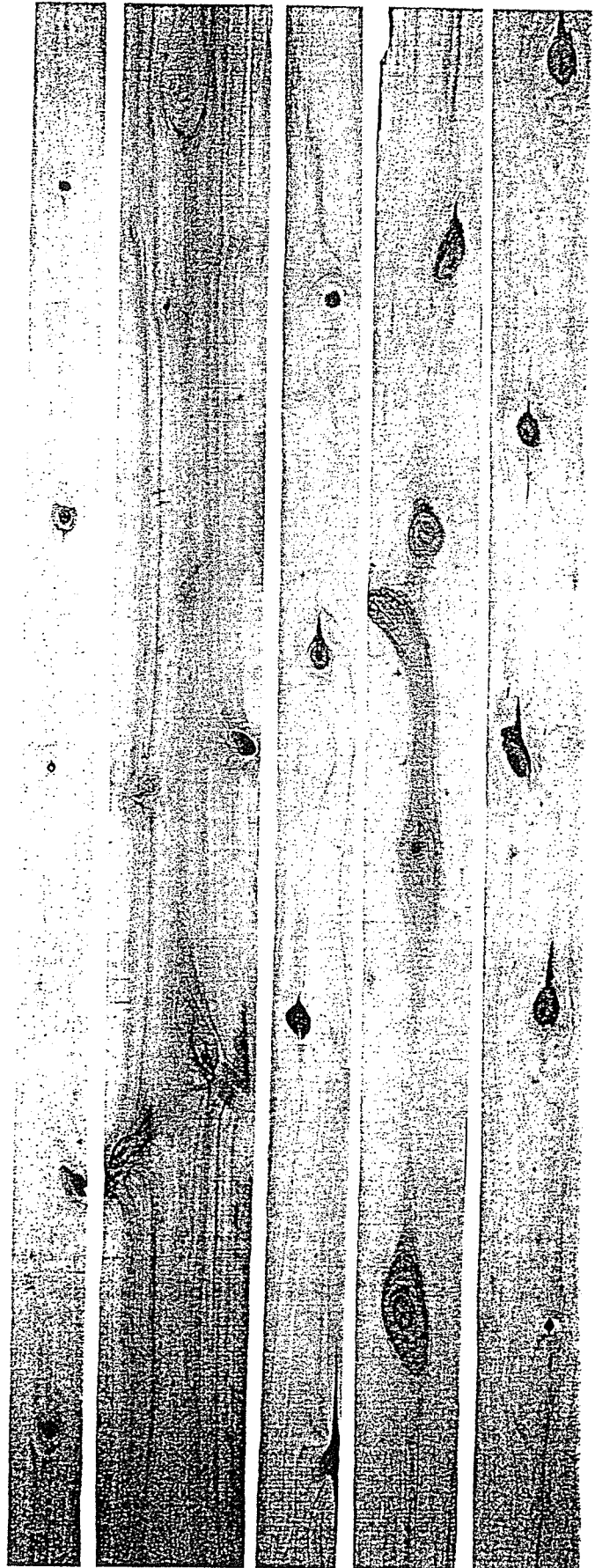


All boards pictured are 10' lengths.





No. 1



No. 2A

Walnut

Species: *Juglans nigra* (American Black Walnut)

Color: Sapwood is a pale yellow. When steamed, it becomes a warm buttery tan. The heartwood ranges from a light brown to a deep purplish-brown.

Characteristics: High figured with small, tight burls; wavy, satiny grain.

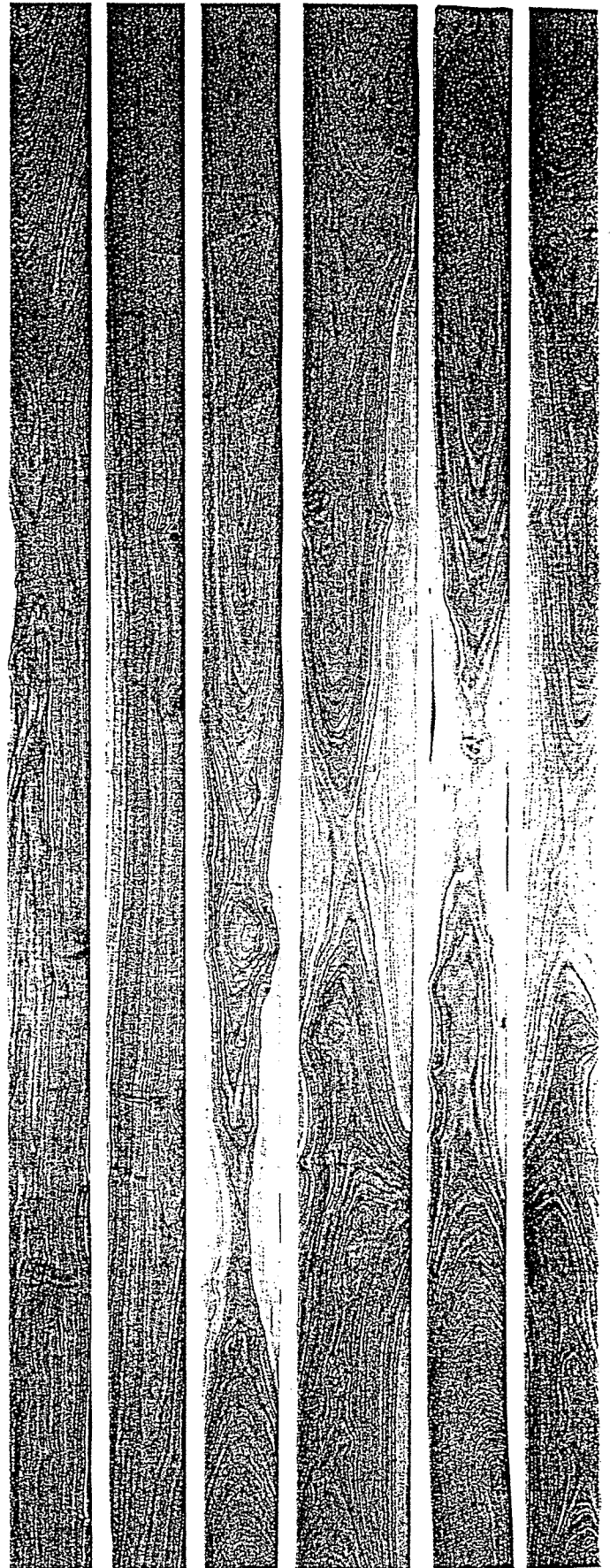
Texture: The Rolls Royce of cabinet woods. Unsurpassed finishing, sanding, turning and carving. (With care) excellent results can be expected in blending sapwood and heartwood.

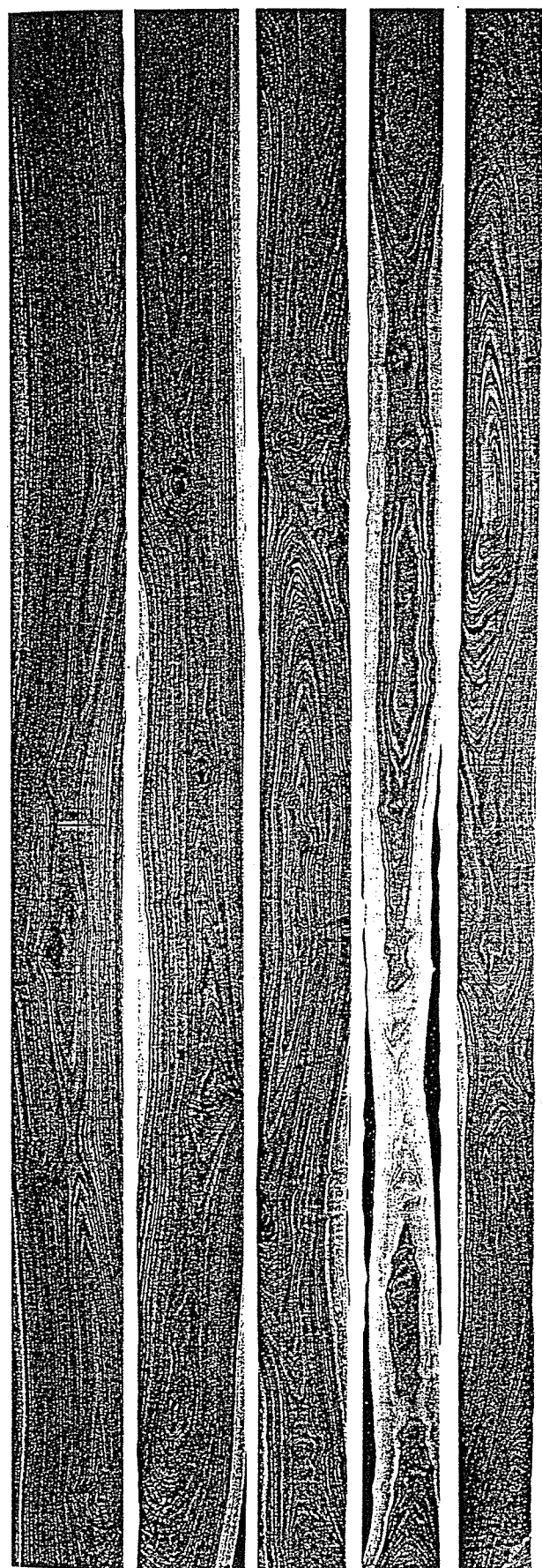
The Wood: The Walnut grading rules are somewhat different from the previous species because of the nature of the tree. Walnut does not grow in pure stands, and often individual trees are shorter-bodied and of medium diameter. In lumber, the FAS grade will allow a 6' long board and shorter clear-face cuttings. The pictures shown depict the lightness of the sapwood, which with finishing work can be made indistinguishable from the heartwood. The lower grades (No. 1 and No. 2) of Walnut lumber tend to be generously figured with numerous knots, tight burls, and wavy grain which enhances the beauty of the wood, setting Walnut apart from all other hardwoods.



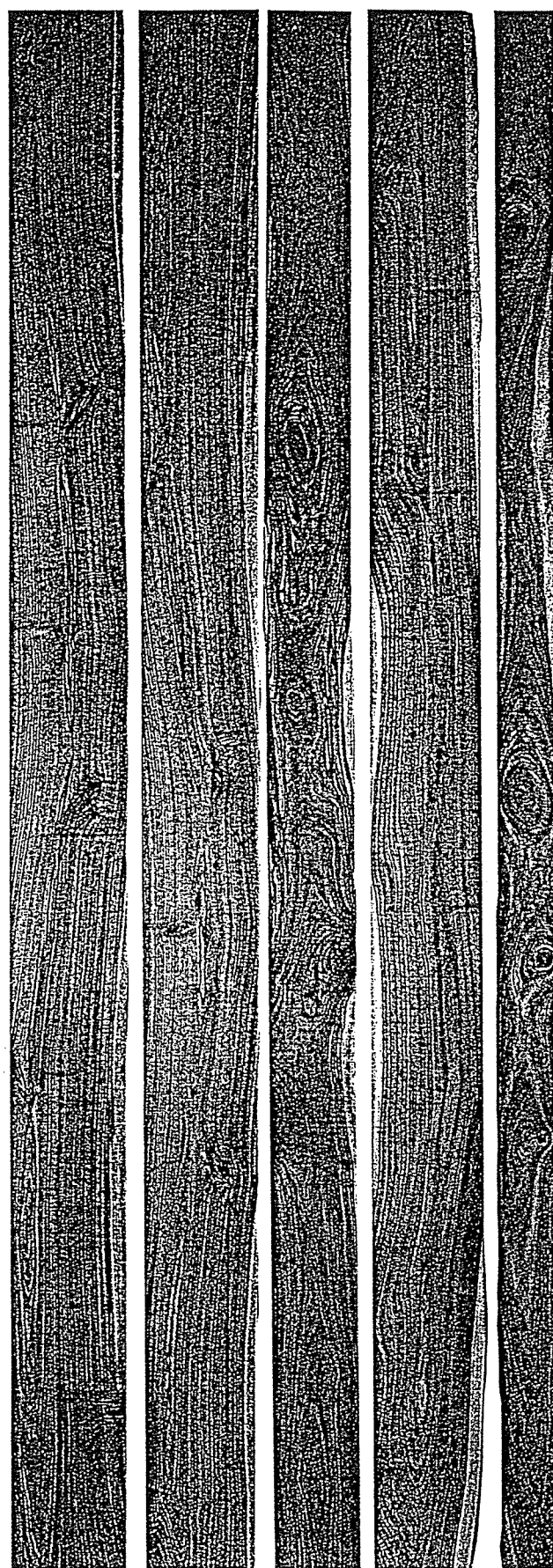
Walnut

All boards pictured are 10' lengths.





No. 1



No. 2A



CONVERSION GUIDE

While most sectors of commerce and industry in the United States have steadfastly avoided conversion to the metric system of weights and measures, anyone involved in international trade will have more than a passing acquaintance with metric conversions. Metric expression have been a fact of Canadian life for some time, and an increasing number of mills on both sides of the border are producing lumber in metric sizes for export markets.

This conversion guide has purposely been restricted to the basics. If you want to convert kilogram-calories into ergs, please look to a more scientific source.

One important thing to remember is that many forest products industry terms are based on rules of thumb; i.e., a cord can be a loosely stacked unit of wood measuring 128 ft³ including bark and air space between the

wood. Board feet, unless applied to full-sawn lumber, is similarly vague, and in the case of sawlogs is an estimate of the lumber yield contained therein. Converting an inexact unit of measurement to a precise volume such as a cubic meter is a matter of consensus rather than mathematics.

We have attacked the often-knotty problem of conversions between board and square feet and cubic meters. Manufactured products are simple as the volumes are precise; it's more a matter of getting them all in one place than anything else. The conversion for logs is an accepted average that should be used only for general estimating purposes. Specific conversion tables exist for Scribner, Doyle and International Log Rule board foot volumes and even these caution that the only way to achieve precision is to calculate the volume for each log.

Common equivalents: US to Metric

Length	1 foot	= 0.305 meter
	1 inch	= 25.400 millimeters
	1 inch	= 2.540 centimeters
	1 mile	= 1.609 kilometers
	1 yard	= 0.914 meter

Common equivalents: US to Metric (*continued*)

Area	1 acre	= 0.405 hectare
	1 square foot	= 0.093 square meter
	1 square inch	= 6.452 square centimeters
	1 square mile	= 2.590 square kilometers
	1 square mile	= 258.999 hectares
	1 square yard	= 0.893 square meter
Volume or capacity	1 cubic inch	= 16.390 cubic centimeters
	1 cubic foot	= 0.028 cubic meter
	1 cubic yard	= 0.765 cubic meter
	1 gallon (Imperial)	= 4.546 liters
	1 gallon (US)	= 3.785 liters
	1 quart (liquid)	= 0.946 liter
Mass or weight	1 ounce	= 28.349 grams
	1 pound	= 0.454 kilogram
	1 long ton (2240 pounds)	= 1.016 metric tons
	1 short ton (2000 pounds)	= 0.907 metric ton
	1 short ton (2000 pounds)	= 907.185 kilograms
Force	1 horsepower	= 0.746 kilowatt
	1 foot-pound	= 1.356 joules
Ratios	1 foot per minute	= 0.305 meter per minute
	1 foot per second	= 18.290 meters per minute
	1 gallon per minute	= 0.063 liter per second
	1 pound per cubic foot	= 16.02 kilograms per cubic meter
	1 pound per square foot	= 4.882 kilograms per square meter
	1 pound per square inch	= 0.070 kilogram per square centimeter
	1 pound per square inch	= 0.068 atmosphere

Wood industry equivalents: US

1 board foot	= 144 cubic inches
1000 board feet	= 160 cubic feet (solid)
1000 board feet	= 1.6 cunits
1 bone dry ton (chips)	= 2000 pounds (dry weight)
1 bone dry unit (chips)	= 84.8 cubic feet (solid)
1 bone dry unit (chips)	= 2400 pounds (dry weight)
1 cord (stacked, including air space)	= 128 cubic feet
1 cord (stacked, excluding air space)	= 78 cubic feet
1 cord (solid wood)	= 390 board feet
1 cord (solid wood)	= 90 cubic feet
1 cord (chips)	= 8.34 cubic yards
1 cord (chips)	= 2.5 tons
1 cord (chips)	= 1.17 units
1 cubic yard (chips)	= 600 pounds
1 cunit (chips)	= 2.25 green tons
1 unit (chips)	= 200 cubic feet
1 unit (chips)	= 0.85 cord
1 unit (chips)	= 4440 pounds
1 cubic foot	= 12 board feet
1 cunit	= 100 cubic feet (solid)
1 cunit	= 625 board feet

Wood industry equivalents: US to Metric

1000 board feet (lumber, full sawn)	= 2.358 cubic meters
1000 board feet (logs, average)	= 4.530 cubic meters
1 bone dry ton (chips, solid)	= 2.400 cubic meters
1 cord (solid)	= 2.550 cubic meters
1 cord (stacked, including air space)	= 3.625 cubic meters
1 cunit (solid)	= 2.832 cubic meters
1000 square feet (panels, 1/8-inch)	= 0.295 cubic meter
1000 square feet (panels, 1/4-inch)	= 0.590 cubic meter
1000 square feet (panels, 3/8-inch)	= 0.885 cubic meter
1000 square feet (panels, 1/2-inch)	= 1.180 cubic meters
1000 square feet (panels, 3/4-inch)	= 1.770 cubic meters
1 unit (chips)	= 5.664 cubic meters

Common equivalents: Metric to US

Length	1 millimeter	= 0.039 inch
	1 centimeter	= 0.394 inch
	1 meter	= 3.281 feet
	1 meter	= 1.094 yards
	1 kilometer	= 0.621 mile
Area	1 hectare	= 2.471 acres
	1 hectare (10,000 square meters)	= 0.004 square mile
	1 square centimeter	= 0.155 square inch
	1 square meter	= 10.764 square feet
	1 square meter	= 1.196 square yards
Volume or capacity	1 square kilometer	= 0.386 square mile
	1 cubic centimeter	= 0.061 cubic inch
	1 cubic meter	= 35.315 cubic feet
	1 cubic meter	= 1.308 cubic yards
	1 liter	= 0.220 gallon (Imperial)
Mass or weight	1 liter	= 0.264 gallon (US)
	1 liter	= 1.057 quart (liquid)
	1 gram	= 0.035 ounce
	1 kilogram	= 2.205 pounds
	1 metric ton (1000 kilograms)	= 2204.586 pounds
Force	1 metric ton (1000 kilograms)	= 1.102 short tons (2000 pounds)
	1 metric ton (1000 kilograms)	= 0.984 long ton (2240 pounds)
	1 kilowatt	= 1.341 horsepower
Ratios	1 joule	= 0.738 foot-pound
	1 atmosphere	= 14.700 pounds per square inch
	1 kilogram per cubic meter	= 0.062 pound per cubic foot
	1 kilogram per square centimeter	= 14.223 pounds per square inch
	1 kilogram per square meter	= 0.205 pound per square foot
	1 kilometer per hour	= 54.680 feet per minute
	1 kilometer per hour	= 0.621 mile per hour
	1 liter per minute	= 0.004 gallon per second
	1 meter per minute	= 0.055 feet per second
	1 meter per minute	= 3.281 feet per minute
	1 meter per second	= 196.800 feet per minute

Wood industry equivalents: Metric to US

1 cubic meter (lumber)	= 0.424 thousand board feet
1 cubic meter (logs)	= 0.221 thousand board feet
1 cubic meter (chips, solid)	= 0.417 bone dry unit
1 cubic meter (pulpwood, solid)	= 0.392 cord
1 cubic meter (pulpwood, stacked)	= 0.276 cord
1 cubic meter (solid)	= 0.353 cunit
1 cubic meter (panels)	= 3390 square feet (1/8-inch)
1 cubic meter (panels)	= 1695 square feet (1/4-inch)
1 cubic meter (panels)	= 1130 square feet (3/8-inch)
1 cubic meter (panels)	= 847 square feet (1/2-inch)
1 cubic meter (panels)	= 565 square feet (3/4-inch)

Temperature conversion

$$\text{Degrees C} = (\text{degrees F} - 32) \times 5/9 \text{ [or .5555]}$$

$$\text{Degrees F} = (\text{degrees C} \times 9/5 \text{ [or 1.8]}) + 32$$



NORTH AMERICAN WOODS

Characteristics and Uses

HARDWOODS

ALDER

Natural color—Pale pinkish brown to almost white, little difference between sapwood and heartwood.

Grain—Straight or mildly wavy.

Grain figure—Plain or mildly figured.

Texture—Diffuse porous, close-textured.

Specific gravity [at 12% m.c.]—0.41

Weight per cubic foot [at 12% m.c.]—28 lbs.

Hardness—Moderately hard.

Strength—Medium.

Stability—Good.

Decay resistance—Not durable.

Shock resistance—Good.

Bending—Poor to fair.

Nailing and screwdriving—Fair to good.

Nailholding and screwholding—Fair to

Gluing—Good.

Sanding—Fair.

(3/0 coarsest grit used without scratching, 4/0 gives best results)

Sawing—Good

(Seldom requires special setting or saw conditioning)

Shrinkage—Medium.

Stiffness—Moderate.

Machinability with hand tools—Good.

General machinability—Good

Planing, joining and moulding—Good (10 to 25 degree cutting angles best, finish—9 to 13 knife cuts per inch).

Shaping—Good.

Boring—Good.

(Brad point bits with strong stubby cutting lips best).

Turning—Good.

Mortising—Fair.

Paintholding—Excellent.

Staining—Takes stain well, wiping, NGR and water stains used.

Filling—Seldom filled.

Sealing—Takes any sealer or primer coat.

Bleaching—Good, for light finishes.

Finishing—Good.

(Takes and holds all kinds of paints, enamels, shellac, varnishes, lacquers and synthetic top coats well).

Natural finish—Good.

Remarks:

Red Alder is the leading hardwood of the Pacific Northwest and grows along the coast from Sitka, Alaska to Santa Barbara, California but reaches its best growth in Oregon and Washington. Although it seldom grows more than 70 to 80 miles inland, some Red Alder is found along the streams in Idaho. Its stand has been estimated at about 2,640,000,000 board feet and the annual cut average about 23,000,000 board feet.

There are few native hardwoods on the Pacific Coast and Red Alder's importance can be appreciated by the fact that Oregon and Washington chair and furniture plants use more Red Alder than all other woods combined. It seasons easily with either air or kiln drying methods. Although green lumber has a tendency to turn reddish brown when exposed to air for prolonged periods, this is just a surface discoloration which is easily dressed off in planing. On plain sawn lumber annual rings provide an obscure pattern, but otherwise the wood contains no decided ornamental figure.

The heartwood and sapwood of Red Alder are usually about the same color, ranging from pale pinkish brown to almost white. Its pores are small, uniform in size and uniformly distributed. In hardness and strength Red Alder ranks between Red Gum and Poplar. The wood is compact, with rather fine,

even grain, not very hard and of medium weight and strength. It is moderately stiff and shrinks very little. Red Alder is not durable in contact with the soil or exposed to the weather, but takes all finishing materials well and glues very well.

Red Alder has little use as a veneer but is very extensively used as corestock for plywood and is sometimes used in 3-ply panels for drawer stock. It's excellent stability also makes it very popular for glued-up tops for tables and case goods. Since it seasons easily, turns and carves well, holds its shape and finishes readily to imitate finer cabinet woods, Red Alder is also very popular for exposed parts of upholstery and other furniture items. These same properties also suit it admirably as a chair stock material and its stiffness is adequate for most chair applications.

Red Alder generally finishes very well in novelty finishes as well as the standard Mahogany, Maple and Walnut finishes. It does sometime vary in color and texture and the slash grain hardness of Red Alder usually provides any staining operation with a highlighting effect which is used to good advantage by many furniture plants. Where highlighting is preferred and uniformity of color is not required, water stains and NGR stains are generally used.

Where a uniform color effect is required, pigment wiping stains are commonly used to uniform and enhance the wood grain. Sometimes a shading stain is used to even up the tone. When water stains or NGR stains are used, the uneven color and texture is also overcome by the use of a lacquer shading operation between the sealer and top coats.

Red Alder is also used to make a wide variety of novelties, such as floor lamps, hat racks, pedestals, mirror and picture frames, stands and stools. Some store fixture plants use this wood for wall cases rack and shelves, and much is used to make paper plugs which are turned and driven into the ends of paper rolls.

Other products produced from Red Alder include: beehives, buckets, bookends, dairy supplies, egg cases, pulleys, rollers, salad sets, toys wooden shoes and wooden soles for shower sandals and sport shoes. It is also much used for fuel and fireplace wood.

ASH

Natural color—White to brown.

Grain—Plain or fiddle back.

Texture—Ring porous, coarse-textured.

Color variation—Medium to extreme color difference.

Specific gravity [at 12% moisture content]—0.58.

Weight, per cubic foot [at 12% moisture content]—41 lbs.

Hardness—Hard.

Stiffness—High.

Strength—Good.

Stability—High.

Shock resistance—High.

Decay resistance—Low.

Bending—Good.

Nailing and Screwdriving—Tendency to split.

Nailholding and screwholding—Fair.

Gluing—Fair to good.

Thermal Conductivity, per hour and square foot—1.05 B.T.U. (measured at 12% moisture content and weight 40 lbs. per cu. ft.) (at mean temperature of 75-degs. F., temperature gradient 1-deg. F.) (per inch of thickness.)

Electrical resistance, at 80-degs. F. and m.c. 12%—55 megohms.

Sanding—Fair.

(2/0 grit if coarsest can be used to polish without scratching.)

Workability with hand tools—Poor.

General machinability—Good.

Sawing—Good. (Requires good set-swaged saws best.)

Planing, molding and jointing—Good.

(Cutting angle—15 to 30 degs., finish—11 to 15 knife cuts per in.)

Shaping—Good.

Boring—Fair.

Turning—Good.

Mortising—Good.

Paintholding—Excellent.

Staining—Good. (Takes any type stain.)

Filling—Good. (Filler is usually brown for standard finishes), white for contrasting novelty finishes).

Bleaching—Good. (Not too commonly used.)

Sealing—Good. (Takes any sealer or priming coat.)

Finishing—Good. (Takes all finishing materials well—lacquer, varnish, or synthetics.)

Natural finish—Excellent. (Popular treatment for wall paneling), (lightly sandblast to simulate weathering and) (finish natural.)

Remarks:

Ash has properties particularly suitable for furniture; possesses sufficient strength and hardness, but is not too hard to work satisfactorily; holds its shape well, and exhibits a good figure when plain-sawn. It takes an excellent finish and Ash veneer is pleasing and attractive. An ideal handle wood, it is extensively used for tools, agriculture equipment, and sporting goods. It provides a strong stiff material for refrigerators and other implements and containers where it is necessary the wood imparts no odors to food products. Ash is also ideal for bent work, upholstery and construction frames, vehicle parts, and aircraft parts, such as propellers, longerons, and bearing blocks.

ASPEN

Natural color—sapwood—whitish to very light gray, heartwood—pale grayish brown or grayish white.

Grain—Straight and mild.

Texture—Diffuse-porous, close-textured.

Color variation—Very little.

Specific gravity [at 12% m.c.]—0.38

Weight per cubic foot [at 12% m.c.]—26 lbs.

Hardness—Soft.

Stiffness—Good.

Strength—Moderate.

Stability [ability to stay in place]—Good.

Decay resistance—Poor.

Shock resistance—Moderate.

Bending—Poor.

Nailing and screwdriving—Little tendency to split.

Nailholding and screwholding—Fair to good.

Gluing—Good.

Sanding—Fair, inclined to fuzziness.

(Will polish with 3/0 without scratching, 4/0 gives best results)

Odor and taste—None.

Workability with hand tools—Good.

General machinability—Good.

Sawing—Fair to good, inclined to fuzz.

Planing, moulding and jointing—Fair to good, inclined to fuzz when dressing.

(Best cutting angles—15 to 20 degrees, finish—10 to 16 knife cuts per inch, back bevel required for best results).

Shaping—Good.
 Boring—Good.
 (Brad-point bits with strong stubby cutting lips best).
 Turning—Good.
 Mortising—Good.
 Paintholding—Good.
 Staining—Good.
 (Takes practically any stain but most used in colored finishes).

Sealing—Good.
 (Takes any sealer or primer coat).
 Filling—Seldom required as wood is very close-textured.
 Bleaching—Not required.
 Natural finish—Seldom used as wood has little character.
 General finishing—Good, provides excellent paint or enamel base.

Remarks:

Aspen is a true Poplar of the Willow family, one of the 11 members of Poplar or Cottonwood group found in the United States. It is generally found in two species: the Big-Tooth Aspen, also known as Large-Tooth Poplar, and Quaking Aspen, also called Popple, and Trembling Poplar. It was long regarded as merely a weed tree and has not been economically important to the wood-working industry until the last few years.

Aspen's growth is widely scattered over a wide range from the Arctic Circle to lower California and northern Mexico across the northern plains through the Lake States to New England and along the Appalachian Mountains as far south as Kentucky and Tennessee. Aspen enjoys its widest usage in the Lake States where the stand of marketable timber has been estimated at about 6,500,000,000 board feet but only about 40% of the annual growth is currently being harvested.

Reports of a single year's cut throughout the country shows an annual cut of 153,720,000 board feet, with the Lake States producing about 152,000,000 board feet of the total cut. The lumber usage reports shows about 75% being used for shipping containers, 14% for building purposes, 8% for plywood core stock, 1.5% for furniture and 1.5% for novelties, Venetian blinds, wooden-ware, etc., but this did not include pulp logs or bolts used for props, excelsior and wood wool.

Aspen is a rapid-growth short-lived tree of relatively small size in comparison with other commercial species. It has been known to reach a height of 50 ft. and a diameter of 3 ft. and matures at 60 to 70 years. Aspen is so subject to heart rot, however, that many trees are destroyed before they are 50 years old. It has also been attacked in recent years by a fungus disease, known as Hypoxylon canker or Aspen canker, which attacks the barks and eats its way into the trunk to destroy its structure.

Both hardwood and softwood grading rules are used in grading Aspen, with hardwood rules applied generally for better grades used in cabinet and furniture and softwood rules for construction and container lumber. Users generally seem to feel that Aspen needs better grading practice to provide proper utilization. Manufacturers of food containers complain that some balm-of-Gilead often gets mixed into their stocks, with its objectionable odor and taste.

Aspen is very similar in appearance to Cottonwood and is often used as an alternate wood for Basswood in many applications. It has a very broad band of creamy white sapwood and narrow heartwood of grayish-brown or grayish-white color and the transition from sapwood to heartwood is usually not distinct. Lower grades are apt to have small and numerous knots but much has been sorted into better grades suited to furniture manufacture.

While some trouble was first

encountered with checking and warping when Aspen first came into general use, checking is not serious in seasoning Aspen with the possible exception of abnormal wood found in the heartwood of old trees. There has been some darkening of the wood at extreme high temperature but it seasons rapidly when milder kiln-drying schedules are used.

The wood is fine and uniform in texture, with indistinct grain markings, contains no resin, has good toughness for its light weight and exceptional stiffness, shows a high resistance to splitting in nailing, is soft and easy to work with either hand or machine tools. Although Aspen will have a tendency to fuzz when dressed wet, it machines fairly clean when proper cutting angles and cutting speeds and feeds are used. It has very good gluing and paint-holding qualities, gives uniform wear and wears smoothly without splintering. Aspen's stability is one of its outstanding qualities.

Aspen is a short-fibered wood much used for pulping purposes. Aside from its popular use in paper pulp, Aspen fibers are used as a basefiller for many building, insulating and roofing papers as well as for floor coverings. They are also used to make a structural wall-board, with a binder or excelsior, which is said to be fireproof, soundproof and waterproof.

Where it is available in sufficient quantity, Aspen is rapidly replacing basswood in the manufacture of excelsior. Excelsior manufacturers claim its light color, light weight, toughness and freedom for odor produces top grade excelsior with less machining difficulties than most other excelsior woods.

Due to its tendency to decay rapidly under damp conditions, Aspen is not too much used for outside purposes. It has been used in limited quantities for fencing, pit props in coal mines, and railroad ties, but does not respond too well to standard preservative treatments.

Aspen's use as a core material has increased considerably due to its ability to take and hold glue, stability, lack of resin, light weight and ease of working. It possesses good uniformity of structure and is a wood of low density to suit it well for core veneer in plywood panels to maintain panel stability and minimize shrinkage stresses in the construction. In veneer cutting Aspen works like basswood as it can be cut successfully without heating the bolts at either the rotary lathe or veneer slicer.

Most Aspen of the Popple variety goes into core and container veneer. Aspen veneer of the decorative grade is usually the silver white Poplar native to Asia and Europe, which was planted in the United States chiefly in Delaware, Maryland and Pennsylvania. This has a velvety white sapwood and light brown heartwood, sometimes streaked with brown, to produce veneer of plain or mild figure. Very little highly figured stock is available.

The largest current use of Aspen is by the container industry and it is often rated as high as Ponderosa Pine for container construction. Aspen is noted for its ability to withstand rough handling as a box or crate. Its popularity as a container wood is due principally because of its light color, light weight, high resistance to splitting in nailing, toughness for its weight, and freedom from taste and odor. It also prints very well.

Aspen is preferred as a food container wood for shipping cheese, fruits, meat and other food stuffs. It is used also for baskets and egg crates, and the cooperage industry is using it in increasing quantities for barrels, kegs, buckets and pails.

Though confined to lumber of relatively small size, Aspen has been used by the building trade for flooring, rafters, sheathing, shiplap, stringers and studding as well as for interior trim and finish. It takes paint very well and is easily worked with hand tools.

Furniture plants have not made an extensive use of Aspen as possible due to the rather limited and somewhat uncertain supply. Its chief applications have been for juvenile and painted furniture, shelving, backs and interior supporting constructions. Workmen like its easy workability and smooth surface and finishers praise its property to take white and tint colors easily. Due to its small size, however, Aspen is usually first glued-up into panels and then dimensioned according to end use.

Other products made from Aspen in some quantity include: clothes pins, brushes, casing, ceiling, door frames, dowels, handles, matches, shoe fillers. Shoe forms, shoe lasts, shoe trees, spool heads, toothpicks toys, vehicle body parts and wood wool.

Aspen has long been recognized as a good fuel wood and is said to burn freely even when green. It was also said to be the principal fuel wood of the northern Canadian Indians, who also used its bark for medical purposes. The inner bark of the Aspen is the chosen food of the beaver and is used to some extent to make an extract used as a quinine substitute.

BASSWOOD

Natural color—Cream, nearly white.
 Grain—Straight, very mild.
 Texture—Diffuse porous, close-textured.

Color variation—Little difference between sapwood and heartwood, occasional mineral streaks.

Specific gravity [at 12% m.c.]—0.37.
 Weight per cu. ft. [at 12% m.c.]—26 lbs.

Hardness—Soft.
 Stiffness—Fairly stiff.
 Strength—Moderate to low.
 Stability [ability to stay in place]—Good.

Decay resistance—Low.
 Shock resistance—Low.
 Bending—Poor.

Nailing and screwdriving—Fair to good.
 Nailholding and screwholding—Moderate.

Gluing—Good.
 Electrical resistance [at 80-degs. F. and 12% m.c.]—45 megohms.

Sanding—Fair but troublesome.
 (4/0 grit is coarsest that can be used to polish without scratching).

Odor and taste—None.
 Workability with hand tools—Good.
 General machinability—Good.

Sawing—Good.
 Planing, moulding and jointing—Fair to good. (Best cutting angles 20 to 30-degs.; finish-9 to 15 knife cut per inch).

Shaping—Fair, if not shaped at sharp angles.
 Boring—Good. (brad-point bits with long taper cutting lips are best).

Turning—Poor.
 Mortising—Fair.

Paintholding—Excellent for both paint and enamel.

Staining—Good (use only non-grain-raising stains as oil stains muddy up because of fuzzy grain).

Bleaching—Not necessary, don't waste time on mineral streaks, practically impossible to remove.

Sealing—Good (takes any sealer or primer coat).

Filling—Fair (only used for natural and stain-colored finishes).

Finishing—Excellent for paint and enamel finishes, good for regular finishes where special treatments are used.

Natural finish—Poor, no grain figure. (not advised).

Remarks:

Basswood is light in weight and color, moderate to low in strength, soft and close in texture, easily workable, straight-grained, easily glued, and diffuse porous; has the ability to remain flat without distortion, excellent nailing and screwing properties, good sound and heat insulating qualities but only moderate shock resisting qualities. It has a fine ability to take paint and enamel finishes.

It dries easily. Basswood's clean look, together with the fact it imparts neither odor or taste, makes it especially desirable for foodstuffs and food items such as honey, fruit and berries. In the form of veneer, it is much used for basket, fruit and berry box manufacture and shipping containers, as well as for crossbanding and low density plywood. It is also well suited as corestock to make substantial and economic cores.

As a furniture wood, Basswood is used in drawer constructions, interior cabinet and case goods parts, hidden upholstery frame construction, table tops that are to be covered or enameled, carvings, fretwork, furniture backings and bottoms, and picture and mirror frames.

It is an ideal toy wood due to its softness and easy workability and is the leading hardwood used in the manufacture of crates and boxes. Basswood is used in the aircraft industry for ribs and flooring, in building, as wall paneling and stock trim that is to be painted or enameled, in general manufacture, for farm tools, laundry appliances, excelsior, advertising accessories, paper pulp, Venetian blinds, and in home workshops, as a general all-purpose wood.

In short, Basswood has the most common and all-around versatility of any of the American hardwoods, chiefly because it is so soft and workable.

BEECH

Natural color—White to reddish.

Grain—Straight to interlocked, mild figure.

Texture—Diffuse porous, close-textured.

Color variation—Some difference between sapwood and heartwood.

Specific gravity [at 12% m.c.]—0.64.
Weight per cubic foot [at 12% m.c.]—44 lbs.

Hardness—Hard.

Stiffness—High.

Strength—Good.

Stability [ability to stay in place]—Low.

Decay resistance—Low.

Shock resistance—High.

Bending—Good.

Nailing and screwdriving—Tendency to split.

Nailholding and screwholding—High.

Gluing—Good, under controlled gluing conditions.

Electrical resistance—Good.

Sanding—Fine, takes good finish.

(Will polish with 3/0 without scratching, 4/0 gives best finish)

Odor and taste—None.

Workability with hand tools—Poor to fair.

General machinability—Good.

Sawing—Fair to good, requires good set in saws.

Planing, moulding and jointing—Good.

(Best cutting angles—10 to 20-degs., finish—12 to 14 knife-cuts-per-inch, back bevel required for best results.)

Shaping—Good.

Boring—Good.

(Brad-point bits with strong stubby cutting lips best)

Turning—Good.

Mortising—Good.

Paintholding—Good, except for white lead and zinc oxide paints.

Staining—Good.

(Use pigment wiping stains where parts to be finished have been steam bent.)

Sealing—Good.

(Takes practically any sealer or primer coat)

Filling—Fair.

(Seldom requires filling for finishing)

General finishing—Good for all types of finishes although seldom used in natural finish except for flooring and interior finish.

Remarks:

Beech is a hard, strong, heavy, close-grained hardwood, from white to reddish in color, with some difference between the sapwood and heartwood; requires careful control in drying and gluing; is not too durable in contact with the soil and shrinks considerably in drying yet is especially wear-resistant to mechanical wear when wet or in water; has a tendency to split with the driving of nails and screws but possesses excellent nailholding and screwholding properties.

It is not toxic and does not impart odor or taste when in contact with foodstuffs and is much used in the form of veneer for baskets, fruit and berry boxes, and from lumber for barrels and boxes as food containers. Beech has strength, hardness, and wear-resistant properties which make it ideal for heavy-duty economical flooring and its excellent shaping and turning properties make it an excellent wood for brushes and handles and other turned and shaped woodenware and novelties.

As a furniture wood, Beech is used extensively for bent-wood parts and interior frame and construction parts. It dresses very smooth and sands to a high polish. It takes practically any type of finish well. Its unusual reaction to friction set up by moving contact with other wood which causes it to wear slick and makes it ideal for drawer construction, guides, fences, and other jig and fixture work used in woodworking, as well as for bushings and loose pulleys. Beech can be used equally well for exterior parts where they are to be stained or where fancy grain figure is not required.

Beech is a good toy wood because of its non-toxic qualities and its lack of any tendency to splinter on corners of square toys. Its peculiar spine, a combination of strength, stiffness and hardness, adapts it to the manufacture of slim, delicate turnings with high strength requirements, such as skewers, dowels, and candy sticks. It is also much used as a vehicle wood, for agricultural implements, sporting goods, textile, dairy and poultry equipment.

Although Beech is very strong and hard and quite heavy, it is not difficult to machine. Its high shock resistance quality in combination with other properties has caused it to be used extensively for railroad ties despite its lack of decay resistance. It is one of the few hardwoods that is available in good quantity and up to now has suffered more from lack of knowledge of its excellent physical properties and possible uses than from any pronounced deficiency and has long been forced to masquerade in various wood product assemblies under the identity of other hardwoods used due to lack of favorable publicity which could lead to public acceptance of Beech as an all-purpose hardwood.

BIRCH

Natural color—Cream to reddish brown.

Grain—Straight to curly, mild.

Texture—Diffuse porous, close-textured.

Color variation—Considerable color

difference.

Specific gravity [at 12% m.c.]—0.57.

Weight per cubic foot [at 12% m.c.]—44 lbs.

Hardness—Moderate hard to hard.

Stiffness—High.

Strength—Good.

Stability [ability to stay in place]—Good.

Decay resistance—Durable to non-durable.

Shock resistance—High to very high.

Bending—Good.

Nailing and screwdriving—Tendency to split.

Nailholding and screwholding—Fair to good.

Gluing—Fair to average.

Electrical resistance—[at 80-degs. F. and 12% m.c.]—200 megohms.

Sanding—Fair.

(Will polish with 3/0 without scratching, 4/0 gives best results.)

Odor and taste—Very little.

Workability with hand tools—Good.

General machinability—Good.

Sawing—Good.

Planing, moulding and jointing—Good.

(Best cutting angles 15 to 20-degs., finish 10 to 16 knife cuts per inch, back bevel required for best results.)

Shaping—Excellent.

Boring—Good.

(Brad-point bits with strong stubby cutting lips best.)

Turning—Very good.

Mortising—Excellent.

Paintholding—Good.

Staining—Good.

(Takes practically any stain. Use pigment stains where parts to be finished have been steam bent.)

Sealing—Good.

(Takes practically any sealer or primer coat.)

Filling—Fair.

(Not necessary except for novelty or fine finishes.)

Bleaching—Fair.

(Not too effective on mineral stains, used principally for light blonde or novelty finishes.)

Natural finish—Good, with rich, uniform effects.

General finishing—Good for all types of finish, either natural or under stain, provides excellent paint or enamel base.

Remarks: Birch is a good all-purpose wood in solid form and in the form of veneer or plywood. It ranks fourth from the standpoint of volume among United States furniture woods and of the 134 representative uses of all American commercial woods finds a place in nearly 50% of the applications. While it is sufficiently strong and hard for most purposes, it is not excessively hard and holds its shape well under ordinary conditions.

In the form of White Birch, it is extensively used for turnings, spools, bobbins, spoons, skewers, candy stick handles, boot and shoe findings, shoe pegs, brush blocks and handles, boxes and woodenware. It is also used for basket veneer, handle and cleat stock.

In the commercial grade which combines yellow, black and sweet Birch, it is popular for furniture, millwork, office and store fixtures, plumber's woodwork, vehicle parts, caskets, interior woodwork and flooring. Birch has a very even texture, a fine and close grain, is relatively easy to work, and takes a fine polish. Its extreme hardness makes it extremely wear-resistant and it is very adaptable to fine finishes, taking any stain, bleach or finishing material and reacts equally well to natural and enamel finishes.

Birch is well-liked as a veneer wood and core-wood for plywood. In straight grained veneer, it is much used for panel faces for high grade commercial plywood and curly Birch veneer has a wavy grain with a changeable silk effect (similar to satinwood) for fancy

face veneer. Rotary-cut Birch veneer does not crack or check along the grain but it should be filled in finishing. Birch is one of the leading woods used in producing compreg and other densified wood products.

Birch has recently been exposed to a blight which has moved from Canada down to New York and the New England states but it is still found in good supply.

BUCKEYE

Natural color—White to grayish brown
Grain—Straight.

Texture—Diffuse-porous, close-grained.

Color variation—Very little.

Specific gravity [at 12% m.c.]—0.36.

Weight per cubic foot [at 12% m.c.]—25 lbs.

Hardness—Moderately soft

Stiffness—Good.

Strength—Fair.

Stability [ability to stay in place]—Good.

Decay resistance—Durable.

Shock resistance—Fair.

Bending—Fair to poor.

Nailing and screwdriving—Fair to good.

Nailholding and screwholding—Fair to good.

Gluing—Good.

Sanding—Good.

(3/0 best for production sanding)

Odor and taste—Noticeable

Workability with hand tools—Good.

General machinability—Good.

Sawing—Good.

(Requires good set in saws)

Planing, moulding, jointing—Good.

(Best cutting angle—15 to 30 degree, finish—11 to 15 knife cuts per inch.)

Shaping—Fair to good.

Boring—Good.

(Brad-point bits with medium-long taper cutting lips best)

Turning—Good.

Mortising—Good.

Paintholding—Good

Staining—Good.

Sealing—Good.

Filling—Fair, not always used.

Natural finish—Seldom used as grain figure has little character.

General finishing—Most used for stained or painted finishes with conventional top coats.

Remarks:

Buckeye is a species of the Horse Chestnut family and includes Ohio Buckeye, also known as Stinking or Fetid Buckeye, and Yellow Buckeye, sometimes called Sweet Buckeye. The Ohio Buckeye gets its unsavory alternate nicknames from its bark, which is very ill-smelling when bruised, and its spring flowers, which also have a very bad odor.

American Buckeye is found generally in the central area of the Alleghenies, the west slopes of the Appalachians and through the Ohio valley. It ranges through the bottomlands from central Pennsylvania to Alabama and west to Kansas. The principal lumber production is in Ohio, Kentucky and adjacent states. Buckeye is not of sufficient commercial importance to make accurate figures available on its stand or annual consumption. It has been estimated that about five million board feet of Butternut lumber is manufactured annually as a by-product of major hardwood lumber production.

One of the reasons the stand of Buckeye is not more plentiful in farm woodlands is the common practice of landowners to destroy the tree as soon as it is found growing in these locations. Farmers generally believe the fruits and leaves of this tree is poisonous to livestock.

Although the nuts of the buckeye are very bitter and non-edible, it is said to

make a paste with better adhesive power than most pastes and more resistant to the attack of insects. In certain sections of the country superstitious folks always carry a Buckeye in their pocket or in a small sack tied around their neck to ward off rheumatism.

The wood is usually quite white and has mechanical properties similar to Basswood as regards softness, lightness and workability. While it has a high resistance to splitting, Buckeye is easily machined and worked with hand tools. In its native habitat it is very popular as a whittling or carving wood. The grain has little character and is seldom used in natural finish but it takes stained and painted finishes very well and where available in the required quantity, Buckeye is much-used for enamel and colored-finished low priced furniture and juvenile pieces.

Buckeye has a combination of properties which suits it very well to the manufacture of artificial limbs. It works up to shape readily, and has the toughness and a certain stiffness required with lightness of weight required for a good prosthesis. Excelsior makers regard it as an excelsior material closely second to Basswood and in some sections of the country Buckeye is cut into long strips and woven into hats.

The chief uses of Buckeye are for boxes and crates and for concealed or exterior parts of furniture and millwork. Its exterior applications are generally in the low priced units that are painted or stained to simulate more expensive woods. Other applications find Buckeye used for excelsior, luggage frames, picture and mirror frames, mouldings, carvings, caskets, toys, laundry appliances, woodenware, artificial limbs and paper pulp.

BUTTERNUT

Natural color—Sapwood-whitish to light brown, heartwood-light chestnut brown or tan to pinkish brown, often streaked with occasional reddish or yellowish tinge or streaks.

Color variation—Very little between sapwood and heartwood.

Grain—Straight or irregular.

Grain figure—Usually plain.

Texture—Diffuse porous and soft textured.

Specific gravity [at 12% m.c.]—0.38.

Weight per cubic foot [at 12% m.c.]—27 lbs.

Hardness—Moderately soft.

Stiffness—Moderately limber.

Strength—Moderate.

Decay resistance—Durable.

Shock resistance—Fair.

Bending—Fair.

Nailing and screwdriving—Fair to good.

Nailholding and screwholding—Fair to good.

Gluing—Excellent.

Sanding—Good.

(3/0 coarsest grit that can be used without scratching, 4/0 best).

Odor and taste—Not noticeable.

Workability with hand tools—Very good.

General machinability—Good.

Sawing—Good.

(Best results with good set in saws.)

Planing, jointing, moulding—Good.

(Best cutting angles—15 to 30 degrees, finish—12 to 14 knife cuts per inch.)

Shaping—Good.

Boring—Good.

(Brad-point bits with strong stubby lips best.)

Turning—Good, some breakage of slender turnings.

Mortising—Good.

Paintholding—Good.

Staining—Good, takes all stains well.

Filling—Good.

(Brown or black fillers, except for light or natural finishes.)

Bleaching—Fair, mineral streaks hard to remove.

Finishing—Good, takes all finishes well and is often painted.

Natural finish—Good, with varied coloring effects in selected pieces.

Remarks:

Butternut is usually found in mixed hardwood stands, seldom in any great quantity. Sometimes called White Walnut, it is related to American Walnut botanically but form is poorer and wood is much softer and weaker than Walnut. No authentic figures are available on the present stand of Butternut timber or annual production of lumber. Butternut is chiefly a by-product of hardwood lumber operations and it's doubtful if more than a million board feet has been produced in a single year and present production is much less. Small quantities are also produced in the form of veneer.

Butternut is a small to medium-size tree, growing from 40 to 60 feet high and about 3 feet in maximum diameter. It is found chiefly along banks of streams and on low hillsides and its growth in the United States extends from Maine through the upper peninsula of Michigan to North Dakota and south into northern Arkansas and elevated sections of Alabama and Georgia.

Besides its more common names of Butternut and White Walnut, the tree is sometimes called Oil-Nut, from the early colonists' practice of making oil from the tree nuts. These early settlers also used to pickle the half-grown trunks in vinegar and made a mild cathartic solution by boiling down the bark and adding honey. Husks of the nuts and the bark also contain a water-soluble dye used for dyeing cloth.

While its quantity is necessarily limited, Butternut produces face veneer usually plain in a gray-brown color, which has an appearance similar to American Walnut veneer, except for color. This is either rotary-cut or sliced, with the greatest amount cut in flat veneer from 14 to 18 inches wide and generally 1/20-inch thick. This veneer is used for decorative purpose where strength is not a factor.

Butternut is attractive in grain and color and would be more widely used as a decorative wood for furniture and fixtures if larger quantities were available. Its pale brown satiny wood is soft textured, resembles the grain of American Walnut but is much lighter in color and does not afford as hard a surface. It is soft and has low stiffness and strength properties which restrict its structural uses. The grain shows a faint growth figure and numerous flakes are sometimes visible, which are grayish-brown in color and lighter than the general background wood.

While Butternut compares closest with Basswood and Buckeye in respect to mechanical properties, it is slightly heavier, harder stronger and tougher than these woods. It works very easily with hand tools and machines very well. The wood may be easily polished to a satiny luster and it takes a very good finish, whether natural, stained or painted.

Its chief applications for industrial use are in the manufacture of furniture and fixtures, where it is used to simulate more costly cabinet woods. Butternut also finds limited application in the manufacture of such items as boxes, crates, millwork, woodenware, musical instruments, boat decks, seats and trimming, altars, cabinets, cameras, caskets, cheese box heading, interior finish, piano cases, screen frames, show cases, display stands, toys and children's vehicles.

In addition to the by-products mentioned previously, Butternut sap is rich in sugar and a fairly good grade of syrup is produced from it for commercial use. Unlike maple syrup, however, it does not harden to make cakes of sugar. One of the reasons given for the restricted use of Butternut as a commercial lumber in greater quantities is that it is not a hardy tree, being subject to attack from many insects and fungus diseases and few trees reach maturity without serious injury.

CHESTNUT

Natural color—Light red to dark reddish brown.
Grain—Straight and mild.
Texture—Diffuse porous, close-textured.
Color variation—Marked color difference.
Specific gravity [at 12% m.c.]—0.50.
Weight per cubic foot [at 12% m.c.]—35 lbs.
Hardness—Medium to moderately hard.
Stiffness—Good.
Strength—Medium.
Stability [ability to stay in place]—Good.
Decay resistance—Durable.
Shock resistance—High.
Bending—Poor.
Nailing and screwdriving—Fair, some tendency to split.
Nailholding and screwholding—Fair to good.
Gluing—Good.
Electrical resistance [at 80-degs. F and 12% m.c.]—160 megohms.
Sanding—Excellent.
(Will polish with 3/0 without scratching, 4/0 gives best results).
Odor and taste—Very little.
Sawing—Very good.
Workability with hand tools—Very good.
General machinability—Very good.
Planing, moulding and jointing—Excellent. (Best cutting angles 10 to 25 degrees.)
Shaping—Excellent.
Boring—Good.
(Brad-point bits with strong stubby cutting lips best).
Turning—Excellent.
Mortising—Excellent.
Paintholding—Good.
Staining—Good.
(Takes practically any type of stain, although water stains are most generally used).
Sealing—Good.
(Takes practically any sealer or primer coat).
Filling—Fair.
(Usually used only on fine finishes.)
Bleaching—Not used.
Natural finish—Good, with attractive color and figure.
General finishing—Good for natural or stain-base finishes, is not adapted to paint or enamel finishes.

Remarks:

Cherry carries about the same grain as Walnut but the grade runs better and the lengths are longer. It is somewhat lighter in weight and softer than Beech or Birch; but is nevertheless a dense, moderately strong hardwood with excellent wearing qualities. Cherry is noted for its superior atmospheric-moisture resistance qualities, shrinking and swelling less and holding the finish better than any other wood. There is no other cabinet wood more free from warping propensities. Its natural finish is beautiful and it takes an excellent Walnut or Mahogany finish.

The supply of Cherry is not large, and nearly all available is used for high-grade work where its attractive color and figure can be used to the best advantage. It is produced in limited

amounts as face veneer in burls, crotches and swirls. Its beauty, luster, ability to withstand knocks, and easy workability makes Cherry most popular for interior trim, boat finish, furniture, clock cases and cabinets. It is similar to Walnut in that its color deepens with age.

Cherry is also extensively used by the printing trade to back electrotypes and zinc etchings. It is a popular tool handle wood and is much used in the construction of professional and scientific instruments and musical instruments. Pattern makers utilize its stability and non-warping qualities to the utmost and these properties also make it a favored wood for table construction, particularly for table tops.

Cherry is also credited with medicinal properties as an extract from the bark is used in medicine as a sedative or a tonic. Its fruit is also sometimes used to flavor rum or brandy.

CHESTNUT

Natural color—Grayish-brown.
Grain—Straight and heavy.
Texture—Ring porous, coarse-textured.
Color variation—Very little.
Specific Gravity [at 12% m.c.]—0.40.
Weight per cubic foot [at 12% m.c.]—30 lbs.
Hardness—Moderately hard.
Stiffness—Low.
Strength—Low.
Stability [ability to stay in place]—Excellent.
Decay resistance—Durable.
Shock resistance—Low.
Bending—Fair.
Nailing and screwdriving—Tendency to split.
Nailholding and screwholding—Good.
Gluing—Excellent.
Electrical resistance [at 80-degs. F. and 12% m.c.]—50 megohms.
Sanding—Good.
(3/0 gives best results for polishing.)
Odor and taste—Very little.
Workability with hand tools—Good.
General machinability—Good.
Sawing—Good.
(Requires good set and swaged saws to give best results.)
Planing, moulding and jointing—Good.
(Best cutting angle 15 to 20 degrees, finish-11 to 15 knife cuts per inch.)
Shaping—Good.
Boring—Good.
(Brad point bits with medium-long taper cutting lips are best.)
Turning—Excellent.
Mortising—Good.
Paintholding—Good to fair.
Staining—Good.
(Oil or wiping stains generally used.)
Sealing—Good.
(Takes practically any sealer or primer coat.)
Filling—Good.
(Is always filled for finishing unless finished V.O.W. (Varnish on wood) by dipping in heavy varnish.)
Bleaching—Not used.
Natural finish—Fair.
(Usually used in medium-priced or cheap furniture.)
General finishing—Good for natural or novelty finishes, but not used too extensively in stain-based finishes, such as Walnut and Mahogany. Takes paint or enamel well when properly primed and filled.

Remarks:

The blight which has infected chestnut stands has taken it from the ranks of important commercial woods. Most of the lumber now being cut has been dead for several years but is still useful and effective for some applications and is sold for a special grade of lumber known as "sound wormy chestnut." Its principal use is as a plywood corestock and for this purpose

is one of the best commercial woods available. Wormy chestnut is also much used in the manufacture of low-priced utility chairs as seat stock, usually splined front and back for added strength.

Chestnut is moderately low in weight and strength, is straight-grained and stays in place well. The sapwood is very narrow and the heartwood is highly resistant to decay. Its softness, lightness, ease of drying, and ability to hold glue adapts it readily to manufacture. Its comparative freedom from warping, and the fact that it shrinks or swells very little either during manufacture or in service, give it a stability seldom found in other wood species commonly used for corestock.

There has been a relatively large cut of chestnut for poles, posts and ties and considerable amounts have been used in the production of tanning extract. Its most common factory uses include: boxes, crates, millwork, medium-priced furniture and fixtures, caskets (cloth covered) and woodenware. Chestnut was formerly the outstanding wood in the casket and burial box industry because of its resistance to decay. The lower grades were used for cloth-covered cases, while better grades were used as an outer-finish wood on high grade caskets. In the New York State area alone, the amount of Chestnut has decreased to only 50,000 bd. ft. compared to the millions of feet previously used.

Chestnut timber is characteristically wormy and yields very little lumber of ordinary standard grades. The average log run stock contains less than five percent FAS, a small amount of No. 3 common, and the bulk of the lumber falls in special wormy grades. These grades satisfy the requirements for core stock as well as higher grade as the worm holes, because of their relatively small size, have no appreciable effect on lumber for core use.

Chestnut lumber is also popular for slack cooperage, such as nail kegs, cement and apple barrels, etc. It has limited application in the manufacture of paperboard and as a rough construction lumber, as backing material.

The cycle of use following the death of the Chestnut tree is usually: up to 2 years and the sapwood and heartwood are sound and the wood may be used for poles, posts and ties; from 2 to 4 years, the sapwood is decayed but the heartwood is sound and unchecked and the wood may be used for corestock, furniture, millwork, caskets, woodenware, boxes and crates; from 4 to 6 years the sapwood is decayed and the heartwood is checked but sound and the wood may be used for rough construction lumber, pulpwood, fence posts and tannin wood; and after 6 years when decay has set in throughout the entire structure the only use-value of the wood is for fuel.

COTTONWOOD

Natural color—White to cream.
Grain—Straight and mild.
Texture—Diffuse porous, coarse-textured.
Color variation—Very little.
Specific gravity [at 12% m.c.]—0.40.
Weight per cubic foot [at 12% m.c.]—28 lbs.
Hardness—Soft.
Stiffness—Good.
Strength—Low.
Stability [ability to stay in place]—Fair.
Decay resistance—Poor.
Shock resistance—Low.
Bending—Poor.
Nailing and screwdriving—Good.
Nailholding and screwholding—Fair.
Gluing—Excellent.
Electrical resistance [at 80-degs. F. and

12% m.c.]—140 megohms.
 Sanding—Poor, inclined to fuzz.
 (use 4/0 for best results).
 Odor and taste—None.
 Workability with hand tools—Good to fair.
 General machinability—Fair.
 Sawing—Fair.
 Planing, moulding and jointing—Poor.
 (Best cutting angles 5 to 20 degrees, with 5-deg. back bevel, finish-9 to 15 knife cuts per inch.)
 Shaping—Difficult.
 Boring—Fair. (Brad point bits with long taper cutting lips give best results).
 Turning—Poor. (Will produce good turnings only if dried down to about 6% moisture content and cutting edges are kept keen).
 Mortising—Fair.
 Paintholding—Fair. (Surfaces should be sized or washcoated before finishing to permit cutting down of fuzzy grain by sanding).
 Staining—Fair. (Use only non-grain-raising stains as oil stains muddy up and water stains raise fuzzy grain).
 Bleaching—Not necessary.
 Sealing—Good.
 Filling—Not used.
 Finishing—Good for paint and enamel finishes, and can be finished in regular finishes where special treatments are used.
 Natural finish—Seldom used as Cottonwood has little or no grain figure.
 Remarks:

Cottonwood is one of the softest hardwoods, more closely resembling Basswood than any other species, but is tougher and stiffer than Basswood and, due to its interwoven fibers, does not split very easily and is extremely wear-resistant for such a soft wood. It contains very few defects, is odorless and tasteless, has unusually uniform texture and works up fairly well. It is comparatively weak, decays quickly in contact with the ground, and has a tendency to warp in seasoning.

Due to the fact it is among the best woods for nailing, light weight, lack of odor, and natural white color for printing, more than one-half of all Cottonwood lumber is used in the manufacture of boxes and crates. Its resilience and cleanliness also makes it a preferred material for excelsior. Large amounts of Cottonwood are cut into commercial veneer for utility and medium-priced furniture products, as well as drawer bottoms and back panels. Cottonwood is much used for food containers, such as baskets, fruit and berry boxes and candy barrels.

Other factory uses include: vehicle parts, planing mill products, agricultural implements, laundry appliances, corestock, drawer stock, refrigerators, dairy appliances, and trunks. Cottonwood is a popular toy material because of its softness, light weight and lack of taste or odor and in some parts of the country it is one of the principal fuel woods. It is most commonly finished in paint or enamel although it can be finished in standard stainbase finishes where special treatments are employed to counteract its natural fuzzy grain characteristic.

ELM

Natural color—Cream to brown.
 Grain—Heavy, straight or interlocked.
 Texture—Ring-porous, coarse-textured.
 Color variation—Marked color difference.
 Specific gravity [at 12% m.c.]—0.50.
 Weight per cubic foot [at 12% m.c.]—35 lbs.
 Hardness—Medium to hard
 Stiffness—Fair.

Strength—Medium.
 Stability [ability to stay in place]—Medium to low.
 Decay resistance—Moderately durable.
 Shock resistance—High.
 Bending—Good.
 Nailing and screwdriving—Good.
 Nailholding and Screwholding—Good.
 Gluing—Fair.
 Electrical resistance [at 80-degs. F. and 12% m.c.]—20 megohms.
 Sanding—Good.
 (2/0 produces best results)
 Odor and taste—None.
 Sawing—Fair (Requires good set-swaged saws best)
 Workability with hand tools—Poor.
 General machinability—Poor.
 Planing, jointing and moulding—poor.
 (Best cutting angles 15 to 25 degrees, finish-8 to 13 knife cuts per inch)
 Shaping—Poor.
 Boring—Poor.
 (Brad-point bits with long taper cutting lips are best)
 Turning—Poor.
 Mortising—Good.
 Paintholding—Good.
 Staining—Fair.
 (On crossgrained stock sometimes difficult to get even color)
 (Water stains usually used)
 Sealing—Good if filled properly.
 Filling—Good.
 Bleaching—Not used.
 Natural finish—Good, with attractive color and figure.
 General finishing—Good for natural or stain-filled finishes, very durable under paint.
 Remarks:

Of the several species of Elm in the United States, White Elm is the most abundant. Other common species include Rock Elm, Slippery Elm, Cedar Elm and Winged Elm. Cedar Elm and Winged Elm are generally used for the same purposes as White Elm and are included in its classification. Rock Elm is heavier and harder than White Elm and ranks second only to Hickory where these properties are important. Slippery Elm is darker in color than either Rock Elm or White Elm and its mechanical properties are about midway between the two. It is very little used because of its scarcity.

The chief difference between Northern and Southern Elm is in color and texture. Their mechanical properties are about the same. Northern Elm is of finer and more uniform texture with less interlocked and diagonal grain but its color and character is rather mild. Southern Elm has considerable character with colorful streaks and grain figure which make it particularly adapted for decorative natural finish panel effects.

American Elm, while not considered a ranking cabinet wood, is a good furniture wood despite difficulties encountered in machining. Its bending properties makes it a good wood for chair parts to be steam bent. Its better grades are used somewhat for exposed parts of high grade furniture but its tendency to warp prevents more extensive use in this field. Elm is also used considerably for cross-banding and corestock.

Because of its toughness and bending properties, Elm has long been a favorite wood of the cooperage industry chiefly for slack barrel staves and hoops. Lacking odor and taste it is also popular for baskets, refrigerators and food containers. Elm's resistance to splitting caused by screwing and nailing causes it to be used extensively for crates, boxes and shipping containers. Its bending property is also taken advantage of in boat building and in the aircraft industry for curved parts of small radii and bearing blocks.

Besides being used for bent work,

Elm's toughness makes it a preferred wood for wagon and vehicle manufacture, particularly the hubs of wheels. It is especially suited not only because it is relatively hard and tough but is usually so cross-grained as to be difficult to split. Elm is relatively easy to dry, sands well but does not polish easily. When plain-sawed, it displays a pleasing appearance and is very attractive when properly filled and finished.

Other uses include flooring, fixtures, handles, saddle trees, sleds, sporting goods, toys, and woodenware novelties.

GUM

Natural color—Heartwood - reddish brown; sapwood - pinkish white.
 Grain—Plain or figured, interlocked.
 Texture—Diffuse porous, close-textured.
 Color variation—Marked difference in color.
 Specific gravity [at 12% m.c.]—0.49.
 Weight per cubic foot [at 12% m.c.]—34 lbs.
 Hardness—Moderately hard.
 Stiffness—High.
 Strength—Medium.
 Stability—Naturally poor, fair when properly seasoned.
 Decay resistance—Moderately durable.
 Shock resistance—Above average.
 Bending—Fair.
 Nailing and screwdriving—Good.
 Nailholding and screwholding—Excellent.
 Gluing—Excellent with proper gluing techniques.
 Electrical resistance [at 80-degs. F. and 12% m.c.]—160 megohms.
 Sanding—Fair.
 (3/0 coarsest grit that can be used without scratching, 4/0 gives best results).
 Odor and taste—None.
 Sawing—Good.
 Workability with hand tools—Excellent.
 General machinability—Good.
 Planing, jointing and moulding—Good.
 (Best cutting angles 10 to 25 degrees, with 15-deg. back bevel, finish-9 to 13 knife cuts per inch).
 Shaping—Good.
 Boring—Good.
 (Brad-point bits with long taper cutting lips best).
 Turning—Excellent.
 Mortising—Fair.
 Paintholding—Good.
 Staining—Very good, takes any stain.
 Bleaching—Used for some finishes.
 Sealing—Excellent.
 (Takes any sealer or primer coat).
 Filling—Seldom used except for novelty finishes.
 Finishing—Excellent for natural, stained, paint and enamel finishes; often high lighted.
 Natural finish—Excellent, with attractive figure.
 Remarks:

For years American Gum has borne the stigma of being unstable and it is true that freshly sawn lumber will warp more than most species. Technical studies of wood structure and developments in stacking, seasoning and kiln drying methods have overcome this tendency to a point where it will retain its dimensional stability about as well as any other wood today.

American Gum is generally divided into two classifications for commercial purposes. Red Gum and Sap Gum. Red Gum is obtained chiefly from the heartwood of old mature trees in somewhat limited quantities while Sap Gum, obtained from the sapwood, is used in greater quantity for a larger range of products because it is available in young as well as old trees.

The color of Red Gum ranges from a light to deep reddish brown and much of the lumber contains irregular dark streaks formed by natural deposits of coloring matter in the wood which closely resemble those in Circassian Walnut. It is equally pronounced in plain-sawed and quarter-sawed lumber and occasionally a stripe can be seen in quarter-sawed boards due to interlocked grain. This stripe is not so noticeable as in some woods because the wood is not very lustrous. This figured lumber is known as figured Red Gum and lumber without streaks as plain Red Gum.

Sap Gum retains the basic red color in a subdued form, from a delicate pink to a pinkish white. It has some of the figure characteristics of Red Gum but not so pronounced. Sometimes Sap Gum is blued by sap-stain fungi and it will be darkened to a pinkish red by steaming. Its texture is usually finer and more uniform than that of Red Gum.

The mechanical properties of Red Gum and Sap Gum are substantially the same. Gum, generally speaking, has a peculiar interlocking grain which makes it strong and stiff and offers high resistance to splitting. It is one of the softer hardwoods of medium weight and its compact grain takes a beautiful finish. Since it is nonresinous it is especially adaptable for painting and enameled woodwork.

Gum has a soft but firm texture which responds well to cutting tools. It is an excellent turning and carving wood and is among the least difficult woods to plane. It works very well as a veneer wood, cutting equally well at the saw, slicer or rotary lathe. It has a natural resistance to marring and has a natural coloration which seems to suffuse through any finish applied over it to provide a warmth of tone.

Red gum is one of the leading furniture and cabinet woods of the country for the better grades of product. Sap Gum is also much used on medium and lower price grades for exteriors and for interior constructions in the better grades. Gum has long been used with Walnut and Mahogany which it so closely duplicates in appearance but with its own beautiful natural figure is gradually coming into prominence in its own right.

Red Gum is second only to Douglas Fir as a veneer wood and since Douglas Fir is chiefly used in construction plywood, Gum is the leading furniture and cabinet veneer for decorative plywood. Gum is used for side, back and end panels, drawer bottoms, dust bottoms, mirror backs and often forms the core and crossbanding for plywood faced with fancy face veneers.

The lower grades make up about 50% of the total footage of package veneers used for containers. It combines the features of low cost, general availability and medium weight with a toughness, stiffness and staple-holding property that is not equaled by any other wood.

As paneling, doors and interior trim, Gum has many features which few other woods can match. Since its pattern is uniform throughout the log, Gum can be used as paneling for the wall treatment of a room in which the predominating figure is continuous to duplicate itself around the entire wall.

Gum is a favored wood for cabinets - radio, television and record player as it is resonant, mellow and can be finished to blend with either cabinet wood or plastic surfaces. Other common applications are found in store fixtures, automobile and wagon bodies, agricultural implements, structural parts of organs and pianos, refrigerators, toys, trunks, handles, novelties and miscel-

laneous woodenware.

In the lower grades, Gum is much used for boxes and crates and is a most important wood for slack cooperage. It is also used for cheap flooring, railroad ties, cigar boxes, and more recently for chemical wood pulps.

HACKBERRY

Natural color—Light yellow to yellowish white.

Grain—Heavy, prominent markings.

Texture—Ring-porous, coarse-textured.

Color Variation—Very little.

Specific gravity [at 12% m.c.]—0.53.

Weight per cubic foot [at 12% m.c.]—37 lbs.

Hardness—Medium.

Stiffness—Medium.

Strength—Moderate.

Stability [ability to stay in place]—Very good.

Decay resistance—Low.

Shock resistance—High.

Bending—Seldom used for bending but bends well.

Nailing and screwdriving—Intermediate, tends to split from nails.

Nailholding and screwholding—Fair to good.

Sanding—Fair.

(2/0 gives best results)

Odor and taste—None.

Workability with hand tools—Fair.

General machinability—Good.

Sawing—Good.

(Saws require good set)

Gluings—Excellent.

Planing, jointing, moulding—Very good.

(Best cutting angles 15 to 25 degrees, 15-degs. back bevel, finish-11 to 14 knife cuts per inch)

Shaping—Fair.

Boring—Fair.

(Brad point bits with long taper cutting lips best)

Turning—Good.

Mortising—Good.

Paintholding—Good.

Staining—Good (Takes practically any type stain)

Filling—Good.

(Brown filler used for most standard finishes, white for contrasting novelty finishes.)

Sealing—Good, when properly filled. (Takes any sealer or primer)

Bleaching—Seldom used.

Finishing—Good.

(Takes all finishing materials well, paint, enamel, lacquer, varnish or synthetics)

Natural finish—Good, has attractive figure in selected stock.

Remarks:

Commercial American Hackberry includes both Sugarberry and Hackberry. As an individual species its reported annual output is not large but this is because it is commonly sold with the lower grades of Ash and Elm. Hackberry was first used by the furniture industry to supplement standard species that were in short supply. While it is not too generally known to the woodworking industry, it has many good qualities which merit consideration where cost is a governing factor.

In color it ranges from a yellow shade slightly deeper than Ash to a light yellowish-white. Its texture closely resembles that of Ash and when finished it provides a rather unusual grain effect that has made it popular for paneling and novelty furniture treatments. Hackberry is medium hard but not strong enough for building construction. It takes a very good polish but is not durable in contact with the soil and does not withstand outside exposure too well. Some Hackberry is found that is badly damaged by

woodboring insects but as commercial lumber it is usually very free from defects.

Furniture manufacturers have found that Hackberry makes very attractive and substantial tables and chairs. Its stability and excellent gluing properties also make it a very good corestock material. It has been very popular for the manufacture of kitchen cabinets and is used somewhat for turnings and carvings.

Its lack of any tendency to impart odor or taste has led to its adoption by makers of candy and cheese containers, lard and butter tubs, and fruit and berry baskets. It is also being used in increasing quantity for the manufacture of refrigerators. Where resistance to shock is required, as in farm implements, slack cooperage, vehicle parts, boxes and crates, Hackberry has been found to work out very well.

Other uses include buggy bodies, cart trees, saddle trees, hoe handles, rakes, interior finish, steps, stair rails, paneling and woodenware novelties.

HICKORY

Natural color—White to reddish brown.

Grain—Straight.

Texture—Ring porous, coarse-

textured.

Color variation—Marked difference in

color.

Specific gravity [at 12% m.c.]—0.73.

Weight per cubic foot [at 12% m.c.]—51 lbs.

Hardness—Very hard.

Stiffness—High.

Strength—Very strong.

Stability—Good.

Decay resistance—Not durable.

Shock resistance—Very high.

Bending—Excellent.

Nailing and screwdriving—Tendency to split.

Nailholding and screwholding—Good.

Gluings—Good.

Electrical resistance [at 80-degs. F. and 12% m.c.]—50 megohms.

Sanding—Very good.

(2/0 coarsest grit that can be used without scratching, 3/0 gives best results)

Odor and taste—None.

Sawing—Good.

(Saws require good set-swaged saws best)

Workability with hand tools—Works relatively hard.

Planing, jointing and moulding—Good.

(Works best with shallow cut, best cutting angles 15 to 30 degrees, with 5 to 15-degrees back bevel) (Finish 12 to 15 knife cuts per inch)

Shaping—Fair to good.

Boring—Good.

(Brad-point bits with strong stubby lips best)

Turning—Good.

Mortising—Excellent.

Paintholding—Good.

Staining—Takes any stain but water and NGR stains more commonly used.

Bleaching—Used for blonde finishes.

Sealing—Good when properly filled.

(Takes any sealer or primer coat)

Filling—Good.

(Brown filler used for most standard finishes, white or transparent fillers used on blonde finishes)

Finishing—Good.

(Takes all finishing material well with fine polish)

Natural finish—Good.

Remarks:

There are about 45 species of Hickory in the United States but true Hickories of commercial importance are confined to shagbark, shellbark, mockernut and pignut Hickory. From a total stand of about 11,000,000,000 board feet, about

125,000,000 bd. ft. is cut annually with more than one-half the production coming from Kentucky, Tennessee, Virginia and West Virginia.

The sapwood of Hickory is usually white while the heartwood is red or reddish brown and sometimes contains darker streaks of deeper shades of red or brown. It is commonly classified as red or white but despite popular opinion all sound Hickory has the same strength, weight for weight, regardless of whether it is red, white or red and white mixed.

Much of the Hickory cut, instead of being manufactured into lumber, is shipped direct to the factory in the form of fitches, blanks or billets or bolts, whichever is best suited to end use. Hickory splits well for the production of slit blanks or billets as was discovered by the early American farmer who used Hickory to build his rail fences.

Hickory is a ring-porous wood whose straight grain has no interlocking and has a very low degree of cross grain. It has a distinct annual ring and strongest Hickory usually has fewer growth rings per inch. Handle stock is usually selected with a maximum of 17 rings per inch but lumber for other uses may be well suited with as many as 40 rings per inch. Best Hickory stock shows an oily side grain surface under a smooth finish and gives out a ringing tone when dropped on end on a hard surface.

While other woods may excel in a single property, Hickory has a combination of strength, stiffness, hardness, elasticity and shock resistance not found in any other wood. It is one of the heaviest of the hardwood species but is low in decay resistance in contact with the soil and has a tendency to shrink some in drying. For this reason Hickory is not much used for structural purposes but for other purposes which demand a hard, tough, practically unbreakable wood, Hickory is a most efficient wood.

Hickory has long been used in the manufacture of chairs for rounds, legs and spindles and its excellent bending property has made it preferred for bentwood parts. It has also long been used as a summer furniture wood and for furniture construction parts where strength and toughness are required. Hickory was formerly used chiefly in standard Walnut and Mahogany finishes but more recently it has become quite popular for blonde and novelty finished furniture.

Fully 80% of all Hickory produced goes into the manufacture of wood handles for striking tools, such as axes, hammers and sledges. As a handle wood it slides easily and polishes smooth under constant hand pressure. Its peculiar properties of elasticity, strength and shock resistance permit it to retain its shape and remain straight which suit it admirably for use of golf club shafts, tennis rackets and other sporting goods handles. Hickory ranks second only to Ash as a material for baseball bats.

The high degree of stiffness, toughness and strength suits it for ladder rungs, gymnastic bars, dowsing and smaller skewers commonly used for pinning meat cuts. The additional property of low conductivity to heat makes Hickory prized for vehicle parts and construction. The light harness sulky owes its development to Hickory and the pioneering covered wagons used Hickory hubs and felloes. Seven percent of all Hickory production goes into the manufacture of wagons, sulkies and trailers and truck bodies.

Hickory is the only wood which will stand up under the terrific vibration on picker sticks of textile looms and is equally popular for drum sticks. It is used in thin strips for basket-making and is considered a superior barrel hoop material. Hickory skis are valued

highly by ski jumpers and argicultural implements use a considerable volume. Many farm tools use this wood in novel applications. Hickory pitman rods are quite common in mowing machines and even sucker rods for deep wells use Hickory because of its high tensile strength. The aircraft industry uses a large quantity of Hickory for propellers, ribs, bearing blocks, spar caps and other highly stressed parts.

Green Hickory has long been used for smoking meats and dry Hickory is one of the best fuel woods. It is claimed that a single cord of Hickory has the same fuel value as a ton of coal. Early pioneers used hickory for ramrods, splits of green Hickory for hinges, and made boxes of Hickory bark. They also used a yellow dye taken from its inner bark to dye their homespun cloth.

Hickory is quite subject to insect attack which has made great inroads on its supply. As a growing tree it is attacked by beetles, chiefly the Hickory bark beetle. After the trees have been cut, the green wood in the log is attacked by pinhole borers. Even after the wood has been dried and sometimes even after it has been fabricated into a wood product, the dry sapwood is subject to attack by powder post beetles.

Although used in limited quantities for chair and furniture manufacture, Hickory is one of the most important specialty woods used principally in the tool handle industry, vehicle trade and for special products where a combination of shock resistance, strength, hardness and flexibility is required.

MAGNOLIA

Natural color—Creamy white to light yellowish brown sapwood, dark brown to purplish black heartwood. Color variation—Marked difference in color.

Grain—Straight, with mild figure.

Texture—Diffuse porous, close-textured.

Specific gravity [at 12% m.c.]—0.50. Weight per cubic foot [at 12% m.c.]—35 lbs.

Hardness—Medium hard.

Strength—Average.

Stability—Fair to good.

Decay resistance—Not durable.

Shock resistance—Moderately high to high.

Bending—Excellent.

Nailing and screwdriving—Good.

Nailholding and screwholding—Good.

Gluing—Excellent.

Sanding—Good.

(3/0 coarsest grit that can be used without scratching, 4/0 gives the best results)

Electrical resistance [at 80-degs. F and 12% m.c.]—435 megohms.

Odor and taste—Not noticeable.

Workability with hand tools—Fair.

General machinability—Good.

Sawing—Good.

Planing, joining, moulding—Excellent.

(Best cutting angles—10 to 25 degrees, 15-degree back bevel, finish—10 to 16 knife cuts per inch)

Shaping—Poor.

Boring—Fair.

(Brad point bits with long taper cutting lips give best results)

Turning—Good.

Mortising—Poor.

Paintholding—Good.

Staining—Good.

(NGR, oil or water stains usually used)

Filling—Seldom filled as not required.

Sealing—Good.

(Takes any sealer or primer well)

Bleaching—sometimes bleached for modern blonde finishes.

Finishing—Good.

(Takes all finishing materials well with fine polish)
Natural finish—Sometimes for natural blonde finish.

Remarks:

It has been estimated that there are about 20 species of Magnolia in the world, principally in the United States and Asia, with about 7 species native to the United States. As a commercial wood Magnolia includes Cucumber, Evergreen and Sweet Magnolias although most commercial Magnolia lumber is made from Evergreen lumber. The principal stand of Magnolia timber is in the South, and is most abundant in eastern Tennessee, the Carolinas and the Gulf coast region. From an estimated stand of over one billion feet of timber, about 40 million board feet of lumber is produced annually on a commercial basis.

Cucumber Magnolia is sometimes sold as "Cucumber" lumber and considerable Cucumber and some Evergreen Magnolia is sold as yellow Poplar in the lower grades although this practice is not quite so prevalent since it was discovered that Magnolia was an excellent wood for certain special uses. Magnolia is very closely related to Yellow Poplar and has many of its characteristics although it is harder and heavier. As a matter of fact, microscopic examination is often required for the positive separation of Yellow Poplar and Magnolia.

The sapwood of Magnolia ranges from a creamy white to a light yellowish brown to present an attractive blonde color. The heartwood is light to dark brown or purplish black, sometimes tinged with yellow or green. While the lighter sapwood lumber is generally preferred for most purposes, some mills produce a selected black heart lumber for paneling which lends itself to striking panel effects. The color in the lower grades is usually a greenish yellow with an occasional burl or dark streak.

While Magnolia is definitely not one of the leading veneer woods, veneer is produced from the white wood of Magnolia logs and is sometimes marketed under the trade name - "Ailon." Magnolia veneer generally has mild grain markings and is usually produced by quarter slicing in figured and plain grades. While it is not as hard as some other veneer woods, it sands to a distinctive silky polished finish.

Magnolia is one of the diffuse-porous woods and its grain is usually straight but more conspicuous than Poplar. Its annual growth rings are generally distinct with a thin whitish line at the beginning and end of each year's growth. The wood is of compact structure and its hardness is medium hard, similar to that of Black Walnut or Tupelo. Magnolia's strength properties are somewhat over average and it ranks close to the top as a bending wood. It is moderately low in shrinkage, moderately stiff and moderately weak in compression. Although it does not possess good decay resistance, Magnolia ranks high in shock resistance and has better than average stability.

Magnolia machines very well in all operations with the exception of shaping and mortising. It can often be planed to a degree of smoothness that requires little or no sanding and works easily and with good sharp detail at the moulder and turning lathes. Its general favorable working properties serve to bring Magnolia to the attention of woodworking plants during the early days of lumber shortages. From a wood that was totally unknown to many industries, Magnolia is now used in large quantities by the industry and has become a favorite wood for certain special uses.

Magnolia lends itself readily to practically any type of commercial

finish. Where it was formerly finished chiefly in paint or enamel finishes, Magnolia is now much used in the popular natural and bleached blonde finishes. It sands and polishes to a satiny luster and since it does not require filling for any type of finish, it is a most economical wood to finish. Although Magnolia's figure is usually mild, selected lumber is available to enable the production of striking natural finish effects.

It has been estimated that about two-thirds of all the Magnolia lumber used in manufacturing wood products now goes into furniture. While furniture manufacturers were very slow to appreciate the superior steam bending qualities of Magnolia, its use for bentwood products, chair and frame parts is increasing annually. Furniture plants have also found Magnolia well suited for furniture frames and are currently using it in solid furniture to be finished in the popular blonde and pickled finishes. Magnolia has always been quite popular for painted and enameled breakfast and kitchen furniture. It is also reported to make a very good imitation satinwood.

Probably one of the most exacting, extensive and popular uses for Magnolia is found in the manufacture of venetian blinds. Venetian blind manufacturers found Magnolia to be admirably suited for their use, particularly for blind slats, and take full advantage of its fine, uniform texture, sufficient hardness, and inherent property of remaining flat without warping.

Next to furniture use, the most popular usage of Magnolia is found in the manufacture of planing-mill and mill-work products. It is said that about 50% of all the Cucumber Magnolia cut goes into millwork as well as the large quantity of Evergreen Magnolia. Magnolia's workability and paintholding properties have made it extremely popular for interior finish, siding, interior trim, moulding, doors and paneling. It is even used for car sheathing. Store fixture concerns make good use of Magnolia, using it all the way from store fronts to cabinets and counters.

The superior nailholding properties of Magnolia, as well as its natural resistance to splitting, has made it a favored wood for boxes and crates. The fact that it has no tendency to impart either taste or odor has also led to its use for egg cases, cheese boxes, pails, tubs and woodenware used in the shipment, storage and serving of food products.

Other common uses for Magnolia include: agricultural implements, boats, broom and brush handles, cotton gins, excelsior, casket trim, kitchen and utility cabinets, mine timbers, sleds, toy wagons, hay racks and wagon boxes. Many other uses are being developed daily as the woodworking industry becomes aware of the versatility and favorable properties of Magnolia as applied to its products.

Natives of the Allegheny region like to tell that the early settlers of that region used to collect the cone-like fruits of the Magnolia tree and steeped them in whiskey to make a medicine to ward off an autumnal fever which was common to that section. Some even continue to make this bitter medicine which is quite difficult to take in spite of the whiskey contained.

HARD MAPLE

Natural color—Sapwood-white with tinge of reddish brown heartwood—light reddish brown.

Grain—Straight, curly, wavy or birds-eye or blistered figure.

Grain figure—Varied.

Texture—Diffuse porous, close-textured.

Color variation—Usually slight difference between sapwood and heartwood.

Specific gravity [at 12% m.c.]—0.63.
Weight per cubic foot [at 12% m.c.]—44 lbs.

Hardness—Hard.

Stiffness—High.

Strength—Very strong.

Stability—Good.

Decay resistance—Not durable.

Shock resistance—High.

Bending—Fair.

Nailing and screwdriving—Poor without pilot holes.

Nailholding and screwholding—Fair to good.

Gluing—Good under controlled conditions.

Sanding—Good.

(4/0 gives best results for polish sanding, 3/0 for regular sanding, 2/0 coarsest grit that can be used without scratching)

Odor and taste—None.

Workability with hand tools—Good.

General machinability—Good.

Sawing—Good.

(Requires good set in saws)

Planing, jointing, moulding—Fair to good.

(Best cutting angles—15 to 30 degrees, finish—12 to 16 knife cuts per inch.

Shaping—Excellent.

Boring—Good.

(Brad-point bits with strong stubby cutting lips give best results)

Turning—Good.

Mortising—Excellent.

Paintholding—Good.

Staining—Good.

(Takes all stains well)

Sealing—Good.

(Takes any sealer or primer well)

Filling—Seldom filled as it is not required.

Bleaching—Sometimes bleached for blonde or novelty pickled finishes.

Finishing—Good.

(Takes all finishing materials well)

Natural finish—Color and grain figure produces attractive natural finish.

Remarks:

The total stand of Maple timber in the United States is estimated to be about 44 billion feet and about 80% of the annual cut is Hard Maple to produce an average lumber cut of about 587 million board feet. This cut is not always in the form of sawlogs for lumber as much of the best timber is made into veneer logs for the cutting of veneer, or into bolts from which turnings, boot and shoe findings and similar items are produced.

Sugar Maple (sometimes called Rock Maple) and Black Maple are two commercial species of Hard Maple and are found chiefly in Canada and the northeast and north central states. Hard Maple is recognized to be one of the best all-purpose hardwoods of the United States in both solid form and in the form of veneer or plywood. It has ranked first for years from the standpoint of volume among native hardwoods and of the 134 representative uses of all American commercial woods. Hard Maple continues to have the largest number of applications. Hard Maple is also rated first among all woods of the United States in the manufacture of charcoal, acetate of lime and wood alcohol by the hardwood distillation process.

Although the wood of Hard Maple normally incorporates fine texture and straight, close grain with a subdued but attractive grain figure, very beautiful effects are produced by variations of structure and appearance due to accidental formations with contorted grain which are much prized for cabinet-making and veneer use. These include birdseye, curly and blistered

figures.

The birds-eye figure is most commonly found in Sugar Maple but is an irregular and rather rare occurrence. It may be scattered over the entire tree; be confined to one side of the tree; or may appear in irregular strips or patches. The figure is formed by local sharp depressions in the annual ring surrounded by considerable fiber distortion. The cause of this phenomena has never been satisfactorily explained although some hold to the theory that these markings are caused by abnormal bud growth. Birds-eye Maple is in great demand today for bleached panel effects.

The curly figure is sometimes found in connection with the birds-eye figure although it is also found by itself. It is a product of distorted fibers which produce a curly or wavy effect. When it is presented in fantastic designs, this is sometimes called a "landscape" figure. Curly Maple with a fine, strong, even ripple figure is used almost exclusively for backs of violins and is said to have given birth to the term "fiddleback" commonly used to describe this type of figure in veneer and furniture circles. This curly Maple figure was extremely popular in Colonial days for chests and gunstocks, many of which are still in existence.

Maple's blistered figure is produced by a characteristic uneven contour of the annual rings to present the effect of being blistered. This figure occurs only occasionally and is highly prized for decorative purposes. In its most beautiful form, it is called "quilted" Maple but this particular form is more common to the Soft Maple known as Oregon Maple than in any of the Hard Maple species.

Maple is one of the few woods whose sapwood is more valuable than its heartwood because of its clean white appearance and freedom from defects. The heartwood has a tendency to shake, worm holes and other defects around the heart center. It is fortunate that sapwood takes up the greatest volume of the tree. The sapwood is generally white with a slight reddish-brown tinge, and the heartwood is light reddish brown. The annual growth rings are usually marked by brown or reddish-brown lines.

While all Maple lumber is light colored, the clear grade of White Maple is exceptional. It is made from unstained sapwood of Sugar Maple sawed in the winter and usually end-piled to prevent staining. Its color is ivory white and it takes a beautiful finish seldom duplicated by any other wood. Selected Maple heartwood is also available for darker finishes and one grade of Maple, with a decided red tone, is sometimes used to imitate Cherry. In present day operations, however, Maple has the status of a leading cabinet wood rather than an imitation wood.

Hard Maple ranks high among hardwoods as one of the best cabinet and furniture woods and possesses a versatility of use that suits it for a wide variety of valuable purposes in many other industries. Hard Maple possesses a very high degree of hardness and strength but not enough to dull tools excessively; has a marked ability to stay in place and hold its shape under sharp variations of humidity; and has good gluing properties.

Aside from its natural strength, stability and toughness, Hard Maple is characterized by a unique fiber cleavage that gives it unusual resistance to checking, splitting and other shearing forces. Its strength permits graceful proportions without sacrifice of sturdiness in intricate and delicate furniture patterns. The hardness of Hard Maple makes possible the design of intricate patterns in relief, beautiful

carvings and slender turnings. Its strength, stiffness and end hardness suits it well for joinery purposes which lend strength and rigidity to the furniture construction.

Hard Maple serves many purposes in the furniture industry. It is in demand for solid pieces, such as chairs, tables, beds and casegoods; in the form of veneer for decorative and utility purposes; in drawer stock, extension-table slides and filing-case runners, where stability and smoothness under moving wear is essential; and in concealed parts where strength and shock resistance is required, as in upholstery frames, chair rungs, chair arms, chair legs, and rockers.

Hard Maple is generally used for all exposed parts which are to be stained, painted or finished in a natural finish and for interior parts where rigidity or strength are required. Its characteristic white, hard wood is particularly in demand for church, school, business and restaurant furniture where good looks and long wear are essential.

Because of its close-grain texture and uniform color and absorption, Hard Maple provides a good foundation for any type of finish. Although close-knit in grain, it absorbs finishes readily and retains them against wear. It also provides a smooth solid backing required for a good supporting surface for enamel or paint which will not easily mar or show indentations. White Maple is well suited to natural blonde finishes and produces excellent novelty finishes, such as honey-tone, wheat, silver gray and frosted effects. Unselected and heartwood grades can be finished to advantage in the popular Early American amber finishes, as well as Walnut, or red, brown and antique Mahogany finishes.

Hard Maple's strength, hardness and shock resistance properties, together with the fact that it wears smooth under abrasion to take on a higher polish as it is subjected to wear, makes it a favored wood for flooring in homes as well as for bowling alleys, gymnasium floors, dance floors and other floors that are subjected to heavy wear.

Hard Maple is also used extensively in the production of meat blocks or butcher blocks which require material with dense fibers, that do not splinter easily, to resist the continual chopping to which they are subjected. It is also used for bread boards and chopping bowls and its failure to impart taste or odor has led to the use of Hard Maple for skewers, toothpicks, butter boxes, churn dashers, pails, tubs, wooden spoons and other food containers.

Hard Maple is also a favored material for sporting goods. Bowling pins probably lead the list which also includes: bowling balls, croquet balls and mallets, dumb bells, billiard cues and rings, baseball bats, oars and paddles, and Indian clubs. It enjoys extensive use in the manufacture of musical instruments, particularly violins, and toys and children's vehicles.

The boot and shoe industry prefers Hard Maple for shoe lasts, wood heels and other boot and shoe findings. In one rather unusual application cross grain cuts of Hard Maple are used for wooden soles on women's shoes, bonded to leather with a plastic under high heat and pressure. Hard Maple is also a popular turning wood and is much used for handles and brush blocks and other shaped products.

Other common uses include: agricultural implements, die blocks, dowels, interior finish and trim, ladders, machine parts, millwork products, plumber's woodwork, refrigerators, showcases and store fixtures, tie plugs, timber grapples, wheelbarrows, wooden bearings and

wood type. In the aircraft industry Hard Maple is used for aircraft plywood, propellers, models, bearing blocks and jigs.

Sugar Maple is famed as a prolific source of maple syrup and maple sugar which are important spring crops of northern states farmers. It is claimed that 45 to 50 gallons of maple sap are required to boil down to a gallon of maple syrup, with good trees giving up from 15 to 20 gallons of sap. One report published recently gave a yield of 2,680,000 gallons of maple syrup and 550,000 lbs., of maple sugar from 10,288,000 trees.

Sugar Maple trees are subject to attack from the Sugar Maple borer which kills large limbs and even entire trees by boring under the bark and in the outer sapwood. These attacks are being met by pruning and burning affected parts in the spring. Fortunately total damage to date has not reached alarming proportions.

SOFT MAPLE

Natural color—Sapwood-white, heartwood-pale reddish brown.

Grain—Straight or wavy.

Grain figure—Varied.

Texture—Diffuse porous, close-textured.

Color variation—Slight variation between sapwood and heartwood.

Specific gravity [at 12% m.c.]—0.54.

Weight per cubic foot [at 12% m.c.]—38 lbs.

Hardness—Medium.

Stiffness—Medium to high.

Stability—Fair.

Decay resistance—Not durable.

Shock resistance—Fair.

Bending—Fair.

Nailing and screwdriving—Poor without pilot holes.

Nailholding and screwholding—Fair to good.

Gluing—Good.

Sanding—Good.

(4/0 gives best results for polish sanding, 3/0 for regular sanding, 2/0 coarsest grit that can be used without scratching.)

Odor and taste—None.

General machinability—Good.

Workability with hand tools—Fair.

Sawing—Good.

(Requires good set in saws.)

Planing, jointing, moulding—Fair to poor.

(Best cutting angles—10 to 20 degrees, finish—12 to 14 knife cuts per inch.)

Shaping—Fair to good.

Boring—Fair to good.

(Brad-point bits with strong stubby cutting lips give best results.)

Turning—Fair.

Mortising—Poor to fair.

Paintholding—Good.

Staining—Good.

(Takes all stains well.)

Sealing—Good.

(Takes any sealer or primer well.)

Filling—Seldom filled as it is not required.

Finishing—Good.

(Takes all finishing materials well.)

Natural finish—Natural color and grain figure takes attractive natural finish.

Remarks:

It is difficult to estimate the total production of Soft Maple because so much of it is mixed with Hard Maple in production and sales. Soft Maple is produced principally from Oregon Maple, Red Maple and Silver Maple, also known in local regions of their origin as Scarlet Maple, Swamp Maple, Water Maple, River Maple, White Maple, Bigleaf Maple and Broad Leafed Maple.

While Soft Maple is found over a greater part of the country, its best

development seems to be in the lower Ohio Valley and its greatest abundance in the lower Mississippi Valley. Oregon Maple (Bigleaf Maple) is an exclusive product of the West Coast and is most abundant in Washington and Oregon which produce an average of about three million board feet annually.

Soft Maple is similar to Hard Maple in appearance and many characteristics, although it is somewhat lighter in color, with a more pronounced grain figure and is not as hard, heavy or stiff. Soft Maple is also somewhat more difficult to machine smooth although modern cutting practice with proper cutting angles has done much to overcome this difficulty.

One species, Oregon Maple, produces fine specimens of quilted Maple for fancy veneer purposes and other species contain curly or wavy figure and fancy-grained burls which are highly-prized for decorative furniture and interior face veneers. Soft Maple is capable of taking a very good finish and the heartwood takes a very good polish.

Soft Maple is superior to Hard Maple in some respects. It is generally considered to bend more easily; is more resistant to warp and twist when subjected to extreme atmospheric changes of temperature and humidity; splits less from nailing and screwing; glues better. Its color ranges from pale to almost white in the sapwood and a pale reddish brown, sometimes tinged with brown streak, in the heartwood and the wood is close-grained and of uniform texture.

The most important use for Soft Maple is for furniture both in solid wood and veneer form. It is used both by itself and in combination with Hard Maple and is very popular for medium-priced Maple lines. Soft Maple takes all the standard furniture finishes very well and is usually finished in the traditional Maple finishes of honey-tone, Early American amber, golden brown, antique Maple and blonde Maple. One of the most beautiful furniture effects on the market today is a line of Maple bedroom furniture with a bleached dusty finish applied to quilted Maple.

Soft Maple's freedom from odor and taste (it ranks next to Ash in this property) makes it a preferred wood for food containers, ice boxes, refrigerators, woodenware, butter bowls and berry baskets. It is also quite popular in the lower grades for shipping containers, boxes, egg cases, cheese boxes and the like.

Soft Maple is also used quite extensively in the agricultural field in the manufacture of vehicles, brooders, cultivators, and tool handles. During recent shortages of other turning woods, it has enjoyed greater demand for use in the manufacture of handles, brush blocks, spools and other commercial turnings.

Soft Maple has always been used in large quantities by manufacturers of chairs and upholstery frames. Its attractive grain and good stability has led to its increased use for interior trim, paneling and flooring. Many novel decorative interior effects have been produced in both natural and stained finishes. One of the show places of the West Coast has a room paneled in quilted Maple that has been described as suggesting the curly head of a platinum blonde angel.

While soft Maple has not been used to any great extent in commercial shipbuilding, it is much used for small boats. Two of its more unusual uses are in the manufacture of saddles and wooden pulleys. It lends itself well to metal impregnation and is used exclusively by a leading wood pulley manufacturer who features metal impregnation in his product.

Soft Maple has long been popular as

a children's vehicle wood and used to make carriages, strollers, scooters and carts as well as wooden toys. Store and office fixture concerns use much Soft Maple in many of their constructions and it also finds use for advertising display racks and other devices. Other common applications include: carpet sweepers, coat hangers, lawn and porch swings, piano parts, millwork and planing mill products.

Considerable Soft Maple is used as fuel and is burned in kilns to produce charcoal, wood acetate and other products of distillation. Possessed of a multitude of good properties, Soft Maple is a most economical wood to use for many purposes. It is available in all standard grades, usually with additional specifications: WHAD—"worm holes and defects," and WHND—"Worm holes no defects," with the latter more easily obtainable.

Soft Maple is susceptible to many insect and fungi attacks. While it is commonly attacked by the Cottony Maple Scale (a sucking insect) and the Boring Leopard Moth, it is probably most susceptible to attack by the larvae of an insect which produces "pith flecks," which show up in the wood as brown streaks more or less parallel with the grain. Many lumbermen use these pith flecks as marks to distinguish Soft Maple from Hard Maple.

RED OAK

Natural color—Sapwood-white, heartwood-reddish brown.

Grain—Straight.

Grain figure—Plain or flake.

Texture—Ring porous, coarse-textured.

Color variation—Some difference between sapwood and heartwood.

Specific gravity [at 12% m.c.]—0.67.
Weight per cubic foot [at 12% m.c.]—44 lbs.

Hardness—Very Hard.

Strength—High.

Stiffness—High.

Stability—Very Good.

Decay resistance—Durable.

Shock resistance—High.

Bending—Good.

Nailing and screwdriving—Good.

Nailholding and screwholding—Fair to good, some tendency to split.

Gluing—Good.

Sanding—Good.

use 2/0 for general sanding, 3/0 to polish for finishing.)

Odor and taste—Some.

Workability with hand tools—Good.

General machinability—Good.

Sawing—Good.

(Saws require good set and swaged saws generally give best results.)

Planing, jointing, moulding—Good.

(Recommended cutting angles—10 to 25 degrees, 15 degrees back bevel; finish—14 to 16 knife cuts per inch.)

Shaping—Fair.

Boring—Fair to good.

(Brad point bits with long taper cutting lips bore best.)

Turning—Fair to good.

Mortising—Good.

Paintholding—Good.

Staining—Good.

(Any kind of stain, water stain has tendency to raise grain to require washcoat application.)

Filling—Good.

(Contrasting fillers much used for novelty effects.)

Sealing—Good when properly filled.

Bleaching—Fair to good, seldom used. (Used for novelty finishes only.)

Finishing—Good.

(Shows up well under all finishes, especially attractive in contrasting novelty finishes.)

Natural finish—Good, with attractive

figure, color and grain structure.

Remarks:

The greater part of this country's Oak production, which is estimated to equal about one-third of the total production of all commercial hardwood lumber, consists of Red Oak and White Oak. Red Oak is produced in greater quantity than White Oak but all of its properties are not quite as good.

The total stand of Red Oak in the United States has been estimated about 31,800,000 board feet. Red Oak lumber is produced in an annual volume estimated at about 1,590,000 board feet. While some Red Oak is found in the Northeast and as far west as Minnesota, Wisconsin, and Iowa, the greatest volume of Red Oak lumber comes from the South, principally from the states of Alabama, Florida, Georgia, Kentucky, Louisiana, Mississippi, South Carolina, Tennessee and Texas.

When sold commercially, Red Oak usually includes: Northern Red Oak; Southern Red Oak—also known as Scarlet Oak, Spanish Oak, Spanish Water Oak and Spotted Oak; Pin Oak; Laurel Oak; Shingle Oak—also known as Northern Laurel Oak; Swamp Red Oak; Texan Oak—also known as Spotted Oak and Texas Red Oak; Black Oak—also known as Yellow Oak; and Willow Oak—also known as Pin Oak; Red Oak is also known in a few parts of the country as Turkey Oak but the name is not as common as those previously listed.

Red Oak is very similar to White Oak in appearance and working characteristics although the wood is not quite as strong. Its grain is more open than White Oak and slightly more obvious and its color is more generally red than brown. In the summerwood the pores of Red Oak are relatively few and distinct enough to count but those of White Oak are very crowded and are usually too numerous to count.

Although it is less resistant to decay than White Oak and is less waterproof because it has fewer tyloses than are present in White Oak, Red Oak varies so slightly in other favorable characteristics that it is generally used as an alternate for White Oak in less expensive constructions and wood products wherever darker pieces can be used. From a commercial standpoint there is little to choose between the two woods aside from color.

Red Oak of the Water Oak and swamp grown species are much used in veneer form for containers, such as fruit crates, shingle boards and wire bound boxes, as well as for utility plywood. In the better grades it is produced as rotary-cut, sliced or sawn veneer for face and decorative purposes. The rotary-cut veneer shows an attractive grain figure, not quite as pronounced as that of White Oak but still possessed of natural beauty and appeal. Sliced or sawn veneer is commonly produced in flat-grain, comb grain, quarter sawn and rift sawn form.

The natural color of Red Oak ranges from reddish brown to a decided reddish tinge, particularly near knots. Plain sawn surfaces show shorter ends of medullary rays than White Oak but quartered Red Oak shows a flake very similar to White Oak. Its color is warm and pleasant and its figure is especially attractive in novelty finish presentation.

Red Oak is most abundant and is sufficiently hard, stiff, and strong to suit it for all types of wood construction although it is best adapted to constructions where some protection is afforded from the elements. It is especially well suited for flooring and interior finish as it has the degree of

hardness required to resist indentation, high abrasive resistance, and an attractive grain and color.

While it is not equal to White Oak in waterproofness to suit it for the manufacture of water-tight containers, Red Oak still is a popular cooperage wood for the manufacture of slack cooperage. It is also much used in the basket industry.

Red Oak is very nearly equal to White Oak in steam bending properties. It appears in the form of bent parts for chairs and furniture in larger quantities than White Oak as it is used more in medium-priced and low-priced furniture applications. Red Oak is also used in bent form in considerable volume for truck body parts, farming implements, and boat and ship members.

Red Oak is one of the leading all-purpose furniture woods for the manufacture of furniture in the lower-price brackets and is used for both interior and exterior parts. It naturally lends itself to unusual decorative effects and is presented in many novelty finishes which are effective only over Oak. Red Oak is seldom bleached but the use of white and other light-colored fillers makes possible a wide variety of contrasting finishes.

Its hardness, strength and ruggedness has made Red Oak very popular not only for flooring and interior finish but for all types of inside building construction. Experiments with laminated timber constructions have shown Red Oak well suited to the production of high quality laminated wood products produced from arbitrarily selected minimum size cuttings and combinations of high and low density wood.

Red Oak has always been one of the preferred woods for wagon parts and agricultural implements and machinery. It is widely used for doors, sash and other millwork items, sewing machines, showcases and store fixtures, church furniture, and car construction. The aircraft industry also uses considerable Red Oak in the form of propellers, spar caps, bearing blocks and other highly stressed parts. Red Oak caskets have long been a staple item with burial case manufacturers and it is also found in the construction of other specialized products, such as ladders, piano parts and elevator constructions.

Large quantities of Red Oak are also used in the lower grades for posts, poles, props and railroad ties. These items all require protective treatment before use, however, to improve resistance to decay in contact with the soil. Recent reports indicate there is also an increased use of Red Oak for blocking in shipping heavy equipment.

Red Oak is one of the most economical hardwoods for commercial use available today in large volume that will provide the strength, weight, hardness, abrasive resistance, stability, good appearance, bending, gluing nailholding and screwholding, and machining properties required for an all-purpose commercial wood as well as a natural affinity for practically any finishing material properly applied. As a military hardwood of many uses, Red Oak ranks second only to White Oak.

WHITE OAK

Natural color—Sapwood-nearly white, heartwood-grayish brown.

Grain—Straight.

Grain figure—Plain or flake.

Texture—Ring porous, coarse-textured.

Color variation—Some difference between sapwood and heartwood.

Specific gravity [at 12% m.c.]—0.67.
 Weight per cubic foot [at 12% m.c.]—47 lbs.
 Hardness—Very hard.
 Stiffness—High.
 Strength—High.
 Stability—Excellent.
 Decay resistance—Durable.
 Shock resistance—High.
 Bending—Good.
 Nailing and screwdriving—Good.
 Nailholding and screwholding—Fair to good, tendency to split.
 Gluing—Good.
 Sanding—Good.
 (2/0 used for general sanding, 3/0 to polish for finishing.)
 Odor and taste—Some.
 Workability with hand tools—Good.
 General machinability—Good.
 Sawing—Good.
 (Saws require good set-swaged saws best.)
 Planing, jointing, moulding—Good.
 (Cutting angles recommended—10 to 25 degrees, 15 degree back bevel; finish—12 to 14 knife cuts per inch.)
 Shaping—Good.
 Boring—Fair to good.
 (Brad point bits with long taper cutting lips best.)
 Turning—Fair to good.
 Mortising—Good.
 Paintholding—Good.
 Staining—Good.
 (Will take practically any type stain although water stain has tendency to raise grain.)
 Filling—Good.
 (Brown filler for most standard finishes, white and light colored fillers for novelty finishes.)
 Sealing—Good, when properly filled.
 Bleaching—Fair to good.
 (Used for novelty finishes only.)
 Finishing—Good.
 (Takes all finishes well, especially attractive in contrasting novelty finishes.)
 Natural finish—Good, with attractive figure, color and grain structure.

Remarks:

Oak can truly be called the Sovereign Wood of America. There are about 500 species of Oak recognized in the world, with about 60 species common to the United States, only 14 of which are of commercial importance. It is cut commercially in about 40 states in a timber stand which has been estimated in quantity varying from 101 billion to 60 billion board feet, 47% of which is in White Oak. The country's annual Oak lumber production is estimated to be about 3 billion board feet, with more than 50% being produced in the South. Most Oak lumber production is confined to regions east of the Great Plains, with the greatest production being reached in the deep South; Louisiana, Arkansas and Mississippi is generally credited with more than 25% of the production. Most of the Oak is marketed under White Oak or Red Oak in about equal amounts. The two other important species belonging to neither White or Red Oak groups are live Oak and California Tanbark Oak.

White Oak is the ranking group and as sold commercially usually includes: White Oak, Bur Oak, Chinquapin Oak, Overcup Oak, Post Oak, Swamp Chestnut Oak and Swamp Oak. These Oaks are sometimes known by different common names in different localities, such as Rock Oak, Yellow Oak, Yellow Chestnut Oak, Basket Oak and Cow Oak.

White Oak is one of the best all-purpose and most used of all American woods. Many different types of grain and figure are obtained from the log by varying the angle of sawing for lumber or slicing for veneer. In the form of lumber quartered White Oak was formerly very popular for decorative purposes because of the pleasing figure

obtained by sawing the log at an angle which brought out and emphasized the radial grain in broad flakes crossing the ring growth from the center of the tree. The comb grain effect that is more popular today is obtained by sawing or slicing the log at an angle which emphasizes the ring growth with scarcely any visible radial grain.

In the form of veneer White Oak is usually rotary-cut, sliced or sawn. The rotary-cut veneer has quite a pronounced grain figure while sliced or sawn veneer can be flat grain, quarter-sawn, rift-sawn or comb grain. The veneer log is also sometimes cut on the half-round or with a staylog to produce novelty grain effects. The ends of the medullary rays are usually longer in White Oak than in Red Oak on plain-sawn or sliced surfaces.

The natural color of White Oak ranges from a light brown with a grayish tinge of the heartwood to lighter tones of ochre or near white of its sapwood. Quartered White Oak shows a very prominent flake in silver grain or elusive flakes created by the large medullary rays which reflect light. The wood has good color, a naturally attractive figure and a fine texture for a coarse-grained wood together with a natural resilience and warmth.

It must be remembered, however, that not all Oak of the same kind is of the same quality. Oak that grows slowly on high, well-drained ground will produce lumber of the finest texture and grain that is easier to work and least likely to swell or shrink in humid atmosphere. Oak that grows in low, warm humid land is usually coarse-grained, though very tough and hard.

White Oak is characterized by abundance, hardness, strength and good appearance which with its all-purpose adaptability to various types of finishes, qualify it for all types of wood construction. Its texture ranges from medium to firm and the heartwood pores are so obstructed at intervals with tyloses (forthlike growth) that the wood is virtually waterproof.

White Oak is outstanding for steam bending, as used in the manufacture of chair parts and boat parts, as its heavy fibers will stand a 20% reduction in length through compression in bending. Its bending characteristics, strength and waterproofness also make it ideal for barrels and all forms of tight cooperage. Also in the field of marine construction, its toughness, elasticity, resistance to decay, and nail and screwholding properties can be used to good advantage. World War II showed it to be most efficient and versatile in replacing scarce metals when it was used in landing craft, PT boats, barges, etc. and the glue-laminated Oak keels used on many ships led to many developments of a laminate nature. In aircraft applications it was also used for propellers, reinforcing blocks and compressed wood parts.

White Oak is one of the most rugged woods known to man and its ability to withstand rough treatment and resist wear and abrasion has made it a favorite wood for floors, interior trim and paneling. Because of its durability in contact with the soil, it is also popular for use as railroad ties and structural material, mining props and fencing material, posts and poles.

Ranking among the leading cabinet woods of this country, White Oak is one of the woods most commonly used in furniture both in the form of lumber and as a veneer. At the present time it is widely used for modern furniture which requires natural or the popular blonde finishes. It possesses all the properties required for a good furniture wood being one of the best woods to plane and shape, turns well, glues well

under proper control, has good stability with little warp or twist, and holds nails or screws very well.

White Oak lends itself to many decorative effects and may be finished in many ways to enhance its natural attractiveness: natural, stain finish of one color and filler of contrasting color, or stained and filled in the same color. Contrasting frosted Oak finishes have proved very popular in the furniture field in modern groups and individual pieces.

White Oak is much used in the manufacture of vehicle parts and agricultural implements, such as plow beams, brake beams, corn grinders and binders, doubletrees, drags, felloes, gear woods, frames, hay rakes and balers, hubs, plow parts, spokes, and windmill parts. In the utility field it is also popular for casings, cages, ladders, wire reels, sandboards, switchboards, tool chests, tanks and vats.

In the specialty field it is the leading wood for church furniture and fixtures, store fixtures, and office equipment, caskets, barber furniture, bar fixtures, billiard and pool tables, handles and brush blocks, refrigerators, sewing machines, doors, cabinet work, mill-work and all kinds of planing mill products. White Oak also is used in the manufacture of basket parts, butter churns, piano parts, sleds and wagons, and truck body and trailer parts.

White Oak may contain mineral streaks, pin worm and grub worm holes. While tannic acid in the wood protects White Oak from some fungi and insects, it is subject to attack from the Oak timber worm or pin worm and several fungi that cause heart rot. Oak wilt is threatening White Oak to some extent but is presently more prevalent in the Red and Black Oaks.

PECAN

Natural color—Sapwood—pale red to white; heartwood—reddish brown, with dark streaks or stripes.
 Grain—Straight.
 Grain Figure—Usually straight.
 Texture—Ring porous, coarse-textured.
 Color variation—Marked difference in color.
 Specific gravity [at 12% m.c.]—0.65.
 Weight per cubic foot [at 12% m.c.]—45 lbs.
 Hardness—Very Hard.
 Stiffness—High.
 Strength—Strong.
 Stability—Good.
 Shrinkage—Low.
 Decay resistance—Not durable.
 Shock resistance—High.
 Bending—Good.
 Nailing and screwdriving—Tendency to split.
 Nailholding and screwholding—Good.
 Gluing—Good.
 Sanding—Good.
 (2/0 coarsest grit that may be used without scratching, 3/0 gives best results.)
 Sawing—Good.
 (Saws require good set, swaged saws best.)
 Odor and taste—None.
 Workability with hand tools—Works relatively hard.
 General machinability—Fair to good.
 Planing, jointing and moulding—Fair to good.
 (Works best with shallow cut, best cutting angles 15 to 30 degrees, with 5 to 15 degree back bevel; finish—12 to 15 knife cuts per inch.)
 Shaping—Very good.
 Boring—Good.
 (Brad-point bits with strong stubby lips best.)
 Turning—Very good.
 Mortising—Excellent.

Paintholding—Good.

Staining—Takes any stain well, but water and NGR stains more commonly used.

Sealing—Good, when properly filled, takes any sealer or primer.

Filling—Good.

(Brown fillers used for standard finishes, white or transparent fillers used for blonde finishes.)

Finishing—Good.

Takes all finishing materials well, with fine polish.

Natural finish—Good.

(Attractive color and grain figure.)

Remarks:

American Pecan is a member of the Hickory family although it is not considered a true Hickory. Botanically it is related to Walnut. There do not seem to be any accurate estimates of the stand of lumber production of Pecan available as it is combined with Hickory in most annual reports, which is credited with a stand of some 11 billion board feet and an annual cut of about 125 million board feet.

Pecan as a commercial wood is generally considered to include: Pecan Hickory, Sweet Pecan, Bitter Pecan, Water Hickory, Bitternut Hickory, Mockernut Hickory and Nutmeg Hickory. It is a native of the United States and grows naturally in the southern states bordering on the Mississippi River, reaches its greatest size in the Ohio basin, and is found in Alabama, Arkansas, Illinois, Indiana, Iowa, Louisiana, Kansas, Kentucky, Missouri, Mississippi, Tennessee, Texas and Mexico.

Like other Hickories, Pecan is commonly classified as red, from the color of its heartwood, or white, from the sapwood, but its color variation is no indication of its strength properties. Pecan naturally has a beautiful figure and its heartwood is usually a rich, reddish brown with very dark streaks or stripes running through it to emphasize its beauty. The sapwood is light, ranging from light red to white, with a relative plain figure.

Pecan is unsurpassed in wearing qualities and possesses the same combination of strength, stiffness, hardness and elasticity as true Hickory species although its shock resistance is not quite as high. Although it does not plane as well as some woods, it shapes and turns very well and its general machining qualities are good. The natural stability of Pecan make it one of the most dependable woods as regards expansion and shrinkage.

Pecan is one of the more attractive hardwoods whose beauty is best appreciated when used in furniture, interior finish and paneling. In some panel applications of natural or light finish various interesting and attractive formations embellish the natural coloring of the wood. Stripes and an occasional burl are found and some pieces will show curly grain. Pecan usually shows a conspicuous annual ring and porous grain on the surface.

It is hard to understand why Pecan is not a more popular furniture wood. While it has enjoyed limited popularity as an alternate furniture wood for Walnut, which it resembles very much when stained, Pecan's natural color is even more attractive. As a chair making material, Pecan meets all requirements. It has the strength, toughness and general machining properties required for good chair construction; has good bending properties for the manufacture of bent parts; and produces turnings of fine quality.

In solid and plywood panel form Pecan's hardness, strength and stability and its attractive appearance suits it well for exterior use. It has the abrasive resistance and stiffness required for frame and drawer constructions and

finishes beautifully. In more recent applications in casegoods manufacture, it has become very effective and popular in blonde and light novelty finishes.

Pecan is available in good quantity in decorative veneers. Considerable difficulty was formerly encountered in slicing Pecan for veneers but this has been overcome to produce beautiful veneers for use in furniture and wainscoting. Pecan sliced veneer is readily obtainable in 1/28-inch veneer but other thicknesses are usually cut to order. Selected Pecan veneer cut from heartwood shows beautiful dark stripes against the characteristic reddish brown background.

Many manufacturers have shied away from the use of Pecan because the wood showed a slight tendency to warp and did not plane as well as some other hardwoods. Modern dry kiln practice has overcome seasoning problems to a great extent and the use of proper cutting angles, feeds and speeds permit Pecan to be machined as easily and accurately as practically any of the hardwoods.

Pecan's combined stiffness, toughness and strength makes it quite popular for the manufacture of vehicle parts, tool and farm implement handles as well as for such special products as golf club shafts, ladder rungs, dowels and gymnasium apparatus. It is also used extensively in automobile, trailer and truck body work. One of the more unusual uses of Pecan is in baseball bats used in scholastic circles.

Pecan is also used for flooring, interior trim and various millwork items. It is a leading school furniture wood and has other uses in bent form, other than for furniture, such as wheels, hoops, and racing sulky parts. It has always been very popular as a fuelwood and is used for basket-making in thin strips.

Pecan has a great potential value as an alternate wood for furniture and high grade cabinet work. It has all of the properties required and is available in both solid lumber and veneer form in good volume at a price below that of many woods now in common use which do not compare in attractiveness, beauty or adaptability. Pecan really needs a good press agent, it has everything else.

YELLOW POPLAR

Natural color—Sapwood-creamy to white, heartwood-light to dark yellowish brown with greenish or purplish tinge.

Grain—Straight.

Grain figure—Mild.

Texture—Diffuse porous, medium textured.

Color variation—Marked difference between sapwood and heartwood.

Specific gravity (at 12% m.c.)—0.40.

Weight per cubic foot (at 12% m.c.)—28 lbs.

Hardness—Soft.

Strength—Moderately weak.

Stability—Excellent.

Decay resistance—Not durable.

Shrinkage—Medium to high.

Shock resistance—Low to medium.

Bending—Fair to poor.

Nailing and screwdriving—Excellent.

Nailholding and screwholding—Fair.

Gluing—Very good.

Sanding—Fair to poor.

(3/0 coarsest grit that can be used without scratching, 4/0 gives best results.)

Sawing—Good.

(Seldom requires special setting or saw conditioning.)

Odor and taste—None.

Stiffness—Good.

Machinability with hand tools—Good.

General machinability—Good.

Planing, jointing and moulding—Good.

Shaping—Fair to poor.

Boring—Good.

(Brad point bits with long tapered cutting lips best.)

Turning—Good.

Paintholding—Excellent.

Staining—Takes any stain but is seldom stained.

Filling—Seldom filled.

Finishing—Good.

(Takes and holds all kinds of paints, enamels and top coats well, never shows raised grain or discoloration from resin.)

Natural finish—Seldom used, has no distinctive figure or grain or attractive coloring effects.)

Remarks:

Yellow Poplar is one of the more important of the commercial hardwoods although it is a "soft" hardwood that is in many respects similar to Basswood. Its name is misleading as it is not of the same family as true Poplars. It is commonly known as the Tulip Tree but is in no way related to Brazilian Tulipwood. In certain parts of the country, as Virginia and Pennsylvania it is also sometimes called "Canoe Tree" because the Indians made their dugouts from it. Yellow Poplar is also known as Whitewood in some parts of the country. This classification is usually used for lumber cut from young Poplar timber which is mostly Sapwood. Although not used commercially to any extent, the tree is sometimes called "Saddle Leaf Tree" because of the distinctive shape of its leaves.

Yellow Poplar is one of the largest hardwood trees grown in this country and is known to have grown to over 10 feet in diameter and up to 200 feet tall. It is found growing naturally in a large area bounded generally by southern New England through New York to southern Wisconsin and south to northeastern Alabama and northern Florida. Yellow Poplar seems to reach its largest size in the lower Ohio Valley and the Southern Appalachian Mountains.

The only two true Tulip tree species known in the world are found only in the United States and central China. The stand of saw timber has been estimated from 9 to over 12 billion board feet, over half of which is in the states of Alabama, North Carolina, Tennessee and Virginia. The annual production of Yellow Poplar lumber is estimated at about 500 million board feet, with the high production cut in 1946 reaching about 790 million board feet. Georgia and Virginia are generally credited with the highest annual production of Yellow Poplar lumber.

Tulip tree lumber is commonly distributed as Yellow Poplar in the usual hardwood grades although special grades of Whitewood are sold in certain parts of the country. Cucumber Magnolia and Evergreen Magnolia are sometimes sold as and with the lower grades of Yellow Poplar and resemble that wood considerably except that they are usually somewhat heavier and harder and have a more greenish or purplish tinge.

Yellow Poplar is available in good quantity both in the form of lumber and as veneer for crossbanding and face veneers. The sapwood is generally creamy to white, with discoloring strips of darker color often present. The sapwood is usually several inches in thickness and there is a marked difference between sapwood and heartwood in color. The heartwood is usually a pale canary-yellow color with a distinctly greenish cast, although it is sometimes a light brownish color in some portions, and purplish brown or purplish black streaks are often found running through it.

Yellow Poplar is a medium textured.

light weight wood noted for its ability to stay in place and hold its position, excellent gluing and nailing qualities, and general good machinability. Although classified as moderately weak in strength properties, Yellow Poplar has sufficient strength for most constructions and is superior to many hardwoods in stability, stiffness and all-round adaptability.

Yellow Poplar is especially popular in the plywood field as a core wood, where its ability to take glue, light weight, ability to hold position with little warping tendencies, and good machinability make it an ideal base for veneers. In the form of veneer it is used both for crossbanding and face veneer, although its application as a face veneer is somewhat limited by its lack of distinctive figure chiefly to utility plywood. As a veneer Yellow Poplar has little definite figure, showing a little curly at times and sometimes shows some blister and burl in selected veneers.

Yellow Poplar is much used for exterior construction and trim as it has good weather and moisture resistance qualities together with an excellent surface for taking and holding paint and enamel. Some of its many outside applications include: battens, siding, outside trim, sash, sill, shutters, blinds, porch ceiling, carriages, stringers columns and railings.

Industrial reports show that Yellow Poplar is used in the manufacture of wood products by more different industries than any other wood, either softwood or hardwood. Its lumber is wide and easily cut so that its use is not confined to any extent by rough dimension. In inside applications yellow Poplar cannot be beat as a hardwood for painted and enameled finished woodwork because of its stability and its lack of any substance in its wood structure which will affect either paint or enamel finish.

In the furniture field Yellow Poplar is chiefly used in panel form for corestock, table tops, case panels, etc., but it is also used considerably for carvings and low-priced turnings. As a furniture wood it is usually finished in enamel or some other finish with good covering capacity as it has little figure of its own and often presents mineral streaks which must be covered or painted out. Yellow Poplar is especially popular for use in breakfast and dinette sets finished in enamel or colored lacquer.

Yellow Poplar is used extensively for toys and general millwork and planing mill products. It is a preferred wood with musical instrument manufacturers and its lack of odor and taste has made it popular for the manufacture of food containers, woodenware, baskets, kitchen cabinets and refrigerators. In one of its more novel applications Yellow Poplar is used to make tobacco and cigar boxes. In cigar box manufacture the wood is either covered by a thin Cedar veneer or the wood is marked and stained to simulate Spanish Cedar.

In the lower grades Yellow Poplar is used for boxes, crates and veneered containers. It is also a leading excelsior wood and is used in small quantities for pulpwood to make paper. The airplane industry also uses Yellow Poplar for beams, braces, frames, longerons, ribs, spacer blocks and struts. Piano manufacturers use Yellow Poplar for piano actions and other parts and it is used in the manufacture of organ parts and pipes.

Other important uses of Yellow Poplar are for motor vehicle and wagon parts, store and office fixtures, caskets, car construction, Venetian blinds, ironing boards, bakers peels, laundry machinery, carpet sweepers, trunks, bungs and faucets, farming implements, ladders, matches, pool tables

and ping pong tables, brush blocks and plumber's woodwork. This is at best only a partial list of Yellow Poplar applications as it is used to make thousands of wood products, large and small.

The inner bark of the trunk and roots of the Yellow Poplar or Tulip tree is a prolific source of hydrochlorate of tulipferine, an alkaloid and stimulant, which has the unique property of stimulating the heart.

Yellow Poplar is suited to the manufacture of any wood product which does not require the ultimate in hardness and strength. It possesses most of the remaining properties required in abundance and is very easily worked. While it is not suited to a natural or stained finished where an attractive figure or coloring is needed, it has an excellent surface for taking and holding paint or enamel for a permanent finish which is not equalled by most hardwoods. It is available in good volume and large dimension at a price which makes it most competitive in the hardwood lumber market.

SYCAMORE

Natural color—Brownish white to reddish brown.

Grain—Irregular, interlocked.

Grain figure—Flake (prominent when quarter-sawn.)

Texture—Diffuse porous, fine uniform texture.

Color variation—Some difference between sapwood and heartwood.

Specific gravity [at 12% m.c.]—0.49.

Weight per cubic foot [at 12% m.c.]—34 lbs.

Hardness—Medium.

Strength—Moderately strong.

Stability—Average.

Decay resistance—Not durable.

Shrinkage—High.

Shock resistance—Medium.

Bending—Fair to poor (retains shape well after bending.)

Nailing and screwdriving—Good.

Naitholding and screwholding—Good.

Sanding—Fair to poor.

(3/0 sandpaper gives best results.)

Sawing—Good.

(Saws require good set, swaged saws give best results.)

Gluing—Good.

Odor and taste—None.

Stiffness—Moderate.

Machinability—with hand tools—Fair to poor.

General machinability—Fair to good.

Planing, jointing and moulding—Fair to poor. (Requires keen cutters and high machine speeds.)

Shaping—Fair to good.

Boring—Good.

(Brad-point bits with strong stubby cutting lips best.)

Turning—Good.

Paintholding—Good.

Staining—Takes any stain.

Filling—Seldom filled.

Bleaching—Seldom bleached—takes pastel finishes without bleaching.

Finishing—Good.

(Takes any finishing material well but is seldom painted as natural figure in quartered form lends itself to natural or non-obscuring stains.)

Natural finish—Much used in quartered form which shows attractive pronounced flake.

Remarks:

American Sycamore belongs to the planetree family and is the most important of the seven species native to the United States, Mexico and Central America. It is sometimes known as Planetree, Button-Ball or Buttonwood and is one of the largest trees of eastern United States. It grows to 80 or 100 feet high and 3 to 8 feet in diameter scattered in mixture with other hardwood trees found along stream

banks and in bottomland.

Sycamore grows widely in the eastern half of the country but a greater portion of the lumber comes from bottomlands along the Mississippi River and its tributaries. Its general distribution is throughout the eastern half of the country from northern Maine to northeastern Nebraska, south into Texas and along the Gulf of Mexico to northern Florida.

No real accurate figures are available on the timber stand of Sycamore due to the scattered nature of its distribution. A rough estimate places the total timber stand at about 3 billion board feet. Lumber cut in an average year is about 68 million feet with about 80% of the total cut coming from the south. Sycamore lumber makes up only a small portion of the total cut in hardwood mills so that it is a by-product rather than a major product due to its limited supply.

A good quantity of Sycamore lumber is cut into 5/8-inch thickness for use as drawer stock by the furniture industry. As plain-sawn lumber Sycamore has little figure and is restricted more or less to utility uses. Most of the better Sycamore timber is quarter-sawn to bring out its very attractive figure in the form of numerous pronounced flakes against a faint growth ring background. These brownish or reddish-brown flakes run up to 1/4-inch in height, greater than Beech, Birch, Maple or Oak, and are darker in color than the background wood. No small narrow rays are seen between the wide flakes as they are in Beech.

Quartered Sycamore is also enjoying increased popularity in veneer and plywood form for furniture, interior finish and wall paneling. In quarter-sliced veneer Sycamore presents a prominent flake figure to impart an attractive mottled texture and a pleasing ribbon stripe is also produced by selective cutting. This Sycamore veneer is very popular for veneered bedroom furniture finished in light novelty finishes which do not obscure the grain.

The sapwood of Sycamore will range in color from brownish white to pale reddish brown or silvery brown and the heartwood from pale brown to dark brown with either a reddish or silvery tinge. The color difference between sapwood and heartwood is moderate and blends together in a single board rather than standing out in bold relief.

Some trouble is experienced with seasoning plain-sawn Sycamore but quarter-sawn lumber seasons well under controlled drying conditions. The wood is of fine, uniform texture, moderately heavy and hard and is generally rated as intermediate in strength stiffness and shock resistance properties. It has unusual resistance against splitting due to its interlocked fiber, somewhat like gum.

Some difficulty has been encountered in machining at surfacing machines, such as the planer, jointer and moulder, but by using higher spindle speeds, 5400 r.p.m. instead of 3600 r.p.m., and keen cutters with cutting angles from about 15 to 25 degrees, a good finish can be produced on plain-sawn Sycamore with 11 to 14 knife-cuts-per-inch and on quarter-sawn stock with 14 to 16 knife-cuts-per-inch. It turns, shapes, saws, bores and mortises exceptionally well and shows good detail on shaped or turned parts.

Sycamore's poor decay resistance prevents its use for posts, poles or railroad ties and it is seldom used for exterior construction or trim. Its peculiar resistance to splitting has made it a preferred wood for the manufacture of meat and butcher's blocks which require dense wood fibers which do not splinter easily and can resist constant chopping.

Sycamore has proved to be an excellent wood for the manufacture of shipping containers for candy, foods, vegetable and dairy products as it has no tendency to impart either odor or taste. This property has also led to its use for tobacco boxes, fruit and berry boxes, and flour and sugar barrels. It is used extensively for slack cooperage also and it has been estimated that about two-thirds of the total Sycamore cut is used for boxes and crates.

The musical instrument manufacturers use considerable Sycamore in the construction of their products. It is commonly used for piano backs and bodies for stringed instruments, such as guitars and mandolins. Sycamore is also used in limited quantities for the manufacture of agricultural implements; small boats, brush blocks, carpet sweepers, refrigerators, handles, shade rollers, vehicle bodies and laundry appliances.

Quartered Sycamore is especially attractive for wall paneling and interior trim. It is used for risers and floor and fancy matched veneer doors. It lends themselves well to interior decoration. Furniture, fixtures and millwork also take a considerable amount of this stock and cabinet manufacturers seem to be using more of it. It takes a pleasing natural finish and is much-used with light stains which enhance the attractive grain figure. Plain-sawn lumber is used in chair manufacture and for moderately priced furniture and breakfast and dinette sets.

Some of the more unusual uses for Sycamore are for blackboards, merry-go-round parts, signs, scientific instruments and fruit and vegetable hoppers. It was the favorite trees from which the Illinois French settlers made their large trade dugout canoes, which were made as long as 65 feet and carried loads up to 9,000 lbs.

Sycamore is one of the most beautiful of the hardwoods in its quartered form and would enjoy a much wider use application if it were in more generous supply. Modern seasoning and machining practice has removed most of the difficulties previously experienced with its preparation for use in a finished wood product and its other properties make it a good all-purpose wood. Sycamore takes a beautiful finish and it has an excellent appearance with a natural finish.

TUPELO & BLACK GUM

Natural color—White or whitish brown to brownish gray or grayish black.

Grain—Interlocked, plain or figured.

Texture—Diffuse porous, fine uniform texture.

Color variation—Little difference between sapwood and heartwood.

Specific gravity [at 12% m.c.]—0.50.

Weight per cubic foot [at 12% m.c.]—35 lbs.

Hardness—Moderately hard.

Stiffness—Moderately stiff.

Strength—Moderately strong.

Stability—Naturally poor, fair when properly seasoned.

Decay resistance—Moderate.

Shock resistance—Moderate.

Bending—Poor to fair.

Nailing and screwdriving—Good.

Nailholding and screwholding—Good.

Gluing—Excellent.

Sanding—Fair to good.

(3/0 coarsest grit that can be used without scratching, 4/0 gives best results.)

Odor and taste—None.

Workability with hand tools—Good.

General machinability—Good.

Planing, jointing and moulding—Fair to good.

(10 to 20 degrees cutting angle, with back bevel 10 to 15 degrees, and 9 to 13 knife-cuts-per-inch for best re-

sults.)

Shaping—Fair.

Boring—Good.

(Brad-point bits with long taper cutting lips best.)

Turning—Good.

Mortising—Fair.

Sawing—Good.

Paintholding—Good.

Staining—Very good.

Bleaching—Seldom used.

Sealing—Very good.

Filling—Seldom used.

Finishing—Excellent for natural, stained, shellac, varnish, lacquer or synthetic finishes and takes paint and enamel very well.

Natural finish—Quarter-sawn Black Gum takes attractive natural finish.

Remarks:

The stand of Tupelo is estimated as 18,957,000,000 board feet made up almost entirely of Water Tupelo and Black Gum. Both are relatively large trees but Water Tupelo is a swamp forest tree found along lake shores and in bottomlands while Black Gum may grow in dryer land. Water Tupelo is distributed in the Coast Region from southeastern Virginia through the Gulf States to Texas and northward in the Mississippi River region to southern Illinois. Its best development is found in the Cypress swamps of Louisiana and southern Texas. Black Gum is found throughout the region east of the Mississippi River and west through southeastern Missouri to Texas. Its best growth is found in the southern Appalachian Mountains of North Carolina and Tennessee.

Water Tupelo is known by various names in certain parts of the country, such as Tupelo Gum, Swamp Tupelo, Cotton Gum, Swamp Gum, Bay Poplar and Hazel Pine. Black gum is also known as Black Tupelo, Pepperidge and Sour Gum. These names are also used indiscriminately for Tupelo.

Tupelo and Black Gum are sold both under their respective names and in mixture as one or the other. While they are distinct botanical species, their wood is so similar there is no way of positively identifying the wood of the two species, except when quarter-sawn Black Gum shows a ribbon stripe figure. Separation is usually made on the basis of hardness, with the harder wood being classified as Black Gum.

Most of the lumber production comes from the south and the total cut in an average year is about 500,000,000 board feet, with slightly more than half the cut being Black Gum. The principal producers are found in Georgia, Louisiana, North Carolina and South Carolina. This timber has only been cut for lumber since about 1910 in any quantity but its progress since then has been remarkable.

The chief difference between Tupelo and Black Gum is its specific gravity or density. The density of Black Gum is the same from tree top to stump but there is a gradual decrease in density down the trunk of Tupelo. Although both species have the same dry-wood density at the top, about 0.50, this density will decrease in Tupelo to about 0.25 in the swelled butt and about 0.13 in the roots to make the rootwood just as light as Balsa wood. This lightweight wood is commonly used as floats for fish nets.

Some users maintain that genuine tough-textured, deep swamp Tupelo is superior and insist on it in preference to Black Gum. Some coast mills have specialized in the production of this so-called genuine Tupelo to meet this demand. The use of Water Tupelo has increased considerably as is evidenced by the fact that of 282,000,000 board feet used in the manufacture of finished products in 1940, fully two-thirds of this lumber was Water Tupelo.

The lumber of Tupelo and Black Gum

is largely sapwood and in color it is generally considered a neutral wood since it is virtually white throughout and contains no perceptible markings. In fact, the sapwood is as nearly white as any wood that grows and is of much greater volume than the heartwood which ranges in color from brownish-gray to grayish-black. There is just a gradual color transition from sapwood to heartwood.

In the heavier grades Tupelo cannot be distinguished from Black Gum, even in hardness, but the lighter-weight Tupelo has less tendency to warp and is generally preferred by manufacturers. Both Tupelo and Black Gum have spiral grain and a tendency to warp and twist, if not properly seasoned or dressed uniformly on each side of the board in machining. When matched into cores or other glued-up panels, it is customary to alternate matching pieces as they are matched up to counteract warping and twisting tendencies.

The wood is of uniform textures and an interlocked grain which makes it resistant to splintering under heavy wear and difficult to split. It is moderately heavy and moderately strong. Its stiffness and shock resistance is adequate for use in most wood products and it is an excellent wood to finish with any finishing material on its close uniform-textured surface. One of the chief reasons for its preferred use in boxes for export shipment is its unusual ability to show lettering to good advantage.

The only marked preference for Black Gum is in its quarter-sawn products which bring out an attractive and distinctive ribbon stripe that is very popular for interior finish, paneling and furniture. In the form of lumber, quartered Black Gum is sold only in FAS grades. The lumber seasons and works well and takes an excellent finish. As a fancy face veneer it is equally popular for furniture and other interior applications for decoration.

Both species are used in volume by the veneer industry, particularly in the south where it makes up a large part of the total production. Rotary-cut veneer is used for utility veneer and crossbanding for fancy face veneers. Some plain veneer is also used for lower grades of furniture plywood. Much of the veneer cut is used for containers: wire-bound boxes, baskets and berry crates and boxes because of its strength and toughness in veneer form, resistance to splitting and wear, and freedom from any tendency to impart odor or taste. The latter property also makes it popular for tobacco and cigar boxes.

Tupelo is used to imitate Spanish Cedar for tobacco boxes by indenting the veneer sheets between toothed rollers to give it a simulated Cedar grain. It is also stained a Cedar color and is sometimes even given an artificial odor by treating it with Cedar oil.

Tupelo and Black Gum are always given consideration where exceptional resistance to abrasion, splitting and wear are of prime importance. They are used as tops for work benches, store counters, and school furniture and have proved very satisfactory for factory floors and platforms subject to heavy wear. Preservative treatment has also permitted their use for docks and wharves as well as bridge planking to reduce maintenance from splintering and abrasion.

The properties of Tupelo and Black Gum which led to their use for ox yokes, wagon parts and chopping bowls are now utilized for gunstocks and pistol grips, hat blocks, rollers in glass factories, axles, felloes, hoppers, hubs, laundry appliances, wooden shoes and railroad cars.

Good nailholding and screwholding properties and resistance to splitting

make this wood well suited to the manufacture of shipping boxes and crates and built-in cabinets and fixtures. Its general adaptability causes it to be used also for coat hangers, picture frames, novelties, toys, musical instruments and woodenware.

The inherent finishing quality leads to major uses in furniture, caskets, chairs, cabinets and general millwork and fixture products. The clear white wood makes it ideal for products requiring either paint or enamel finish, such as interior finish doors, cabinets and fixtures and in stained finishes for furniture it is equal to any hardwood and is much-used to imitate more expensive cabinet woods.

Tupelo and Black Gum have been exported to Europe for some time and their utilization in this country has by no means reached its peak. The veneers are inexpensive, practical and have excellent quality. The lumber is plentiful in supply and if seasoned properly and handled through the plant properly, will remain flat, and be as durable and finish as well if not better than other hardwoods.

WALNUT

Natural color—Sapwood-pale to whitish brown, heartwood-medium to chocolate brown.

Color variation—Distinct difference between sapwood and heartwood.

Grain—Straight or irregular.

Grain figure—Varied.

Texture—Diffuse porous, close-textured.

Specific gravity [at 12% m.c.]—0.55.

Weight per cubic foot [at 12% m.c.]—38 lbs.

Hardness—Medium.

Stiffness—High.

Strength—Very high.

Stability—Excellent.

Decay resistance—Durable.

Shock resistance—Good.

Bending—Fair to good.

Nailing and screwdriving—Fair to good.

Nailholding and screwholding—Fair to good.

Gluing—Excellent.

Sanding—Very good.

(Best results with 4/0 for polishing, 3/0 for production sanding.)

Odor and taste—Some.

Workability with hand tools—Good.

General machinability—Good.

Sawing—Good.

(Best results with good set in saws.)

Planing, jointing, moulding—Good.

(Best cutting angles—15 to 30 degrees, finish—14 knife cuts per inch.)

Shaping—Good.

Boring—Good.

(Brad-point bits with strong stubby cutting lips best.)

Turning—Excellent.

Mortising—Excellent.

Paintholding—Good.

Staining—Good, takes all stains well.

(Water stains and NGR stains most used.)

Filling—Good.

(Brown or black fillers used except for light or natural finishes.)

Sealing—Good, takes any sealer.

Bleaching—Good, for light finishes.

Finishing—Good, takes all finishing materials well but is never painted.

Natural finish—Excellent, with varied figure and coloring.

Remarks:

The growth of American Walnut timber is scattered over a wide natural range, with the trees growing singly or in small groups, and no reliable estimate figures are available on the stand in connection with forest surveys. Rough estimates have been made from 900,000,000 to 1,750,000,000 board feet

of timber which must supply from 40,000,000 to 50,000,000 board feet consumed annually. In an average year, the lumber cut was 41,000,000 board feet with an additional 15,000,000 board feet being used in manufacture of veneers. The drain has been so great that the Walnut industry has instituted a progressive forestry program including woodland management, and the planting of young trees to replenish the annual cut. In a single year (1948) 3,241,000 stratified Walnuts and seedlings were planted as part of this program, according to a report made by the American Walnut Manufacturers Association.

Under favorable conditions American Walnut is a rapid-growth tree and reaches a height of 30 to 40 feet and a breast-high diameter of 5 to 9 inches in 20 years. The industry has set a cutting standard of a minimum 15-inches d.b.h. (diameter breast high) for all uses. It grows best in deep, rich, well-drained soil where moisture is plentiful and has reached its best size in the region of the Mississippi Basin. The timber is scattered over a wide natural range from Ontario, Canada south to Texas and from Massachusetts west to mid-Nebraska, with commercial quantities found chiefly in Illinois, Indiana, Iowa, Kansas, Kentucky, Missouri, Ohio and Tennessee. Kansas and Missouri are the leading states in Walnut lumber production.

The Walnut family numbers about 13 species with American Walnut and European - Asiatic Walnut (variously known as English, French, Italian, Persian and Circassian, according to habitat) being the most important species. Most of these yield fine cabinet lumber and top-grade veneer but none of the foreign species approach the yield of American Walnut.

The reason for the use of the commercial name, Black Walnut, for American Walnut has never been accurately determined. The wood has various shades of brown coloring but is never black. The sapwood ranges from a creamy-white to a pale brown and the heartwood varies from light to chocolate brown, sometimes with darker streaks and/or a slate-blue cast. The natural coloring of Walnut is characteristically light and warm and is so nearly neutral that it harmonizes with any kind of decorative color scheme.

American Walnut has an endless variety of figures, most of which are a distinct Walnut type seldom seen in other woods. This varied figuration is caused by the annual growth rings and the natural irregular or wavy grain of the wood. Visible pores, relatively large and numerous in the spring wood, emphasize each ring of growth. Careful cutting of the logs produces plain wood of quiet dignity and beauty as well as veneers of many figured types. As used in the manufacture of veneer, Walnut yields up to 24 distinctive types of figures which are easily matched into individual patterns of beauty for decorative purposes.

American Walnut veneers are produced by sawing, slicing and rotary cutting, with the last two methods being used principally for high grade veneers. Slicing and half-round cutting done at right angles to the growth rings produce various stripe effects. Rotary-cut Walnut veneer generally shows a series of widely-spaced irregular lines as the knife stays within a single growth ring for several inches in cutting around the log.

The longwood veneer is produced in plain, semi-figured and figured patterns and include such well-known patterns as cross figure, fiddle back, mottle, and rope. Quartered logs present a range from fine pencil to wide stripes. Wood of decided grain is also obtained in veneer from butts or

stumps, varying from plain to 80% figure, with most showing wavy grain where the roots spread out from the tree. Very attractive Walnut veneer is also produced from burls, some of which weigh as much as a ton, which shows a very attractive wavy and swirl figure as well as the distinctive moonshine effect.

Distinctive swirl figures are also produced from crotchwood and many figured quartered effects are obtained by first flitching the log into quarters. This method produces a very effective Circassian Walnut effect in a California Walnut, known as Claro. All Walnut veneers are matched into distinctive decorative patterns using every known matching method. The adaptability of Walnut veneer for decorative matching is well shown by the common use of Walnut in making inlaid pictures, using various kinds for their wide range of color, grain and figure to assure desired effects.

The most prized effects are produced from burls and other freak tree formations. This material is so highly prized that it is sold by the pound. Even stumps bring high prices as evidenced by the stump of a Black Walnut tree near Smithfield, Va. which sold for \$3,800 in 1937—more than was paid proportionately for the tree.

It seems hardly necessary to expound at length on the value of Walnut as a cabinet or furniture wood. Its known use in both fields extends back to the early 1400's. Walnut has recorded furniture application during the early Renaissance period, 1400 to 1500 A.D. and in English history is particularly associated with Queen Anne furniture. One of the architectural uses of Walnut for decorative work of early record was the S. Zaccaria choir stalls, made of Italian Walnut by Francesco and Marco di Vicenza sometime between 1455 and 1464.

Known through the ages as the Royal Cabinet Wood, Walnut has all the desirable properties for an all-purpose wood. It has sufficient hardness and strength for general use but not enough hardness to dull cutting tools excessively. Because of its close, even grain it is easily worked into the most artistic designs and is well suited for carving. Walnut is valued for its rich color and luster as well as a fine figure that is distinctive but not obtrusive its line finishing and polishing qualities, stiffness without excessive weight, good machining and sanding properties, and exceptional ability to stay in place when properly seasoned.

Walnut's unusual stability has led to almost universal use for airplane propellers and gun stocks. A leading armorer states Walnut is preferred as gun stock material because after seasoned Walnut has been cut and shaped it alters very little if at all, so the gun barrel and locks drop into position and rest without bending locks or throwing barrels out of line. The American Walnut Manufacturers Association reported that large quantities of unshaped Walnut gun stocks, left over from World War I, were used to make guns for World War II with practically no change in shape or other deterioration.

The extreme variety of Walnut's grain, figuring and color have made it most popular for interior trim and even for flooring of the best American homes. In both solid and veneer form, with veneer generally preferred, Walnut is extensively used for panels and doors, usually finished in its natural rich, brown color in a hand-rubbed or polished gloss finish. It is never painted for that would truly be sacrilegious.

While its most important uses are in solid and veneer construction of furniture, high-grade cabinet work, and interior trim and paneling, Walnut is

also much used in the manufacture of church appointments (altars, pews, etc.), caskets, carvings, clock cases, museum cases, instrument cases, jewel caskets, showcases, passenger car construction, decorative ornaments, desks, fixtures, mouldings, novelties, organs and pianos, boat paneling, trim and instrument boards, radio and television sets, sewing machines, stringed musical instruments, steering wheels and other decorative vehicle parts.

Aside from its wide use for propellers, Walnut has many other uses in the aircraft industry, such as interior paneling, patterns, high-grade plywood, spar caps and highly-stressed parts.

In any and all of its many applications Walnut can be finished in natural, traditional or novelty finishes with all types of finishing materials. Properly cleaned up and sanded, it produces a very smooth finish and is very easy to keep clean and take care of in use. When Walnut is stained, only those stains which will bring out the beauty of figure and grain are used so as not to obscure the varied texture, figure and graduated color effects.

Although its growth may be retarded by excessive crowding or shading, Walnut is a relative hardy tree. Even though its chief foes, tent and Walnut caterpillars, may disfigure the trees, they seldom kill them. Durability of Walnut in furniture or other forms of cabinet construction is most eloquently attested by the number of antique pieces still in active use after hundreds of years of service, whose drawers still move in and out as smoothly as when they were first made of this Royal Cabinet Wood.

WILLOW

Natural color—Sapwood—light tan or whitish brown, heartwood—creamy light brown to pale reddish brown.

Color variation—Non-uniform, intermediate.

Grain—Heavy and coarse.

Grain figure—Varied.

Texture—Diffuse porous.

Specific gravity [at 12% m.c.]—0.37.

Weight per cubic foot [at 12% m.c.]—26 lbs.

Hardness—Soft.

Stiffness—Intermediate.

Strength—Intermediate.

Toughness—Good.

Stability—Very good.

Decay Resistance—Not durable.

Shock Resistance—Fair to good.

Bending—Fair, seldom bent commercially.

Nailing and screwdriving—Good.

Nailholding and screwholding—Fair to good.

Gluing—Excellent.

Sanding—Poor to fair, inclined to fuzz. (3/0 or 4/0 for best results after glue sizing.)

Odor and taste—None.

Workability with hand tools—Fair.

General machinability—Fair.

Sawing—Fair.

(Saws required good set, swaged saws best.)

Planing, jointing, moulding—Poor to fair.

(Requires cut bevel—30 degrees, back bevel—10 degrees. Cutting angle—20 degrees gives best results, finish—8 to 12 knife-cuts per inch.)

Shaping—Fair.

Boring—Fair.

(Brad point bits with long taper cutting lips best.)

Turning—Poor to fair.

(Best turning with keen cutting edges on knives and wood at about 6% m.c.)

Mortising—Fair.

Paintholding—Good.

Staining—Good.

(Used chiefly for imitation Mahogany

and Walnut finishes.)

Filling—Not much used.

Sealing—Good, takes any sealer or primer.

Bleaching—Good, for light finishes and uniforming base color.

Finishing—Good, takes all finishing materials including paint and enamel.

Natural finish—Good, used for interior trim.

Remarks:

Of the 70 species of Willow in North America, only 21 are recognized as trees and only the Black Willow reaches commercial size although some quantity of Yellow and White Willow is used for special purposes and the shoots of Purple Willow are used somewhat in basket making. So-called Missouri Willow, named from its location along the Missouri River, is also mixed with Black Willow for lumber in limited quantities.

Willow has a wide distribution and is very abundant in the Mississippi Valley and throughout the Atlantic states. It is said to reach its largest dimension in southern Illinois and along the Colorado River Valley in Texas, but its commercial production is limited chiefly to the Mississippi River Delta. It is characterized by tall, clear stems, growing as tall as 130 feet and about 3 feet in diameter.

Willow is a fast growing tree on islands and river banks and has been known to average 5 feet in height per year for 10 to 15 years under favorable conditions. It is not a dominant species and stagnates if it is not properly thinned out, starting as soon as practicable and continuing for 5 year intervals. Although it will stand flooding and silting without appreciable damage, stands that are not properly thinned have been known to lose up to 50% of volume in 5 to 8 years because Willow trees have been killed out by competition of other trees.

There are no statistics available on the total stand or lumber production of Willow. Its production has been chiefly a by-product of mixed hardwood stands and it has not been developed to commercial importance sufficient to warrant special study and treatment. A move is underway, however, to acquaint wood-users of the possibilities of Willow as an alternate wood. Black Willow is also known in some regions by the names "Southern Willow" and "Swamp Walnut" and has been promoted under those names.

The sapwood is light, usually a light tan or fleshy white, and the heartwood is a pale reddish brown or a creamy light brown, often with darker streaks along the grain. The color is seldom uniform and has some of the characteristics of Walnut in this respect, although it is somewhat lighter in color. It takes a very good imitation Mahogany or Walnut finish and is also bleached to produce the modern novelty finish effects.

The wood of Willow is soft, uniform in texture, and very light in weight. While it does not possess extreme strength, it does have a peculiar property that makes it tougher than many other hardwoods and is exceptionally free from warping. It is rather difficult to machine with cutters, although use of proper feeds, speeds and cutting angles at cutting machines produces as good results as the average hardwoods, and applying a glue size to the dressed surface effectively combats its tendency to fuzz in sanding. Willow possesses excellent stability and no other wood will glue better or under as wide a range of working conditions.

Its tendency to curl and interlock has made it a favored wood for the production of excelsior. Its lack of tendency to split from nailing and satisfactory nailholding properties has

resulted in placing Willow in a preferred position as a box and container material in those regions where it is in plentiful supply. The lack of any tendency to transmit odor or taste has also led to the wide use of Willow in the manufacture of food containers and dairy, poultry and apiary supplies. It has long been used for cheese box heading, staves and hoops.

Despite its so-called structural weaknesses, Willow has long been used in the manufacture of caskets and is being developed for increased use in the manufacture of furniture. Its stiffness and strength have been found adequate for many constructions and in assembly, Willow has been proven tougher than many heavier woods. Its possibilities for extended use are being investigated by many progressive agencies looking for alternate woods in this period of short supply.

Willow grows abundantly along the lower Arkansas and White Rivers and has long been used in this section for box manufacture. In answer to inquiries for extending the field of this wood, the Arkansas Resources and Development Commission ran various tests and made their findings available to manufacturers of their state. Their tests showed Willow to be suited to various furniture items, that it could be bleached, and that it would serve as a good substitute for Honduras Mahogany when properly finished and would also take finish similar to many fine furniture woods.

More than 90% of all artificial limbs manufactured today are made of Willow due to its combination of lightness and freedom from warping, and ability to bruise without splintering. While some Black Willow is used, the upland variety of White Willow is generally preferred as it is tougher and does not have as much a tendency to check. Black Willow of the lowland swamps takes too long to dry and checks excessively in air-drying. This wood is also said to have unusual shape-holding characteristics in this application.

Black Willow is extensively used in certain regions of the country as interior trim and moulding in painted finish and as solid wall paneling in natural or stained finishes. When properly kiln-dried, little trouble is encountered with checking. It is also used for a variety of millwork products, novelty and woodenware. Other important uses include the manufacture of baseball bats, bookcases, boats, fixtures, furniture shelving, vehicle parts and wagon beds.

Willow is produced commercially in the form of factory lumber, commercial and package veneer. A special grade of interior trim is also produced from red heart lumber. It is used in bolt form for excelsior and in small sections as fuel and for charcoal. A large part of the charcoal used in the manufacture of gunpowder is made from Willow. The bark of some species is extremely tough and is used as strings or is twisted into rope and small Willow shoots are preferred for basket and mat weaving.

The Willow bark is high in tannin content and both the bark and the roots contain a bitter principle that is sometimes decocted from either or both for use as a substitute for quinine in the treatment of fever.

As the advantages of Willow are explored and exploited to the wood-using industries, it is hoped that the increased demand will lead to the establishment of better management of Willow timber. The profit possibilities of this timber under proper management and good woodland practice are very good. The owners of tracts containing considerable Willow state they have already cut over their holdings two or three times in a normal lifetime.