

SUSTAINABLE SOLUTIONS

SUSTAINABLE

AMERICAN
HARDWOODS



Far more American hardwood grows than is harvested each year.

www.americanhardwoods.org



The Hardwood Council
www.americanhardwoods.org
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When mature hardwood trees are harvested, more sunlight reaches the forest floor to stimulate new growth.





“With his materials the architect can do whatever the masters have done with pigments or with sound – in shadings as subtle, with combinations as expressive – perhaps outlasting himself. Wood is universally beautiful to man. It is the most humanly intimate of all materials.”

– Frank Lloyd Wright

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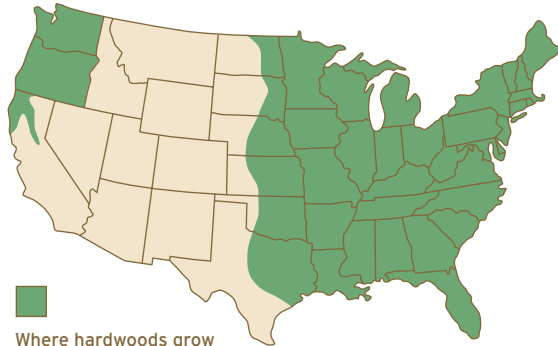
American Hardwoods: Renewing, Abundant and Sustainable

American hardwoods have entered their fourth century of providing beauty and authenticity, warmth and integrity, lasting aesthetic and functional value to interiors. For floors, furniture, mouldings, millwork, cabinetry and built-ins, they are quintessentially green materials in abundant and self-renewing supply.

American hardwoods are sustainable solutions for eco-effective design and building:

- **Harvesting levels are far below the levels of growth:** Nearly twice as much hardwood grows each year as is harvested in the U.S. For this reason, the volume of hardwoods in American forests today is 90 percent larger than it was 50 years ago.
- **Hardwood foresters follow professional best practices that mimic natural forces.** Individual trees are selected for harvest, encouraging forests to renew and regenerate themselves naturally and prolifically.
- In addition to providing wildlife habitat and filtering the water supply, **trees produce oxygen, remove carbon dioxide and store carbon**, reducing greenhouse gases in the atmosphere.
- **Virtually every part of the log is used** as lumber or by-products, and finished products are re-useable, recyclable and biodegradable.

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Most hardwood forestland is in the eastern half of the United States.

All hardwood forests in the continental United States are temperate—not tropical. They are home to the oaks, maples, cherry, ash, poplar and scores of other broad-leaved deciduous species, many of which grow nowhere else in the world. The term “hardwood” has no reference to the wood’s actual hardness, which differs by species.

Unlike the area blanketed by the evergreen conifers (softwoods), most hardwood forestland is in the eastern half of the country. Hardwood forests cover 279 million acres:

the equivalent of hardwood trees covering every square inch of New York, Pennsylvania, Ohio, Illinois, Indiana, West Virginia, Virginia, North Carolina, South Carolina and Georgia.

This resource is neither scarce nor finite.

Collectively, across all hardwood trees in all American hardwood forests, there is nearly twice as much new wood growth as there is wood removed through harvesting. We are not running out of trees. The volume of hardwood in American forests is 352 billion cubic feet, and they are adding growth of

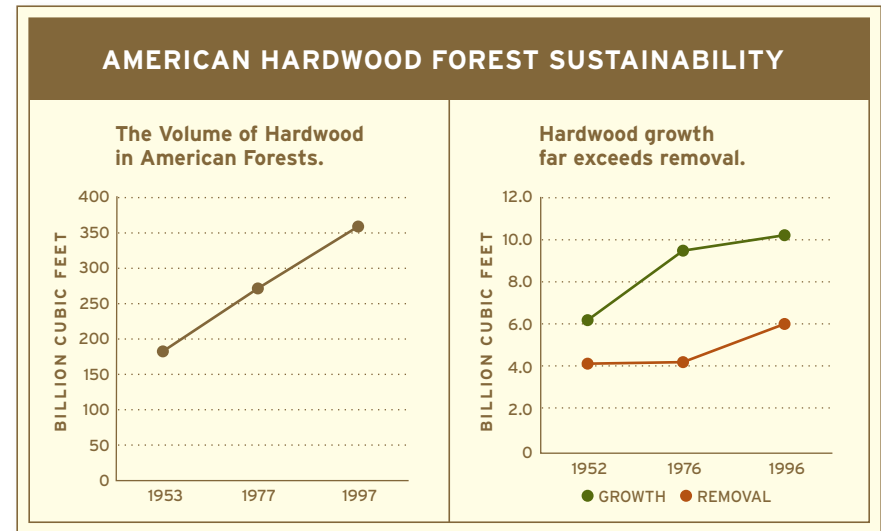
SUSTAINABLE SOLUTIONS

10.2 billion cubic feet a year. This compares to annual removal of 6 billion cubic feet.

“Sustainability” is meeting today’s needs, without compromising the ability of future generations to meet their needs. With hardwood growth well exceeding removal, the U.S. supply of hardwoods for flooring,

furniture, cabinetry and millwork is—by definition—sustainable now and for future generations.

Just as important, hardwoods are green design choices with the intrinsic beauty and versatility so lacking in recycled cartons, glued-up grass stalks and compressed grain husks.



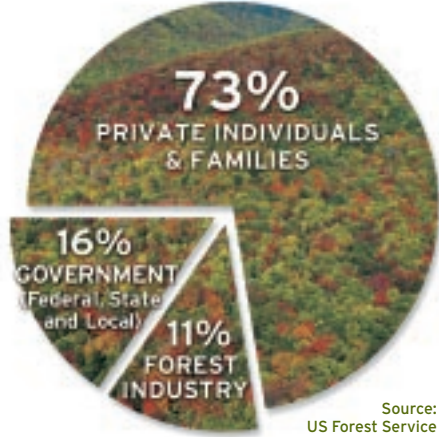
Source: US Forest Service

STEWARDSHIP OF AMERICAN HARDWOOD FORESTS

7 million individual, private owners

What or who is responsible for this renewing and eminently sustainable supply of American hardwoods? Those who own the forestland, their foresters and the forest management practices they employ.

Ownership of American Hardwood forestland



More than 7 million private individuals and families own fully 73 percent of all hardwood forestland in the United States.

While individual private ownership of hardwood forestland predominates, the hardwood processing industry owns 11 percent, with 16 percent under the public ownership of the federal, state and local governments.

Under their collective stewardship, the volume of hardwood in American forests has increased 90 percent since 1953. This is attributable to responsible and sustainable forestry practices that continue today.

Significantly, this ongoing record of sustainability long pre-dates the fee-based, third-party certification programs estab-

STEWARDSHIP OF AMERICAN HARDWOOD FORESTS

lished in the mid-1990s, which cover just a fraction of all sustainably managed U.S. hardwood forestland.

In the woods, every day, professional foresters practice the complex science of silviculture. Their hardwood forest management plans reflect the profession's best practices for long-term sustainable timber production, and also address water quality, wildlife habitat, biodiversity, forest aesthetics and recreational opportunities.

Foresters adapt their practices and methods to the unique requirements and conditions of each site: What are the landowner's objectives? What is the species mix? How much new growth is there already? Are seeds well-distributed? Is there a stream? A slope? Are any trees diseased or dead? How will we minimize soil erosion, and avoid damage to unharvested trees and other vegetation?

At the same time, all forestry operations are subject to federal, state and local



laws and regulations designed to protect water quality as well as threatened and endangered species.

The goal is improvement and sustainable renewal of the forest. Deforestation is the result of road-building, agriculture and development—not forestry.

MIRRORING NATURAL FORCES

Foresters practice single-tree selection in American hardwood forests

In American hardwood forestry, the predominant harvesting method is single-tree selection—not clear-cutting. Foresters choose individual trees for harvest based on a complex array of considerations.



By mirroring natural occurrences, hardwood forest practices are a long-established form of biomimicry that supports natural regeneration.

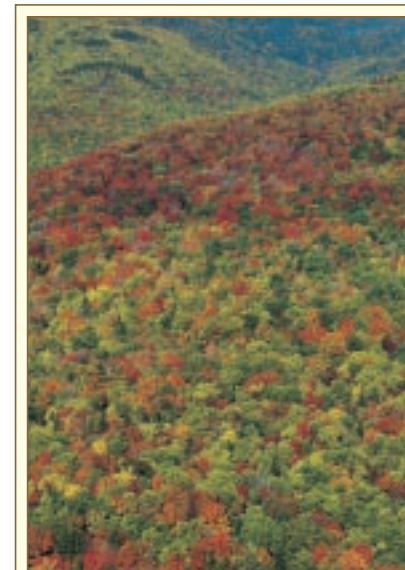
MIRRORING NATURAL FORCES

In practice for decades, this harvesting method mirrors the natural process of single trees or small groups of trees dying and falling, or being blown down by localized winds.

A well-planned harvest pays at least as much attention to the trees that will remain as to those that will be removed.

American hardwood forests are not uniform plantations or even-aged, single species monocultures. They are instead complex ecosystems that are home to a diversity of tree species of varying ages: sprout, seedling and sapling, mature and aging; dying and decaying.

In a hardwood forest, trees compete for the water and sunlight that come through the forest canopy—the leafy “roof” over the forest floor. Carefully removing individual trees creates openings in that canopy so that more precipitation, sunlight and nutrients reach the forest floor. This type of thinning improves growing conditions. No longer suppressed by larger trees, the seedlings and saplings are free to grow vigorously.



UNPARALLELED DIVERSITY

American hardwood forests offer a greater number of species than any other temperate hardwood forest resource.

ENCOURAGING SELF-REGENERATION

Hardwood forests renew and replenish themselves naturally

In hardwood forests, the trees reproduce naturally and prolifically. This regeneration is irrepensible: it is not necessary to intervene and plant hardwood trees after a harvest.



Single-tree selection reduces competition and supports this spontaneous renewal: the future forest.

In the cycle of natural self-replenishment, young hardwood trees sprout from roots, stumps and seeds, assuring the continuing diversity of species and tree ages in the forest. The single-tree selection method of harvesting reduces competition and gives this new growth more sunlight, water and nutrients.

Hardwood forest renewal happens at its own, natural pace. *Foresters work with the timeline that Nature dictates: sustained supply and ongoing replenishment are the result.*

FOREST STRATIFICATION



- 1. Emergent** – A tree that grows above the general level of the forest canopy. These trees are exposed to the strongest sun and winds.
- 2. Canopy** – This level forms the roof of the forest with crowns of the dominant trees and other vegetation.
- 3. Understory** – This level receives little light. Many of these trees tolerate shade and remain at this level; others grow and replace older, fallen trees.
- 4. Forest Floor** – This lowest level is made up of tree seedlings, dead leaves and needles, grasses, ferns, flowers, fungi and decaying plants and logs.

ECO-EFFECTIVENESS

Re-creation and Recovery

Thanks to photosynthesis, healthy forests are net producers of oxygen. Growing trees take carbon dioxide from the atmosphere, and separate the carbon and oxygen atoms. Trees then return oxygen to the air and use the carbon to grow roots, trunk, branches and leaves. This process reduces greenhouse gases in the atmosphere.

To grow a pound of wood, a tree uses 1.47 pounds of carbon dioxide and gives off 1.07 pounds of oxygen. Consequently, an acre of trees can remove about 13 tons of dust and gases from the atmosphere.

Once a tree stops growing and begins to decay, the process reverses. For every pound of wood that decays, the tree uses 1.07 pounds of oxygen and releases 1.47 pounds of carbon dioxide into the air.

Birds and animals scatter the seeds that continue regeneration in the hardwood forest.



ECO-EFFECTIVENESS

Single-tree harvesting removes older, carbon-dioxide-emitting trees, allowing the younger carbon-using trees to grow more vigorously.

Growing forests also pump water up from the soil and back into the air through transpiration. A tree that's 100 feet tall with 200,000 leaves will take 11,000 gallons of water from the soil and transpire it into the air in a single growing season.

This process not only cools the environment, but also plays a vital role in collecting and releasing water into natural channels and courses.

SUSTAINABLE MANUFACTURING

Once trees are harvested and taken to the sawmill for primary processing, advanced manufacturing technology assures the least wood waste and greatest yield of lumber. As with the secondary manufacturing facilities where finished goods are made, all wood processing by-products have a use:

- Tree bark is processed into mulch and soil conditioners.
- Sawdust fuels the boilers that operate dry kilns or is sold for animal bedding.
- Trimmings are chipped and processed into paper, among other products.
- Small pieces are recovered and processed or finger-jointed into wood components or other products.

The next green steps are taken by architects, designers or specifiers who practice sustainable design and building.



SUSTAINABLE DESIGN

Transcending Tradition

Each hardwood species requires a particular set of conditions to thrive. Each needs specific types of soil and nutrients, and certain amounts of moisture, warmth, sunlight or shade. That's why most American hardwoods grow in the Eastern part of the country, and it's why species distribution varies by region.

The stewards of American hardwood forests deal with what Nature gives them—the types of trees destined to grow on that particular site. What thrives on forested land is not the landowner's choice: it's pre-ordained by the forces of nature.

And those forces have determined that the oaks grow from Maine to Mississippi, in more abundance than any other hardwood species. Eco-inspired designs recognize that

52 percent of all American hardwoods are oak. They find fresh expressions for this most plentiful material by asking “What if?” and “Why not?”

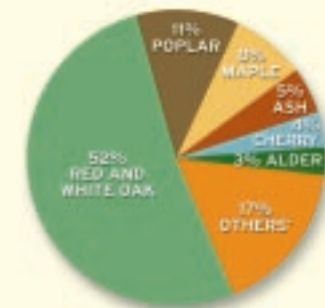


SUSTAINABLE DESIGN

For hundreds of years, American hardwood forests have provided more than 20 species suitable for cabinetry, flooring, millwork and furniture. For reasons of current fashion, custom or convention, many of them are unexplored or under-used despite their commercial availability. Designers and specifiers may well be overlooking the wealth of hardwood possibilities, and unduly limiting their repertoire.

The next generations of American hardwoods are growing right now: will they all be embraced as part of new eco-aesthetic, in fresh combinations and with other materials?

WHICH HARDWOODS ARE MOST ABUNDANT?



American hardwoods renew and regenerate themselves abundantly. Some species have been and will continue to be relatively more plentiful than others because that is how they occur in nature.

* Includes Basswood, Birch, Cottonwood, Elm, Gum, Hackberry, Hickory/Pecan, Walnut and other hardwood species

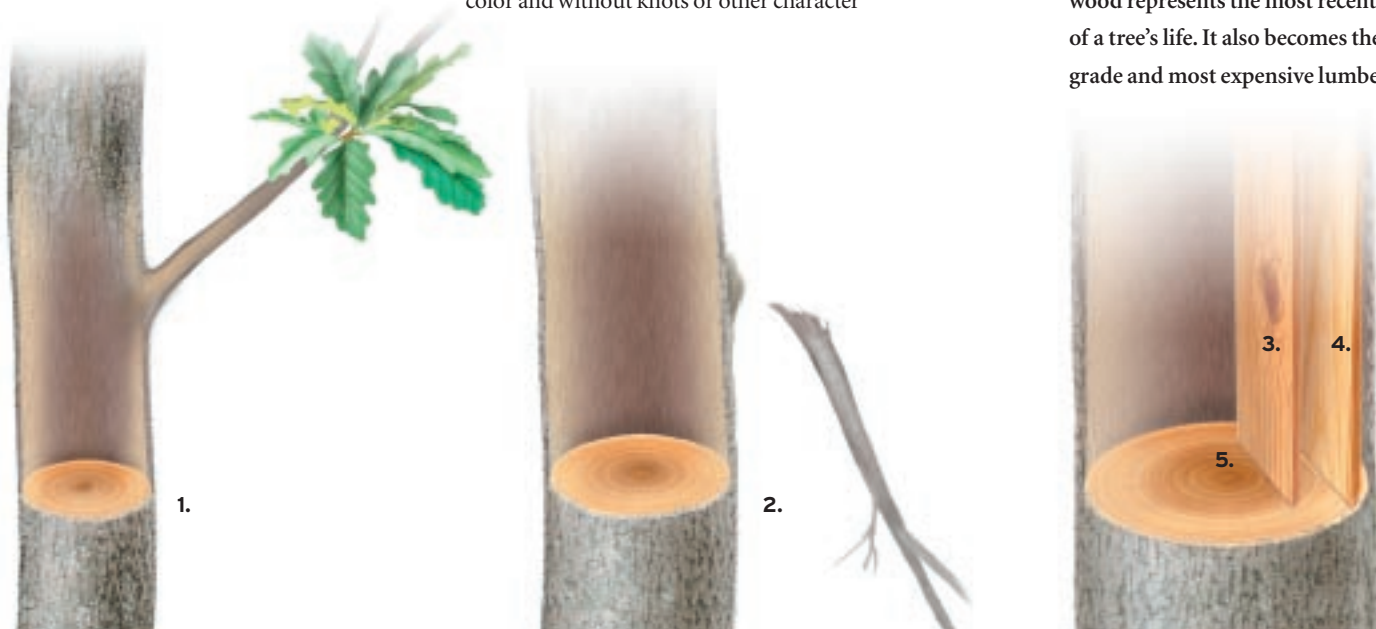
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Celebrating Diversity

When trees grow, they become taller and they add annual growth rings of wood just under the bark, increasing their girth. Over the years, branches grow, die off and fall to the forest floor. **(1 and 2)** Yet, they leave a legacy in the tree's wood: a knot where every branch once

was. **(3)** Eventually, layers of wood grow over the knots and new branches will grow higher on the tree trunk—closer to the sunlight and the forest canopy.

The tree's newest wood, closest to the bark, is known as sapwood. It usually is lighter in color and without knots or other character



markings. **(4)** The oldest wood toward the center of the tree – the heartwood – has ceased to contain living cells and generally is darker than sapwood. **(5)**

A mature hardwood tree has more character-marked than clear wood. Clear wood represents the most recent chapters of a tree's life. It also becomes the highest grade and most expensive lumber.

SUSTAINABLE DESIGN

Eco-effective designs make fullest use of the forest resource and reflect the tree's entire history. They celebrate natural variety in coloration and character markings.

Sustainable materials use is economical as well as responsible. The concealed portions of a built-in, for example, need not be made of high grade, and costly, clear lumber.



SUSTAINABLE DESIGN

Specifying Respectfully

Sustainable design respects a material's origin and connects it to the application.

A hardwood tree may be 55 feet tall and 24" in diameter, but today's high-recovery, high-yield sawing methods will not produce 24" wide boards.

Profiling will reduce this board's width. Sustainable design makes the connection between source and product and accommodates accordingly.



SUSTAINABLE DESIGN

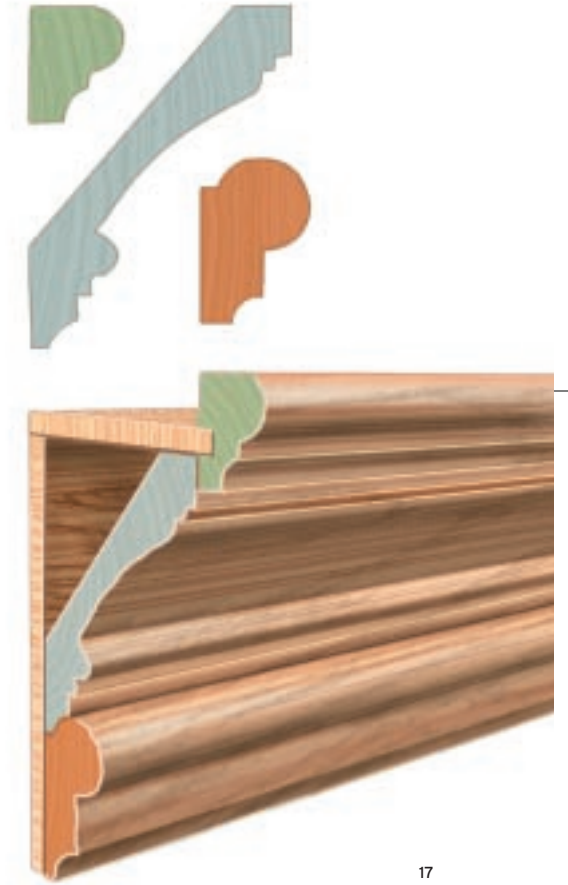
It takes an especially large-diameter hardwood tree to yield the wide, long plank needed to make a very wide, long, clear moulding.

Since these are the exception, eco-effective practice achieves that look with finger-jointed mouldings or with several profiles that are built-up or stacked. The result is economical and responsible use of widely available material.

Eco-inspired designs embrace the distinctive signatures of natural materials precisely because they are not mass-produced and artificially uniform.

STACKING MOULDINGS

An intricate moulding design can be created by combining individual profiles through "stacking." With more than 350 stock profiles available, custom profiles often are an unnecessary expense.



SUSTAINABLE DESIGN

Choosing Reasonably

Grain pattern or figure is created when the log is sawn into lumber.

At what angle does the saw meet the growth rings? In flat- or plain-sawn hardwood boards, growth rings are parallel to the board's surface and create the flame-shaped, arch or cathedral grain pattern. Compared to the other methods, flat-sawing produces the most lumber and the widest lumber at the least cost.

Classic Quarter-Sawn

Quarter-sawing is a slower and thus more expensive process than flat-sawing. The log actually is cut into quarters and sawn quarter by quarter. A single board is sawn from one face, then the next board is sawn from the opposite face and the sawing proceeds on alternate faces.

In quarter-sawn lumber, the growth rings are perpendicular to the board's broad face, producing a vertical and uniform grain pattern.



SUSTAINABLE DESIGN

This method yields fewer and narrower boards per log than flat-sawing, boosting their cost significantly.

The growth rings in rift-sawn lumber are at 30 to 60 degree angles to the board surface, producing vertical graining that is easily confused with quarter-sawn. Rift-sawn lumber also is available in limited quantities.

All lumber processing produces some quarter-sawn and some rift-sawn lumber. However, at least 95 percent of all hardwood lumber commercially produced in the U.S. is flat-sawn.

Sustainable design recognizes that no sawing method is superior and that all hardwood products will expand and contract as they reach balance with the relative humidity of their surroundings. Regardless of how they are sawn, all hardwood products should be stored and handled properly at the job site.



Sustainable Design

America's temperate forests provide hardwoods in ever-renewing and sustained supply.

Their rich history, beauty, warmth and versatility are unmatched.

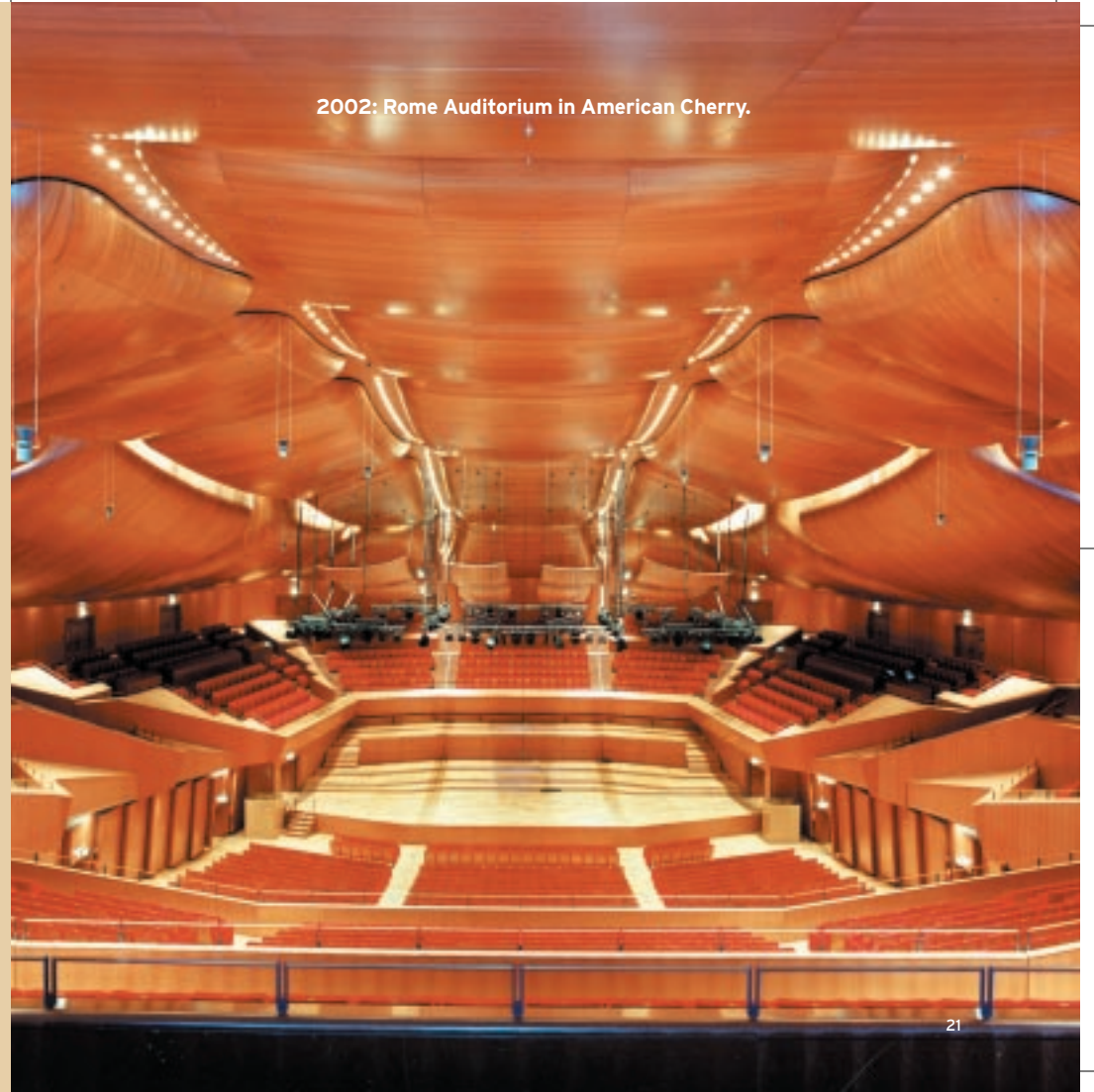
For centuries, they have been the essence of classic value and authenticity.

Prized then and now for their enduring quality, they are timeless restored, refinished or reclaimed.



Thomas Jefferson designed this hardwood floor, installed at Monticello in 1805.

2002: Rome Auditorium in American Cherry.





When trees mature, it is fair and moral
that they are cut for man's use,
as they would soon decay and return to the earth.

Trees have the yearning to live again,
perhaps to provide the beauty, strength and utility
to serve man and even to become
an object of great artistic worth.

—George Nakashima



SPECIES: American black cherry



DISTRIBUTION Principally the Pacific Northwest, where it is the most abundant commercial hardwood.

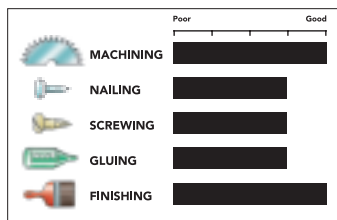
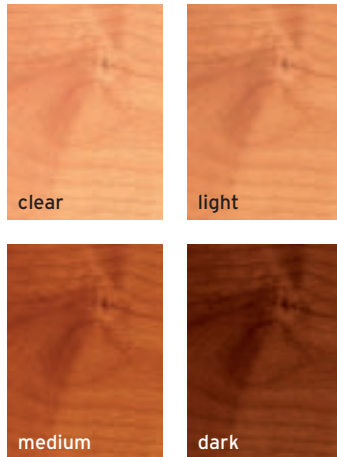
GENERAL DESCRIPTION Alder, a relative of birch, is almost white when freshly cut but quickly changes on exposure to air, becoming light brown with a yellow or reddish tinge. Heartwood is formed only in trees of advanced age and there is no visible boundary between sap and heartwood. The wood is fairly straight-grained with a uniform texture.

WORKING PROPERTIES Alder machines well and is excellent for turning. It nails, screws and glues well, and can be sanded, painted, or stained to a good finish. When stained, it blends with walnut or cherry. It dries easily with little degrade and has good dimensional stability after drying.

PHYSICAL PROPERTIES Alder is a relatively soft hardwood of medium density that has low bending strength, shock resistance and stiffness.

AVAILABILITY Available in dimension stock and lumber.

MAIN USES Furniture, kitchen cabinets, doors, shutters, mouldings, panel stock, turnings, carvings and kitchen utensils.



DISTRIBUTION Throughout the Eastern U.S.

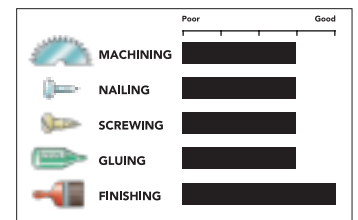
GENERAL DESCRIPTION The sapwood is light-colored to nearly white and the heartwood varies from greyish or light brown, to pale yellow streaked with brown. The wood is generally straight-grained with a coarse uniform texture. The degree and availability of light-colored sapwood, and other properties, will vary according to the growing regions.

WORKING PROPERTIES Ash machines well, is good in nailing, screwing and gluing, and can be stained to a very good finish. It dries fairly easily with minimal degrade, and there is little movement in performance.

PHYSICAL PROPERTIES Ash has very good overall strength properties relative to its weight. It has excellent shock resistance and is good for steam bending.

AVAILABILITY Readily available.

MAIN USES Furniture, flooring, doors, architectural millwork and moulding, Kitchen cabinets, paneling, tool handles, baseball bats, sporting equipment and turnings. It is particularly suitable for food and liquid containers since there is no odor or taste.





DISTRIBUTION Commercially in the Northeast.

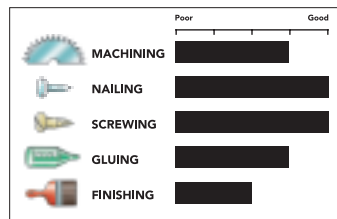
GENERAL DESCRIPTION Sapwood is white, blending into the light brown heartwood. The contrast between sap and heartwood is small. The wood has a fine uniform texture and is straight-grained.

WORKING PROPERTIES Aspen does not split when nailed, it machines easily with a slightly fuzzy surface, and turns, bores, and sands well. It takes paint and stain well to produce a good finish, although care is required where the surface is fuzzy. It has low to moderate shrinkage and good dimensional stability.

PHYSICAL PROPERTIES The wood is light and soft, with low bending strength and stiffness, and medium shock resistance. It has a very low bending classification.

AVAILABILITY Limited, and rarely available in thick stock.

MAIN USES Furniture parts (drawer sides), doors, mouldings, picture frames, millwork, toys, kitchen utensils, matchsticks. Important specialized uses include sauna laths because of its low conductivity of heat, and chopsticks.



DISTRIBUTION Principally the Northern and Lake states.

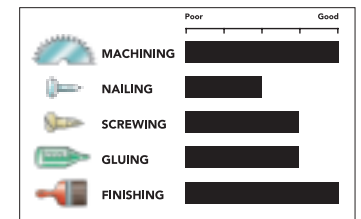
GENERAL DESCRIPTION The sapwood of basswood is usually quite large and creamy white in color, merging into the heartwood which is pale to reddish brown, sometimes with darker streaks. The wood has a fine uniform texture and indistinct grain that is straight.

WORKING PROPERTIES Basswood machines well and is easy to work with hand tools, making it a premier carving wood. It nails, screws, and glues fairly well and can be sanded, and stained, to a good smooth finish. It dries fairly rapidly with little distortion or degrade. It has fairly high shrinkage but good dimensional stability when dry.

PHYSICAL PROPERTIES The wood is light and soft with generally low strength properties and a poor steam-bending classification.

AVAILABILITY Reasonable availability.

MAIN USES Carvings, turnings, furniture, pattern-making, mouldings, millwork and musical instruments. An important specialized use is Venetian blinds and shutters.





DISTRIBUTION Eastern U.S., principally Northern and Lake states.

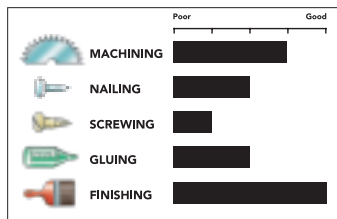
GENERAL DESCRIPTION Birch has a white sapwood and light reddish brown heartwood. The wood is generally straight-grained with a fine uniform texture. Generally characterized by a plain and often curly or wavy pattern.

WORKING PROPERTIES The wood works fairly easily, glues well with care, takes stain extremely well, and nails and screws satisfactorily where pre-boring is advised. It dries rather slowly with little degrade, but it has moderately high shrinkage, so is susceptible to movement in performance.

PHYSICAL PROPERTIES The wood of birch is heavy, hard and strong. It has very good bending properties, with good crushing strength and shock resistance.

AVAILABILITY Reasonable availability, but more limited if selected for color.

MAIN USES Furniture, millwork and paneling, doors, flooring, kitchen cabinets, turnings and toys.



DISTRIBUTION Throughout Midwestern and Eastern U.S. Main commercial areas: Pennsylvania, Virginia, West Virginia and New York.

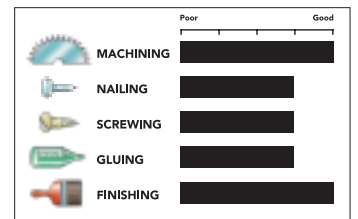
GENERAL DESCRIPTION The heartwood of cherry varies from rich red to reddish brown and will darken with age and on exposure to light. In contrast, the sapwood is creamy white. The wood has a fine uniform, straight grain, satiny, smooth texture, and may naturally contain brown pith flecks and small gum pockets.

WORKING PROPERTIES Cherry is easy to machine, nails and glues well and when sanded and stained, it produces an excellent smooth finish. It dries fairly quickly with moderately high shrinkage, but is dimensionally stable after kiln-drying.

PHYSICAL PROPERTIES The wood is of medium density with good bending properties, it has low stiffness and medium strength and shock resistance.

AVAILABILITY Readily available.

MAIN USES Fine furniture and cabinet making, mouldings and millwork, kitchen cabinets, paneling, flooring, doors, boat interiors, musical instruments, turnings and carvings.





DISTRIBUTION Eastern U.S., main commercial areas: Middle and Southern states.

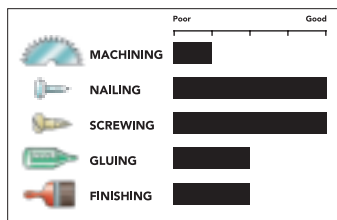
GENERAL DESCRIPTION The sapwood is white and may contain brown streaks while the heartwood may be pale to light brown. It is a diffuse porous wood with a coarse texture. The wood is generally straight-grained and contains relatively few defects. Cottonwood is a true poplar, and therefore has similar characteristics and properties to aspen.

WORKING PROPERTIES General machinability is fair, although tension wood is frequently present and can cause a fuzzy surface when cut, which in turn will require additional care when finishing. The wood glues well and has good resistance to splitting when nailing and screwing. It dries easily but may still have a tendency to warp, with slight movement in performance.

PHYSICAL PROPERTIES Cottonwood is relatively light in weight. The wood is soft, and weak in bending and compression, and low in shock resistance.

AVAILABILITY Widely available.

MAIN USES Furniture, furniture parts, millwork and mouldings, toys and kitchen utensils. Specialized uses are Venetian blinds, shutters, and caskets.



DISTRIBUTION Most cypress trees are natives of the South. They are found primarily in wet, swampy areas along the Atlantic Coastal Plain from Delaware to Florida, and west along the Gulf of Mexico to the border of Texas and Mexico. Cypress also thrives along the Mississippi Valley from the Louisiana delta to southern Indiana.

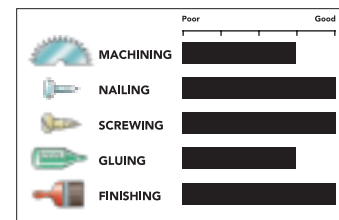
GENERAL DESCRIPTION The sapwood is pale yellow white with the heartwood varying in color from light to dark or reddish brown.

WORKING PROPERTIES Cypress machines well, planes easily and resists warping. Pre-boring at board edges will help prevent splitting. It nails and screws very well. It glues well, sands easily and readily accepts finishes.

PHYSICAL PROPERTIES Although cypress is a softwood, it grows alongside hardwoods and traditionally has been grouped and manufactured with hardwoods.

AVAILABILITY Readily available.

MAIN USES Exterior: siding, shutters, shingles, trim, fence posts. Interior: paneling, moulding, millwork, cabinetry, flooring, furniture, beams and columns.





DISTRIBUTION The Eastern to Midwest U.S.

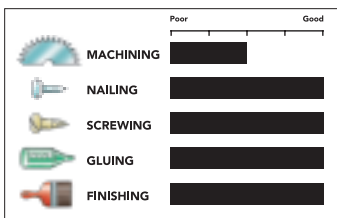
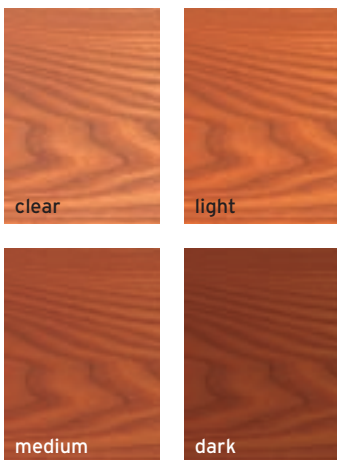
GENERAL DESCRIPTION Red elm has a greyish white to light brown narrow sapwood, with heartwood that is reddish brown to dark brown in color. The grain can be straight, but is often interlocked. The wood has a coarse texture.

WORKING PROPERTIES The wood of red elm is fairly easy to work, it nails, screws and glues well, and can be sanded and stained to a good finish. It dries well with minimum degrade and little movement in performance.

PHYSICAL PROPERTIES Elm is moderately heavy, hard and stiff with excellent bending and shock resistance. It is difficult to split because of its interlocked grain.

AVAILABILITY Available.

MAIN USES Furniture, cabinet making, flooring, millwork, paneling and caskets.



DISTRIBUTION The gums are an important part of the Eastern hardwood forests, and are found throughout the Southeastern U.S.

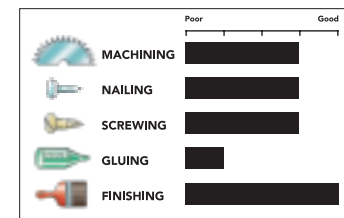
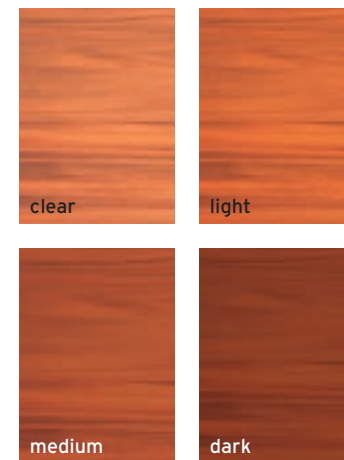
GENERAL DESCRIPTION The sapwood tends to be wide and is white to light pink, while the heartwood is reddish brown, often with darker streaks. The wood has irregular grain, usually interlocked, which produces an attractive figure. It has a fine uniform texture.

WORKING PROPERTIES The wood is easy to work, with both hand and machine tools. It nails, screws and glues well, takes stain easily and can be sanded to an excellent finish. It dries rapidly with a strong tendency to warp and twist. It has a high shrinkage, and is susceptible to movement in performance.

PHYSICAL PROPERTIES American gum is moderately hard, stiff and heavy and has a low steam-bending classification.

AVAILABILITY Readily available, often separated for color and sold as sapgum (sapwood) and redgum (heartwood).

MAIN USES Cabinet making, furniture parts, doors, millwork, strips and mouldings, turnings and rail ties. Good substitute for walnut when stained.





DISTRIBUTION Eastern U.S.

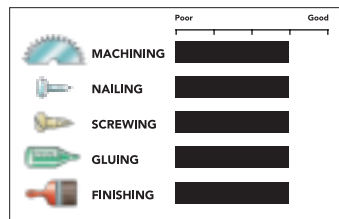
GENERAL DESCRIPTION Hackberry is closely related to sugarberry (*Celtis laevigata*) and is a member of the elm family. There is little difference between sapwood and heartwood which is yellowish grey to light brown with yellow streaks. The wood is very susceptible to blue staining before and after kiln drying and has irregular grain, occasionally straight and sometimes interlocked, with a fine uniform texture.

WORKING PROPERTIES The wood planes and turns well and is intermediate in its ability to hold nails and screws, and stains satisfactorily. Hackberry dries readily with minimal degrade. It has a fairly high shrinkage and is most suitable in cut stock (small/short pieces).

PHYSICAL PROPERTIES Hackberry is moderately hard, heavy and has medium bending strength, high shock resistance but is low in stiffness. It has a good steam-bending classification.

AVAILABILITY Reasonable.

MAIN USES Furniture and kitchen cabinets, millwork, doors and mouldings.



DISTRIBUTION Eastern U.S., principal commercial areas: Central and Southern states.

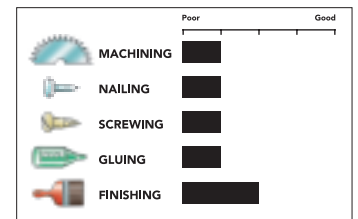
GENERAL DESCRIPTION The hickories are an important group within the Eastern hardwood forests. Botanically they are split into two groups; the true hickories, and the pecan hickories (fruit bearing). The wood is virtually the same for both and is usually sold together. The sapwood of hickory is white, tinged with brown while the heartwood is pale to reddish brown.

WORKING PROPERTIES The heaviest of American hardwoods, the hickories can be difficult to machine and glue, and are very hard to work with hand tools, so care is needed. They hold nails and screws well, but there is a tendency to split so pre-boring is advised. The wood can be sanded to a good finish. It can be difficult to dry and has high shrinkage.

PHYSICAL PROPERTIES The wood is well-known for its very good strength and shock resistance and it also has excellent steam-bending properties.

AVAILABILITY Readily available.

MAIN USES Tool handles, furniture, cabinetry, flooring, wooden ladders, dowels and sporting goods.





DISTRIBUTION Eastern U.S., principally Mid-Atlantic and Lake states. A cold weather tree favoring a more northerly climate.

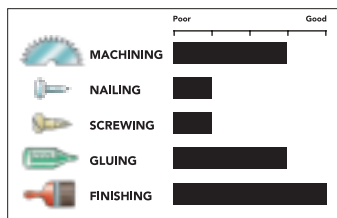
GENERAL DESCRIPTION The sapwood is creamy white with a slight reddish brown tinge and the heartwood varies from light to dark reddish brown. The wood has a close fine texture and is generally straight-grained.

WORKING PROPERTIES Hard maple dries slowly with high shrinkage, so it can be susceptible to movement in performance. Pre-boring is recommended when nailing and screwing. With care it machines well, turns well, glues satisfactorily, and can be stained to an outstanding finish.

PHYSICAL PROPERTIES The wood is hard and heavy with good strength properties, in particular its high resistance to abrasion and wear. It also has good steam-bending properties.

AVAILABILITY Widely available.

MAIN USES Flooring, furniture, paneling, ballroom and gymnasium floors, kitchen cabinets, worktops, table tops, butchers blocks, toys, and kitchenware, millwork: stairs, handrails, mouldings, and doors.



DISTRIBUTION Principally the Pacific Northwest, where it is an abundant commercial hardwood. Average height is 60ft. It grows scattered or in small groves.

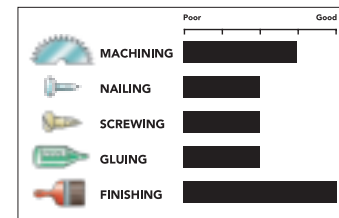
GENERAL DESCRIPTION Its color is pale pinkish-brown to almost white. Generally there is no marked difference between heartwood and sapwood. Its fine grain is similar to birch and cherry with respect to growth ring contrast. It dries easily with little degrade and has good dimensional stability after drying.

WORKING PROPERTIES PC maple machines well and is excellent for turning. It nails, screws and glues well, and can be sanded, stained or painted to a good finish.

PHYSICAL PROPERTIES PC maple has medium density, but is slightly harder than eastern soft maple. It has medium bending strength, shock resistance and stiffness.

AVAILABILITY Available as lumber and dimension stock.

MAIN USES Furniture, kitchen cabinets, doors, shutters, mouldings, panel stock, turnings, carvings and kitchen utensils.





DISTRIBUTION Throughout Eastern U.S.

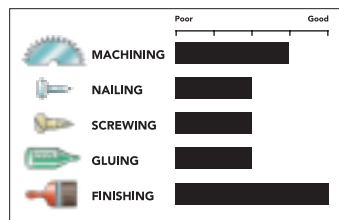
GENERAL DESCRIPTION In most respects soft maple is very similar to hard maple. Generally the sapwood is greyish white, sometimes with darker colored pith flecks. The heartwood varies from light to dark reddish brown. The wood is usually straight-grained. The lumber is generally sold unselected for color.

WORKING PROPERTIES Soft maple machines well and can be stained to an excellent finish. It glues, screws, and nails satisfactorily. Polishes well and is suitable for enamel finishes and brown tones. It dries slowly with minimal degrade and there is little movement in performance.

PHYSICAL PROPERTIES Soft maple is about 25 percent less hard than hard maple, has medium bending and crushing strength, and is low in stiffness and shock resistance. It has good steam-bending properties.

AVAILABILITY Readily available.

MAIN USES Furniture, paneling and millwork, kitchen cabinets, mouldings, doors, musical instruments, and turnings. Soft maple is often used as a substitute for hard maple or stained to resemble other species.



DISTRIBUTION Widespread throughout Eastern U.S. The oaks are by far the most abundant species group growing in the Eastern hardwood forests. Red oaks grow more abundantly than the white oaks. The red oak group comprises many species, of which about eight are commercial.

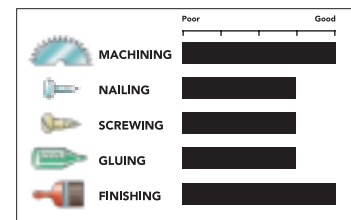
GENERAL DESCRIPTION The sapwood of red oak is white to light brown and the heartwood is a pinkish reddish brown. The wood is similar in general appearance to white oak, but with a slightly less pronounced figure due to the smaller rays. The wood is mostly straight-grained, with a coarse texture.

WORKING PROPERTIES Red oak machines well. Nailing and screwing are good although pre-boring is recommended, and it can be stained to a good finish. Can be stained with a wide range of finish tones.

PHYSICAL PROPERTIES The wood is hard and heavy, with medium bending strength and stiffness and high crushing strength.

AVAILABILITY Abundant. Most widely used species.

MAIN USES Furniture, flooring, architectural millwork and mouldings, doors, kitchen cabinets, paneling, and caskets.





DISTRIBUTION Widespread throughout the Eastern U.S. The white oak group comprises many species, of which about eight are commercial.

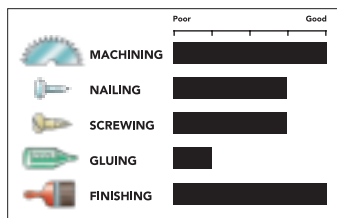
GENERAL DESCRIPTION The sapwood is light-colored and the heartwood is light to dark brown. White oak is mostly straight-grained with a medium to coarse texture, with longer rays than red oak. White oak therefore has more figure.

WORKING PROPERTIES White oak machines well, nails and screws well although pre-boring is advised. Since it reacts with iron, galvanized nails are recommended. Its adhesive properties are variable, but it stains to a good finish. The wood dries slowly.

PHYSICAL PROPERTIES A hard and heavy wood with medium bending and crushing strength, low in stiffness, but very good in steam bending. Great wear-resistance.

AVAILABILITY Readily available but not as abundant as red oak.

MAIN USES Furniture, flooring, architectural millwork, mouldings, doors, kitchen cabinets, paneling, barrel staves (tight cooperage), and caskets.



DISTRIBUTION Widespread throughout Eastern U.S.

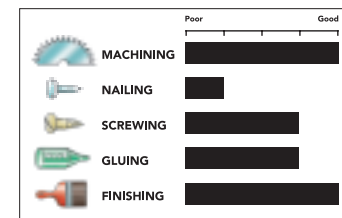
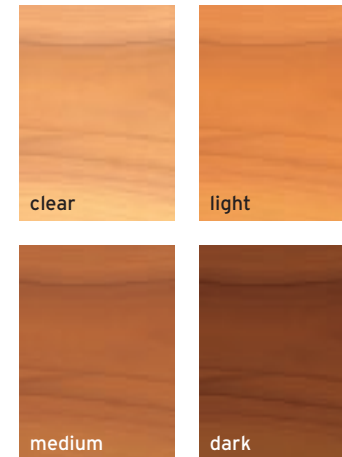
GENERAL DESCRIPTION The sapwood is creamy white and may be streaked, with the heartwood varying from pale yellowish brown to olive green. The green color in the heartwood will tend to darken on exposure to light and turn brown. The wood has a medium to fine texture and is straight-grained.

WORKING PROPERTIES A versatile wood that is easy to machine, plane, turn, glue and bore. It dries easily with minimal movement in performance and has little tendency to split when nailed. It takes and holds paint, enamel and stain exceptionally well.

PHYSICAL PROPERTIES A medium density wood with low bending, shock resistance, stiffness and compression values, with a medium steam-bending classification.

AVAILABILITY Very widely available.

MAIN USES Light construction, furniture, kitchen cabinets, doors, panelling, mouldings and millwork, edge-glued panels, turnings and carvings.





DISTRIBUTION Throughout Eastern U.S.

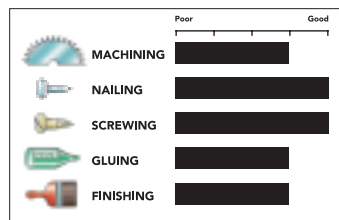
GENERAL DESCRIPTION The sapwood of sycamore is white to light yellow, while the heartwood is light to dark brown. The wood has a fine close texture with interlocked grain. Contrasts well with other species.

WORKING PROPERTIES The wood machines well, but high speed cutters are needed to prevent chipping. It is resistant to splitting due to the interlocked grain. The wood glues well and stains, with care, to an excellent finish. It dries fairly rapidly, with a tendency to warp. It has moderate shrinkage and little movement in performance.

PHYSICAL PROPERTIES The wood is classified as moderate in weight, hardness, stiffness and shock resistance. It turns well on the lathe and has good bending qualities.

AVAILABILITY Reasonable availability.

MAIN USES Furniture, furniture parts (drawer sides), millwork, paneling and mouldings, flooring, kitchen ware, butchers blocks, toys and fruit crates.



DISTRIBUTION Throughout Eastern U.S., but principal commercial region is the Central states.

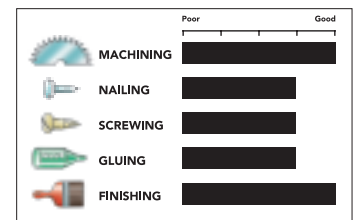
GENERAL DESCRIPTION The sapwood of walnut is creamy white, while the heartwood is light brown to dark chocolate brown, occasionally with a purplish cast and darker streaks. Walnut is usually supplied steamed, to darken sapwood. The wood is generally straight-grained, but sometimes with wavy or curly grain that produces an attractive and decorative figure.

WORKING PROPERTIES Walnut works easily with hand and machine tools, and nails, screws and glues well. It holds paint and stain very well for an exceptional finish and is readily polished. It dries slowly, and care is needed to avoid kiln degrade. Walnut has good dimensional stability.

PHYSICAL PROPERTIES Walnut is a tough hardwood of medium density, with moderate bending and crushing strengths and low stiffness. It has a good steam-bending classification.

AVAILABILITY Reasonable availability.

MAIN USES Furniture, cabinets, architectural millwork, doors, flooring, paneling, and gun stocks. A favored wood for using in contrast with lighter-colored species.



Strength and Mechanical Properties (inch - pound)^a

COMMON SPECIES NAMES	MOISTURE CONTENT	SPECIFIC GRAVITY (b)	STATIC BENDING			IMPACT BENDING TO GRAIN (in.)	COMPRESSION PARALLEL TO GRAIN (lbf/in ²)	COMPRESSION PERPENDICULAR TO GRAIN (lbf/in ²)	SHEAR PARALLEL TO GRAIN (lbf/in ²)	TENSION PERPENDICULAR TO GRAIN (lbf/in ²)	SIDE HARDNESS (lbf)
			MODULUS OF RUPTURE (lbf/in ²)	MODULUS OF ELASTICITY (c) (10 ⁶ lbf/in ²)	WORK TO MAXIMUM LOAD (in-lbf/in ²)						
Alder	Green - 12%	0.37 - 0.41	6,500 - 9,800	1.17 - 1.38	8.0 - 8.4	22 - 20	2,960 - 5,820	250 - 440	770 - 1,080	390 - 420	440 - 590
Ash	Green - 12%	0.45 - 0.60	6,000 - 15,000	1.04 - 1.74	11.8 - 16.6	-- 43	2,300 - 7,410	350-1,420	860 - 2,030	-- 940	-- 1,320
Aspen	Green - 12%	0.35 - 0.39	5,100 - 9,100	0.86 - 1.43	5.7 - 7.7	-- 22	2,140 - 5,300	180 - 450	660 - 1,080	-- 260	-- 350
Basswood	Green - 12%	0.32 - 0.37	5,000 - 8,700	1.04 - 1.46	5.3 - 7.2	16	2,220 - 4,730	170 - 370	600 - 990	280 - 350	250 - 410
Birch	Green - 12%	0.48 - 0.65	6,400 - 16,900	1.17 - 2.17	15.7 - 20.8	29 - 33	3,540 - 7,110	360 - 690	1,130 - 1,700	560 - 570	660 - 950
Cherry	Green - 12%	0.47 - 0.50	8,000 - 12,300	1.31 - 1.49	11.4 - 12.8	34 - 55	2,360 - 8,540	270-1,080	840 - 2,240	-- 950	560 - 1,470
Cottonwood	Green - 12%	0.31 - 0.40	3,900 - 8,500	0.75 - 1.37	4.2 - 7.4	-- 22	1,690 - 4,910	140 - 380	500 - 1,040	-- 580	-- 430
Cypress	Green - 12%	0.42 - 0.46	6,600 - 10,600	1.18 - 1.44	6.6 - 8.2	24 - 25	3,580 - 6,360	400 - 730	810 - 1,000	270 - 300	390 - 510
Elm	Green - 12%	0.46 - 0.63	7,200 - 14,800	1.11 - 1.54	11.8 - 19.8	38 - 56	2,910 - 7,050	360 - 1,230	1,000 - 1,920	-- 660	620 - 1,320
Gum	Green - 12%	0.46 - 0.52	7,100 - 12,500	1.20 - 1.64	10.1 - 11.9	32 - 36	3,040 - 6,320	370 - 620	990 - 1,600	540 - 760	600 - 850
Hackberry	Green - 12%	0.49 - 0.53	6,500 - 11,000	0.95 - 1.19	12.8 - 14.5	43 - 48	2,650 - 5,440	400 - 890	1,070 - 1,590	580 - 630	700 - 880
Hickory/Pecan	Green - 12%	0.56 - 0.75	9,100-20,200	1.29 - 2.26	13.8 - 31.7	-- 104	3,920 - 9,210	760 - 1,980	-- 2,430	-- 680	-- 1,820
Hard Maple	Green - 12%	0.52 - 0.63	7,900 - 15,800	1.33 - 1.83	12.5 - 16.5	39 - 48	3,270 - 7,830	600 - 1,470	1,130 - 2,330	-- 720	840 - 1,450
Pacific Coast Maple	Green - 12%	0.44 - 0.48	7,400 - 10,700	1.10 - 1.45	7.8 - 8.7	23 - 28	3,240 - 5,950	450 - 750	1,110 - 1,730	540 - 600	620 - 850
Soft Maple	Green - 12%	0.44 - 0.54	5,800 - 13,400	0.94 - 1.64	7.8 - 12.5	23 - 32	2,490 - 6,540	370 - 1,000	1,050 - 1,850	-- 600	590 - 950
Red Oak	Green - 12%	0.52 - 0.69	7,400 - 18,100	1.14 - 2.28	8.0 - 21.5	26 - 54	3,000 - 8,740	550 - 1,250	930 - 2,080	-- 1,050	860 - 1,510
White Oak	Green - 12%	0.57 - 0.88	7,200 - 18,400	0.88 - 2.05	9.4 - 19.2	-- 50	3,290 - 8,900	530 - 2,840	1,210 - 2,660	-- 940	-- 1,620
Poplar	Green - 12%	0.40 - 0.42	6,000 - 10,100	1.22 - 1.58	7.5 - 8.8	24 - 26	2,660 - 5,540	270 - 500	790 - 1,190	510 - 540	440 - 540
Sycamore	Green - 12%	0.46 - 0.49	6,500 - 10,000	1.06 - 1.42	7.5 - 8.5	26	2,920 - 5,380	360 - 700	1,000 - 1,470	630 - 720	610 - 770
Walnut	Green - 12%	0.51 - 0.55	9,500 - 14,600	1.42 - 1.68	10.7 - 14.6	34 - 37	4,300 - 7,580	490 - 1,010	1,220-1,370	570 - 690	900 - 1,010

a Results of tests on small clear specimens in the green and air-dried conditions. Definition of properties; impact bending is height of drop that causes complete failure, using 0.71-kg (50-lb) hammer; compression parallel to grain is also called maximum crushing strength; compression perpendicular to grain is fiber stress at proportional limit; shear is maximum shearing strength; tension is maximum tensile strength; and side hardness is hardness measured when load is perpendicular to grain.

b Specific gravity is based on weight when oven-dry and volume when green or at 12% moisture content

c Modulus of elasticity measured from a simply supported, center-loaded beam, on a span depth ratio of 14/1. To correct for shear deflection, the modulus can be increased by 10%.

Source: *Wood Handbook, Wood as an Engineering Material*, USDA Forest Service