WOOD SPECIES

Technical Publication No. A200
Revised © 2023 | 4th Edition

nwfa
National Wood Flooring Association

NOTICE

This technical publication was developed by subject matter experts serving on the NWFA Technical Standards and Publications Committee, using reliable principles, with research of all available wood flooring data and in consultation with leading industry authorities.

The information contained in this publication represents generally accepted descriptions of wood species and their properties. However, wood is a natural material subject to variations in aesthetic qualities, mechanical properties, and working properties, and no description is able to encompass all possible variations.

NO GUARANTEE OR WARRANTY

The National Wood Flooring Association accepts no risk or liability for application of the information contained in this publication.

Copyright © 2023. National Wood Flooring Association. St. Louis, Missouri, U.S.A. All rights reserved under both international and Pan American copyright conventions.

WOOD SPECIES

Technical Publication No. A200

2 THE BOTANICAL HIERARCHY OF WOOD

3 THE BIOLOGICAL NATURE AND ANATOMY OF WOOD
- Softwood & Hardwood
- Tree Anatomy

5 AESTHETIC QUALITIES
- Appearance/Color
- Porosity
- Grain/Texture
- Grain Angle
- Figure
- Photosensitivity
- Grading

15 MECHANICAL PROPERTIES
- Shrink/Swell
- Shrinkage Values
- Dimensional Change Coefficient
- Hardness
- Specific Gravity
- Average Dried Weight
- Comparison Chart

22 WORKING PROPERTIES
- Installation
- Sanding
- Finishing
- Health and Safety

24 SUSTAINABILITY

26 WOOD SPECIES: DOMESTIC
- Ash
- Beech
- Birch
- Cherry, Black
- Chestnut
- Douglas-fir
- Hickory, Pecan
- Hickory, True
- Maple, Hard
- Maple, Soft
- Mesquite
- Oak, Red
- Oak, White
- Pine, Eastern White
- Pine, Southern Yellow
- Walnut, Black

83 WOOD SPECIES: IMPORTED
- Acacia, Big Leaf
- Acacia, Short Leaf
- Amendoim
- Andiroba
- Australian Cypress
- Bubinga
- Cumaru (Brazilian Teak)
- Goncalo Alves
- Ipé
- Jarrah
- Jatoba (Brazilian Cherry)
- Kempas
- Koa
- Mahogany, African (Khaya)
- Mahogany, Honduran
- Mahogany, Santos
- Merbau
- Padauk
- Patagonian Rosewood
- Pau Marfim (Brazilian Maple)
- Purpleheart
- Sapele
- Teak
- Tiete Rosewood
- Tigerwood/African Walnut
- Wengé

110 SOURCES AND CREDITS

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

INTRODUCTION

Wood floors are one of the rare building products that inherently showcase the natural beauty of the material itself, which is one of the primary reasons that wood has been used as a flooring material for centuries. Wood is durable, long-lasting, can enhance any architectural style or design scheme, can add value to any home or building, and is oftentimes capable of being refinished, essentially resulting in a brand-new floor.

One of the keys to ensuring a wood floor's timeless beauty is having a fundamental understanding of the species itself. As a wood flooring professional, knowing about general wood properties, as well as properties of individual wood species, is an important component of a successful installation.

A combination of qualities should be considered when selecting a species for flooring: appearance-related attributes such as texture, grain and color, as well as performance attributes such as dimensional stability, hardness, and installation and finishing properties.

It is estimated that there are more than 73,000 tree species on Earth, including about 9,200 species yet to be discovered. Of the 73,000 known species, fewer than 400 are available for commercial use. Many of the species are used exclusively in their country of origin, and are not exported. This publication is not intended to be a resource for all species used across the world. Rather, it represents an overview of the mechanical and physical properties of some of today's more-popular domestic species, while offering a general listing of many of the more-common tropical and imported species of wood commonly used in the wood flooring industry.

Note: The samples used to illustrate each species and their grades were selected to be as representative as possible. However, there are many variations within each species and grade, and the methods used in sanding and finishing also affect the final appearance of a given species. Therefore, the appearance of any wood species may vary from the sample photos shown.

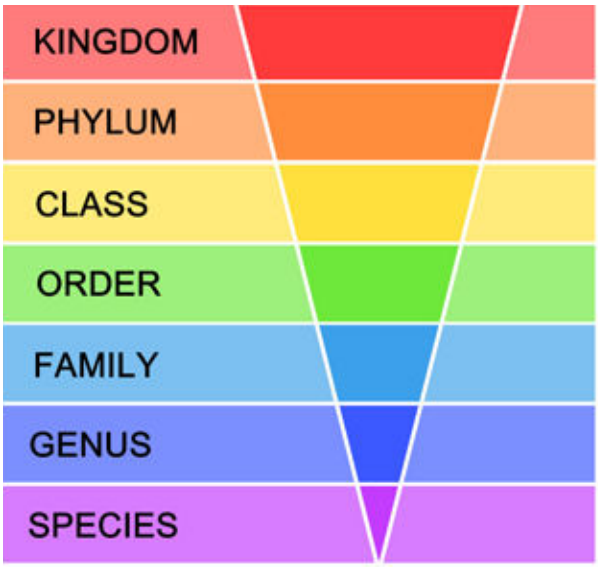
© 2023 NATIONAL WOOD FLOORING ASSOCIATION

BOTANICAL HIERARCHY OF WOOD

Throughout this technical publication, species are listed alphabetically by the common flooring name, followed by the botanical name (in parenthesis). Also included is the scientific name, the family the species is a part of, and many of the common names of each species.

Each wood species used in the wood flooring industry often is referred to by its common, or commercial name. These names can vary from region to region, and often are misleading (such as Brazilian Cherry or Santos Mahogany, neither of which are related to cherry or mahogany, respectively).

To assist in keeping track of species, scientists primarily have settled on using Latin for scientific names, although they sometimes use Greek or other languages. The important thing is that, regardless of the language the scientist uses for communication, the scientific names chosen for all classified living organisms are the same worldwide. This hierarchical system is organized from largest to smallest.



Kingdom is the highest taxonomic division of living things.

Phylum distinguishes whether the seeds produced by the trees are naked (non-flowering) or encased (flowering).

Class distinguishes areas of commonality based on important, more-detailed, similarities within subsets of each division.

Order further subsets into groups with like characteristics.

Family is a group of individuals directly related by descent from at least one common ancestor based on commonality of distinguishing characteristics, especially those inherent in their reproductive structures.

Genus represents groupings based on commonality in fundamental traits such as flowers, fruits, and sometimes roots, stems, buds, and leaves. Members of a given genus have more characteristics in common with each other than other groupings within the same family.

Species are a group of similar interbreeding individuals sharing a common morphology (external and internal structure of plants), physiology and reproductive process. Species may further be broken into subspecies, which may be differentiated by geography or other physical characteristics.

As an example, white oak is in the Fagaceae family, the *Quercus genus*, and is referred to as *Quercus alba* in its botanical name, where *alba* is the species. When two or more species are included in a genus under a single common name, only the genus will be listed, with a "spp." afterward.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

THE BIOLOGICAL NATURE AND ANATOMY OF WOOD

All woody plants, whether shrubs, woody vines, or trees, share similar biological characteristics that produce wood as their structural tissue. When considering only trees, there are two general categories of wood: softwoods from gymnosperms (pine, spruce, Douglas-fir, etc.), which are coniferous, or "cone-bearing" plants with needle-like leaves, and hardwoods from angiosperms (maple, oak, hickory, etc.), which are deciduous, or broadleaved plants with enclosed seeds. Despite the names, some hardwoods are soft, and some softwoods are hard; the terms are biological in nature and not necessarily literal.

Hardwood

- Leaf-bearing
- Lose leaves annually
- Come from deciduous angiosperm trees (enclosed seeds, like acorns)
- Oak, maple, ash, cherry, etc.

Softwood

- Needle-bearing
- Remain green year-round
- Come from coniferous gymnosperm trees (uncovered seeds, like pinecones)
- Pine, spruce, Douglas-fir, cedar, etc.

Tree Anatomy

All trees grow with roots below ground and leaves above ground. This is the basis for understanding wood as the water-conducting tissue of any given plant.

Roots

The roots help anchor the tree and collect water and nutrients from the soil. This liquid then travels through the trunk and branches to the leaves.

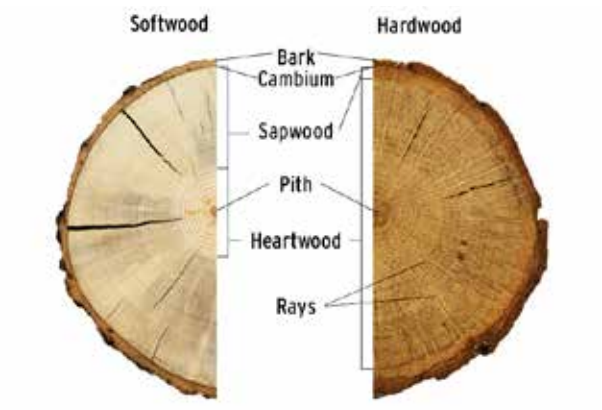
Leaves

The leaves absorb carbon dioxide from the air and energy from the sun, which enables photosynthesis to happen.

Photosynthesis

The process by which trees use energy from the sun, water, and carbon dioxide to create their own sugars (glucose). Long chains of glucose form cellulose molecules. Bundles of cellulose are called microfibrils, which form one of the major structural components of the tree's cell walls.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION



Bark
The exterior layer of the tree is outer bark, which provides protection from the environment. The inner bark is living tissue that transports glucose to growing parts of the tree.

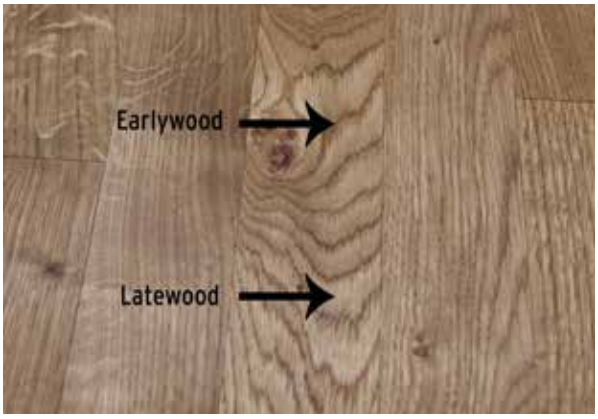
Cambium
The next layer inward, between the bark and wood, is the cambium. The cambium is a thin living layer less than 1/16 of an inch thick that is responsible for increases in the tree's diameter by creating new growth rings of wood to the inside and new inner bark to the outside.

Sapwood
The outermost growth rings that are alive and functional (water transport and food storage) are referred to as sapwood, which can vary in appearance and width, by species. Sapwood is the younger portion of a tree that lies between the cambium and the heartwood. It is more permeable, less durable, and usually lighter in color than the heartwood.

Heartwood
Heartwood is the older, central portion of a tree. It is composed of often darker-colored inactive cells. The chemicals these cells store, called extractives, determine the color. It is less permeable and more durable than the surrounding sapwood.

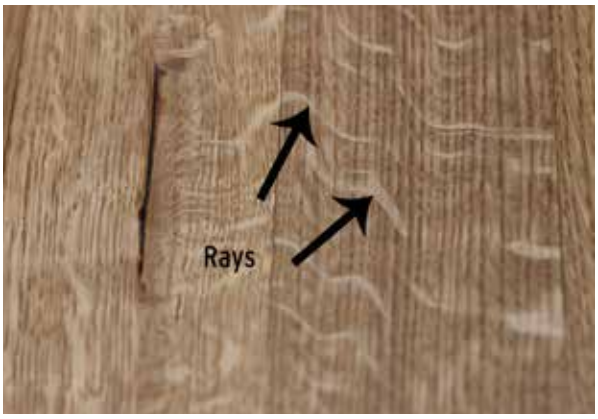
Pith
The small, soft core, occurring near the center of the tree trunk, branch, twig, or log.

Growth Rings
As the tree grows, it develops growth rings. The growth rings of hardwoods are composed in part of special cells called vessels or pores that carry water up to the leaves. Each growth ring is essentially a thin cone from the top of the tree to the bottom of the trunk, and through to the roots. Most species grown in temperate climates produce visible growth rings that show differences in density and color between wood formed early and that formed late in the growing season. The growth rings, when exposed by conventional sawing methods, provide the grain or characteristic pattern of the wood. The distinguishing features among the various species result in part from differences in growth-ring formation. Within species, natural variations in growth ensure the unique character and beauty of each piece of wood.



Earlywood
The inner portion of the growth ring is called the earlywood (or springwood), which is formed during the early part of the growing season. In some woods, earlywood is identifiable by larger cell cavities and thin walls. Earlywood is less dense than latewood and has wider vessels to transport nutrients.

Latewood
The outer portion of the growth ring is called the latewood (or summerwood), which is formed later in the growing season each year. Latewood is more-dense than earlywood and has narrow vessels.



Rays
A defining feature in wood is the presence of rays (wood rays), which run from the bark toward the center of the tree, much like spokes on a bicycle wheel. These rays are made of living cells in the tree that help move sugars and other materials from pith to bark, as well as provide other biochemical functions to trees. Because they are a system of cells running perpendicular to the grain, the rays can contribute visual interest to finished flooring in some species such as oaks, depending on how the boards are cut from the log. This often is referred to as ray-fleck.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

AESTHETIC QUALITIES

Appearance/Color

The physical appearance and range of color in a given species are the result of many naturally occurring characteristics of that species, including color variations between heartwood and sapwood. The extractives in the wood are what give the heartwood its colors. Some species have a clearly defined line of demarcation between the heartwood and sapwood, while others do not.

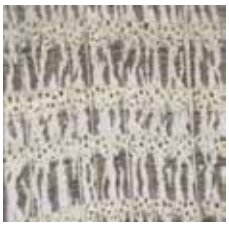
Porosity

Viewing and categorizing the open end of the vessels (or pores) in the end grain (or transverse cut) of wood is referred to as porosity.

- Softwoods are referred to as non-porous woods, because they do not have vessel elements.

Pine

- In hardwoods, porosity is divided into three main categories:
  - **Ring-porous:** Hardwoods in which the pores of the earlywood are large compared to the latewood, thus forming a distinct zone or ring of pores (oak, ash, chestnut, etc.).



Oak

  - **Diffuse-porous:** Certain woods in which the pores exhibit little or no variation in size or distribution throughout the growth ring, only decreasing slightly in size, gradually toward the outer border of the ring (maple, birch, etc.).

Maple

  - **Semi-ring-porous:** Pores where there may be a difference in density between earlywood and latewood, but no pronounced zoning (walnut, etc.).

Walnut

Grain/Texture

The direction, size, arrangement, appearance, or quality of the fibers in wood is what defines grain. Texture often is used interchangeably with grain. It sometimes is used to combine the concepts of density and degree of contrast between earlywood and latewood. Texture refers to the finer structure of the wood, rather than the growth rings.

- **Grain** may be described as being either "open-grain (course-grain)" or "closed-grain (fine-grain)," which directly affects the way a wood accepts stain and finishes. Open-grain species typically have larger pores and accept stain more evenly than some closed-grain species (compare staining oak and maple).
- **Straight-grain** refers to wood fibers that grow straight and parallel with the tree's axis.
- **Cross-grain** refers to wood fibers that do not run parallel to the tree's axis.
- **Irregular grain** refers to wood fibers that twist in abnormal ways. Irregular grain often is found near burls, knots, branches, or crotches in the tree.
- **Interlocked grain** refers to wood fibers that occur when the tree changes its growing direction. The grain patterns tend to interlock and spiral back and forth, which can create a ribbon effect on the face of the board.
- **Spiral-grain** refers to wood fibers that grow in a spiral-like pattern, circling or twisting around the trunk of the tree.
- **Wavy grain** refers to wood fibers that form a short wavy pattern.
- **Curly grain** refers to wood fibers that are distorted so that they have a curly appearance. The areas on the face of the board showing curly-grain may vary up to several inches in diameter.

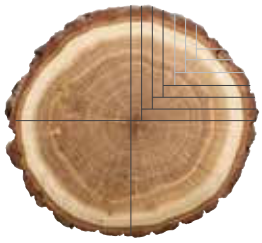
© 2023 NATIONAL WOOD FLOORING ASSOCIATION

Grain Angle

The orientation of the growth rings with respect to the wide face of the board is the grain angle. Traditional sawn material can be cut in any of these ways:

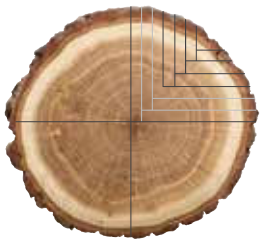
Plainsawn

Wood that is cut parallel to the growth rings so that the growth rings are cut from 0° to 45° to the wide face of the board (a tangential cut) is called plainsawn in hardwoods, and flatsawn in softwoods. Plainsawn flooring is more dimensionally stable in thickness (radially) and less stable in width (tangentially).



Quartersawn

Wood that is cut perpendicular to the growth rings so that the growth rings are cut from 45° to 90° to the wide face of the board (a radial cut) is called quartersawn in hardwoods, and vertical-grain in softwoods. To be classified as quartersawn flooring, at least 50% of the piece must contain quartersawn characteristics. Quartersawn lumber is more dimensionally stable in width (radially) and less stable in thickness (tangentially).



Riftsawn

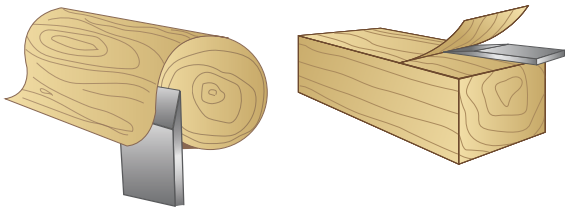
Wood that is cut neither parallel nor perpendicular to the growth rings so that the growth rings make angles of 30° to 60° to the face of the board is called riftsawn in hardwoods, and bastard-sawn in softwoods. To be classified as riftsawn flooring, at least 75% of the piece must contain riftsawn characteristics.

Livesawn

Wood that is cut from the outside diameter through the heartwood incorporating the full range of the characteristics for plainsawn, quartersawn, and riftsawn on the face of the board is known as livesawn material. This cut of wood typically is wider and incorporates all of the dimensional stability and aesthetic characteristics for plainsawn, quartersawn, and riftsawn.

End-Grain

Wood that is cut so that the face of the board surface exposes the ends of the growth rings is the transverse cut, more often known as end-grain. End-grain flooring will shrink and swell according to the tangential value in the direction across the circumference of the growth rings and according to the radial value in the direction perpendicular to the growth rings, with essentially no movement in thickness.



Sliced and Rotary Peeled Veneers

Wood that is peeled or sliced from the log, and used as the finished veneer on engineered flooring.

Ash

Plainsawn Riftsawn Quartersawn

Beech

Plainsawn Riftsawn Quartersawn

Birch

Plainsawn Riftsawn Quartersawn

Cherry, Black

Plainsawn Riftsawn Quartersawn

Hickory, True

Plainsawn Riftsawn Quartersawn

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

Maple, Hard

Plainsawn Riftsawn Quartersawn

Oak, Red

Plainsawn Riftsawn Quartersawn

Oak, White

Plainsawn Riftsawn Quartersawn

Walnut, Black

Plainsawn Riftsawn Quartersawn

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

Figure

The pattern produced in a wood surface by growth rings, rays, knots, deviations from regular grain such as interlocked and wavy grain, and irregular coloration is referred to as figure. Figure provides decorative value and is characterized by its diversity, rarity, and unique aesthetic properties, which historically are valued highly in the market in comparison to non-figured wood of the same species.

The following are descriptions of some common figure characteristics:

- **Ambrosia** is figure most-commonly found in eastern red and silver maples that has streaks of color caused by an infestation of the ambrosia beetle. The ambrosia figure has a tapered, oblong shape running with the grain, and usually is a grayish color.

- **Angel Step** is a staircase-like curly figure pattern caused by cutting across the stump or butt-section of the tree; frequently found in black walnut, but also can occur in ash and maple.

- **Bird's Eye** is a pattern of small, rounded, lustrous spots (or eyes), most-often associated with maple. The size of the "eyes" can vary from small salt granular sizes to larger coin sizes.

- **Blister** is figure resembling billowing clouds, or on occasion, bubble-like forms. The surface of the board looks blistered. An uneven contour in the growth rings can create this effect in a rotary peeled veneer. It is similar to pommelé, but with sparser, larger figure.
- **Burls** are balloon-shaped deformations or growths on the tree. They usually form as the result of injury or infection, or an unformed bud that does not grow properly. They are composed of swirls of grain laced with eyes. They often are sliced into veneer, but also can be produced into solids. Many burls are found in the root structure, but they also occur on the trunk and branches.
- **Crotch** is a typically Y-shaped pattern formed where the main trunk begins to split and branch out. This is an area of high stress inside the trunk, which can result in some beautiful figuring in the wood.
- **Curl/Tiger/Ripple** are contortions in grain direction lying across the grain of a board that give the appearance of undulating compressed waves or ripples with a chatoyant effect. This figure can vary in density and spacing from one board to another.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

- **Fiddleback** is a specific type of curl, exposed by quartersawn wood, which produces a very straight pattern with perpendicular curls from edge to edge, close to a 90-degree angle to the wood grain. Typically, the spaces in between a curl have to be a quarter of an inch or less for it to be classified as "Fiddleback" curl. The name is derived from its use in violins, and is prized by luthiers for instrument backs and sides.

- **Flame** is another sort of figure that looks more like flames of fire. Flame is similar to curl and quilt, visually speaking.

- **Mottle** is a type of cross-grain figure, where spiral interlocked grain combines with wavy grain, to give a blotchy, wrinkled effect.
- **Pommelé** is a pattern of small circles or ovals that sometimes overlap each other, similar to a puddle during a light rain.
- **Quilt** is a pattern that almost looks like bubbling on the surface of the wood. It is a three-dimensional effect caused by an uneven or wavy interlocking pattern, causing a bumpy surface on the log.

- **Rays** also are referred to as ray-fleck, or wood rays. Rays are a lustrous effect that can be exposed with quartersawn wood, and are more-prominent in white oak and sycamore.

- **Ribbon Stripe** is an effect resembling a slightly twisted ribbon.
- **Roe or Roey** are short or broken stripes or ribbon figure found in some quartersawn hardwoods, arising from interlocked grain.
- **Spalting** is a figure pattern caused by fungus growing in trees and logs. It produces black streaks usually growing with the grain, and can result in a beautiful marbling effect. If left too long, the fungus will rot the log from the inside out.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

Photosensitivity

Photosensitivity is the degree to which all species change color in response to natural sunlight or UV light. Depending on how much natural sunlight or UV light the wood is exposed to will determine how quickly and how drastically the change occurs. Whether finished or unfinished, wood changes color over time due to age, oxidation, and exposure to light. Some color change is to be expected for all species. Certain species, such as American cherry, walnut, and Jatoba, are notorious for drastic change in color. The intensity of the color change depends on many factors: the species, finish, exposure to various forms of lighting, and exposure to the particles in the air. Some species darken in color, some lighten in color, and some change color altogether, over time. Oak, maple, hickory, walnut, and many other domestic species generally will fade in color and/or amber as the finish/stain is affected by the UV light. Generally, tropical/exotic species will darken and richen in color with exposure to UV light. Species are classified in this publication based on how drastic they can change color, as being low, low-to-moderate, moderate, moderate-to-high, or high.

Jatoba (Brazilian Cherry) is notorious for drastic change in color.

PHOTOSENSITIVITY (COLOR CHANGE)

SPECIES
LOW
Ash
Australian Cypress
Hickory, Pecan
Hickory, True
Mesquite
Pau Marfim (Brazilian Maple)
LOW-TO-MODERATE
Acacia, Big Leaf
Acacia, Short Leaf
Beech
Birch
Chestnut
Ipé
Koa, Acacia
Maple, Hard
Maple, Soft
Oak, Red
Oak, White
Pine, Eastern White
Wengé
MODERATE
Amendoim
Andiroba
Bubinga
Cumaru (Brazilian Teak)
Douglas-fir
Goncalo Alves
Kempas
Mahogany, African (Khaya)
Mahogany, Honduran
Mahogany, Santos
Merbau
Patagonian Rosewood
Pine, Southern Yellow
Tiete Rosewood
Tigerwood/African Walnut
MODERATE-TO-HIGH
Jarrah
Purpleheart
Teak
Walnut, Black
HIGH
Cherry, Black
Jatoba (Brazilian Cherry)
Padauk
Sapele

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

Grading

Among the many qualities that influence the appearance of wood flooring is the grade of the wood. The tree from which lumber and flooring is obtained is a product of its environment, which includes varying combinations of the soil, moisture, air, and sunshine that it is exposed to through its life. The tree also is subjected to extremes of temperature, wind, floods, insect infestations, drought, and injury. As a result, wood varies in structure and in appearance. In addition, further characteristics develop through the process of manufacturing and drying. All of the aforementioned characteristics are what differentiate one grade from another.

Sawn hardwood lumber is graded to provide categories for the wood that is processed, to determine the value, waste factor, and potential use, for each board of sawn lumber. The National Hardwood Lumber Association (NHLA) established grading standards for the hardwood lumber industry in 1898. The NHLA grading rules provide consistent language, based on the percentage of clear wood in each board, to identify and categorize it based on its aesthetic characteristics. These rules originally were designed with the furniture trade in mind to provide a measurable percentage of clear, defect-free wood for each grade.

Much of the wood flooring industry manufacturers purchase sawn lumber to produce wood flooring. Wood flooring is graded to a minimum standard that describes the extent and limitations of the characteristics permitted in a piece of flooring. Similar to sawn lumber, the purpose of flooring grading is to sort wood flooring into groups with similar characteristics. Since no two pieces of flooring are identical, complete uniformity in grades or shipments is impossible. Appearance alone determines the grades of hardwood flooring since all grades are equally strong and serviceable in any application. All characters included in a higher grade are automatically accepted in lower grades. Wood flooring grading rules specifically identify frequency, size, and number of some common characteristics.

Grading is an essential part of doing business in the hardwood flooring industry. Grades group flooring with similar qualities, bringing a degree of consistency to products from different mills. Grades give the purchaser information about what they should expect when buying wood flooring products, including surface characteristics, required lengths, and milling tolerances. All wood flooring should conform to its grade description. There is a general allowance of not greater than 5% of the pieces that may be off grade.

In some cases, grades are established by industry associations, such as NWFA/National Oak Flooring Manufacturers Association (NOFMA), established in 1909, and Maple Flooring Manufacturers Association (MFMA), established in 1897. The development of hardwood flooring grades was the main impetus in the formation of those groups in the early 1900s. The NWFA/NOFMA grading system has become such a well-established tradition in hardwood flooring production, even mills that are not members of the NWFA or participants with NWFA/NOFMA certification routinely separate their production along NWFA/NOFMA grading guidelines.

In addition to using standard flooring grades such as those developed by NWFA/NOFMA and MFMA, many flooring manufacturers have their own proprietary grading standards. There are various reasons for this; some grade names are more marketing-friendly; others wish to be either more specific, or more general, than the industry standards; some may have been created in response to a void in a specific product or species.

Most industry wood floor grading standards also include configuration guidelines such as width, thickness, match-position, match-fit, overwood, moisture content, board length, square footage, and packaging.

The following are some of the common natural growth characteristics that are assessed when assigning grade:

Burl is a hard, woody outgrowth on a tree, usually resulting from entwined growth of a cluster of adventitious buds. Burls also are a source of highly figured veneers.

Knots are that portion of a board or limb that has been surrounded by subsequent growth of wood of the trunk or other portions of the tree. As a knot appears on the sanded surface, it merely is a section of the entire knot, its shape depending upon the direction of the cut. Knots may be classified as tight, sound, broken, or as a knot hole, depending on the integrity of the knot itself.

Mineral streaks are an olive to greenish-black (in maple) to light brown to black (in oak) discoloration of undetermined cause in hardwoods. They may be caused by an accumulation of mineral matter.

Decay (rot) is the disintegration of the wood substance due to the action of wood-destroying fungi. Incipient decay is an early state of decay in which disintegration of wood has not gone far enough to soften or change the hardness of the wood.

Worm holes are holes caused or made by a wood-boring insect.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

Engineered wood flooring normally is graded differently. The top-most wear-layer (face grade veneer) is what dictates the "grade" of the material used for the engineered flooring. The top veneer may be cut by three different methods, which are referred to as sawn, sliced, and rotary peeled. Each of these cuts may be graded and sold differently.

- Sawn veneers normally are from the same sawn lumber that solid wood is cut from, and is sawn to varying thicknesses to accommodate the flooring being assembled.

- Sliced and peeled veneers usually are graded through an A to D scale, based on character, color, cut, and quality of the wood.

Most manufacturers of engineered wood flooring create products based on the veneers, and name them in a way that differentiates one product from another. The products normally are categorized according to veneer, finish, and character.

Other countries that produce large amounts of hardwood flooring often have their own grades for hardwood floors. In Australia, for example, grades are developed by the Standards Association of Australia, and are the same as those used for any hardwood-milled products in the country. Australian grades are determined primarily by the face appearance of the products, and include, from highest to lowest: clear, select, standard, and utility grades. Another example would be the ABCDE grading system, which is often utilized in China and Southeast Asia. Unlike the Australian grading system, the ABCDE grades are not administered by any formal association or group, and can vary from manufacturer to manufacturer. They generally are described from highest to lowest as: AB grade, ABC grade, ABCD grade, and CD grade.

Softwood flooring grades are established by a variety of agencies that vary by region and by species. Most softwood grades apply to the lumber itself, and not specifically to flooring. Like hardwood flooring grades, the grades are based on appearance criteria.

- The Southern Pine Inspection Bureau (SPIB) has formulated and published grading rules for southern pines, in conformity with the basic provisions of the American Lumber Standard. The grades are, from highest to lowest: B&B, C, C&BTR, D, D&BTR, No. 1, No. 2, and No. 3. C&BTR and D&BTR are the most-typical southern pine flooring grades available.
- The Northeastern Lumber Manufacturers Association (NELMA) is the rules-writing agency for eastern white pine lumber. Grades are D & Better Select, Finish, Premium, Standard, and Industrial.
- The Western Wood Products Association (WWPA) and the Pacific Lumber Inspection Bureau have formulated and published grading rules for a long list of softwood species on the west coast, including Douglas fir and western hemlock. From highest to lowest select grades, the grades are B & Better Select, C Select, and D Select. In finish grades, there are Superior, Prime, and E grades.

MECHANICAL PROPERTIES

Shrink/Swell

Moisture plays a large part in how wood behaves, from the manufacturing process, through installation, and all the way to its in-service use. As a general overview, moisture content is defined as the weight of water in wood expressed as a percentage of the weight of oven-dry wood. Weight, shrinkage, strength, and other properties depend on the moisture content of wood.

Different grain angles result in different properties of movement of solid wood in response to changes in moisture content. They generally shrink and swell the most in the direction of the growth rings (tangentially), about half as much across the rings (radially), and only slightly along the grain (longitudinally). This means that plainsawn flooring will tend to shrink and swell more in width than quartersawn flooring, and that most flooring will not shrink or swell much in length.

Shrinkage Values

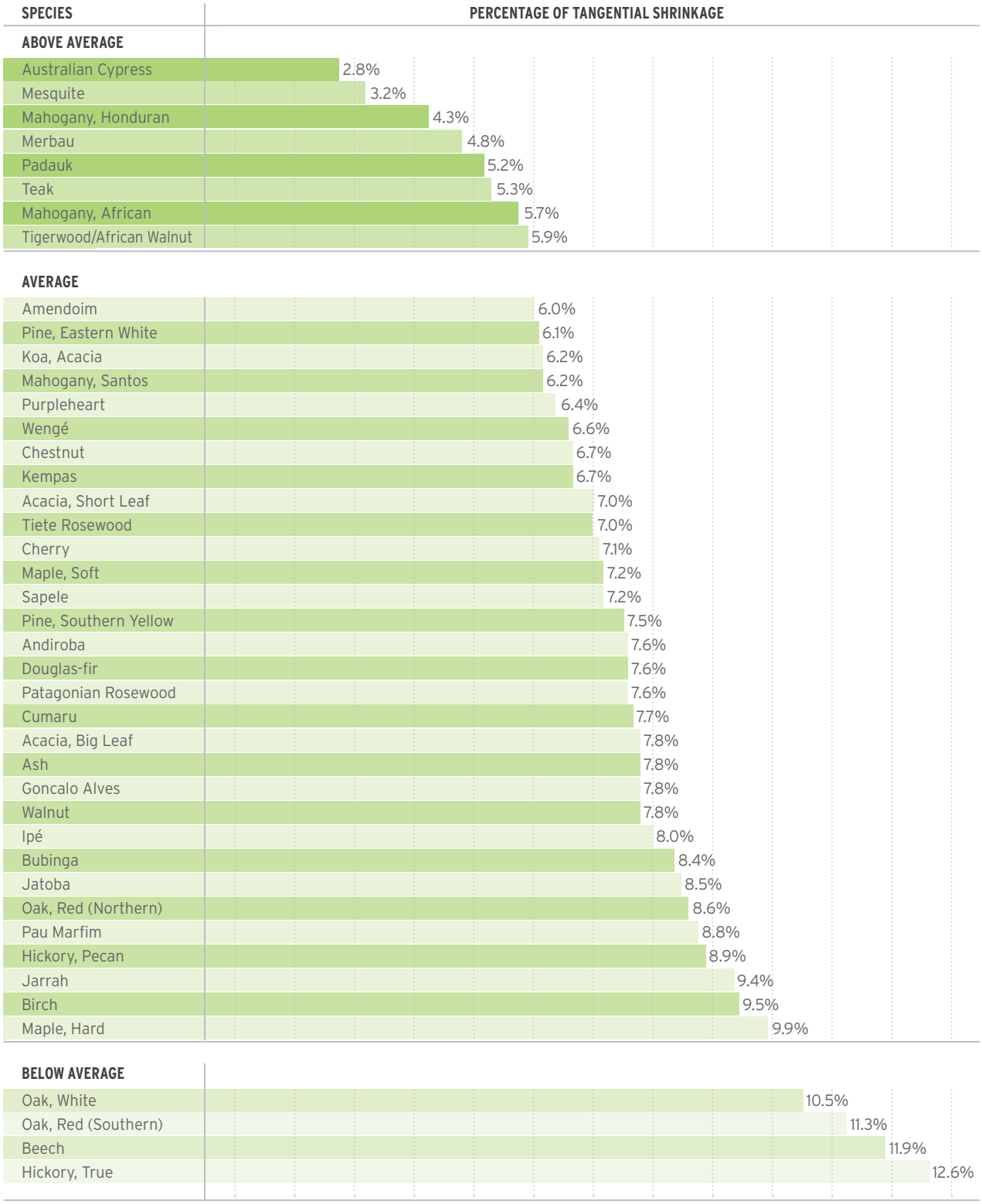
(Tangential Shrinkage Value Δ Green to Oven-dry)

A basic measurement of shrinkage, expressed as a percentage, is the amount that the wood shrinks when going from a green state (fiber saturation point) to an ovendry (0% MC) state. In other words, wood in its green state is at its largest dimension, and ovendry represents wood in its driest (and therefore smallest) dimension. *Green to ovendry* is a measurement of the maximum possible percentage of shrinkage.

Each species is given a stability rating of above average (>10% tangential shrinkage), average (6-10% tangential shrinkage), and below average (<6% tangential shrinkage). These percentages are listed as a means of comparison of stability among species. Keep in mind that the shrinkage values come from laboratory testing, and some woods that are shown to be relatively stable in the lab have demonstrated significant movement on actual jobsites.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

SHRINKAGE VALUES
(TANGENTIAL SHRINKAGE VALUE Δ GREEN TO OVEN-DRY)



Dimensional Change Coefficient (DCC)

While shrinkage values represent the percentage of volumetric shrinkage going from a green state to an oven-dry state, DCC represents shrinkage values of solid wood within moisture content ranges more representative of a floor in-service.

The Forest Products Laboratory of the U.S. Department of Agriculture developed the values in the accompanying chart. These values reflect the dimensional change coefficient (DCC) for the various species, measured as tangential shrinkage or swelling within normal moisture content limits of 6-14%.

The DCC can be used in a simple calculation as a tool to predict, during installation, approximately how much shrinkage or swelling to expect in solid wood when the environmental conditions change. Simply multiply the change (Δ) in moisture content by the DCC value for the species of flooring. Then multiply that product by the width of the flooring material. The result will indicate an approximate shrink/swell per board value based on moisture loss/gain.

DCC x Board Width x Δ MC (expected change in moisture content) = Approximate Shrink/Swell for each plank of solid wood.

Keep in mind, no two trees from the same species are identical, no two boards from the same tree are identical, and properties can vary even within one individual plank of wood. In actual practice, shrinkage and swelling may be diminished by the boards' proximity to each other, installation methods, fastening systems, and moisture interactions from the substrate. These all can influence how an installed floorboard performs when it changes MC.

DIMENSIONAL CHANGE COEFFICIENT

SPECIES	C_T
Mesquite	0.00129
Merbau	0.00158
Australian Cypress	0.00162
Padauk	0.00180
Teak	0.00186
Mahogany, African	0.00201
Wengé	0.00201
Cumaru*	0.00212
Pine, Eastern White	0.00212
Purpleheart	0.00212
Chestnut	0.00234
Mahogany, Honduran	0.00238
Mahogany, Santos	0.00238
Cherry	0.00248
Maple, Soft	0.00252
Sapele*	0.00259
Pine, Southern Yellow	0.00263
Douglas-fir	0.00267
Andiroba	0.00274
Ash	0.00274
Walnut	0.00274
Ipé*	0.00280
Jatoba	0.00300
Pau Marfim*	0.00312
Hickory, Pecan	0.00315
Birch	0.00338
Oak, Red (Southern)	0.00350
Maple, Hard	0.00353
Oak, White	0.00365
Oak, Red (Northern)	0.00369
Jarrah	0.00396
Hickory, True	0.00411
Beech	0.00431
Tigerwood/African Walnut	* Unavailable
Amendoim	* Unavailable
Bubinga	* Unavailable
Kempas	* Unavailable
Acacia, Short Leaf	* Unavailable
Tiete Rosewood	* Unavailable
Patagonian Rosewood	* Unavailable
Goncalo Alves	* Unavailable
Acacia, Big Leaf	* Unavailable
Koa, Acacia	* Unavailable

NOTE: *The estimated DCC was derived using a green to oven-dry tangential shrinkage values from Wood Handbook and other resources, assuming a 30 percent Fiber Saturation Point (FSP). It is possible, however, that FSP may be less than 30 percent with some of these species, affecting the values given. To find the DCC of other domestic and imported species, or to find the radial DCC values for any of these species, refer to the Wood Handbook, Wood as an Engineering Material.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

Hardness

Another valuable property of wood used in flooring applications is its hardness.

Solid Wood

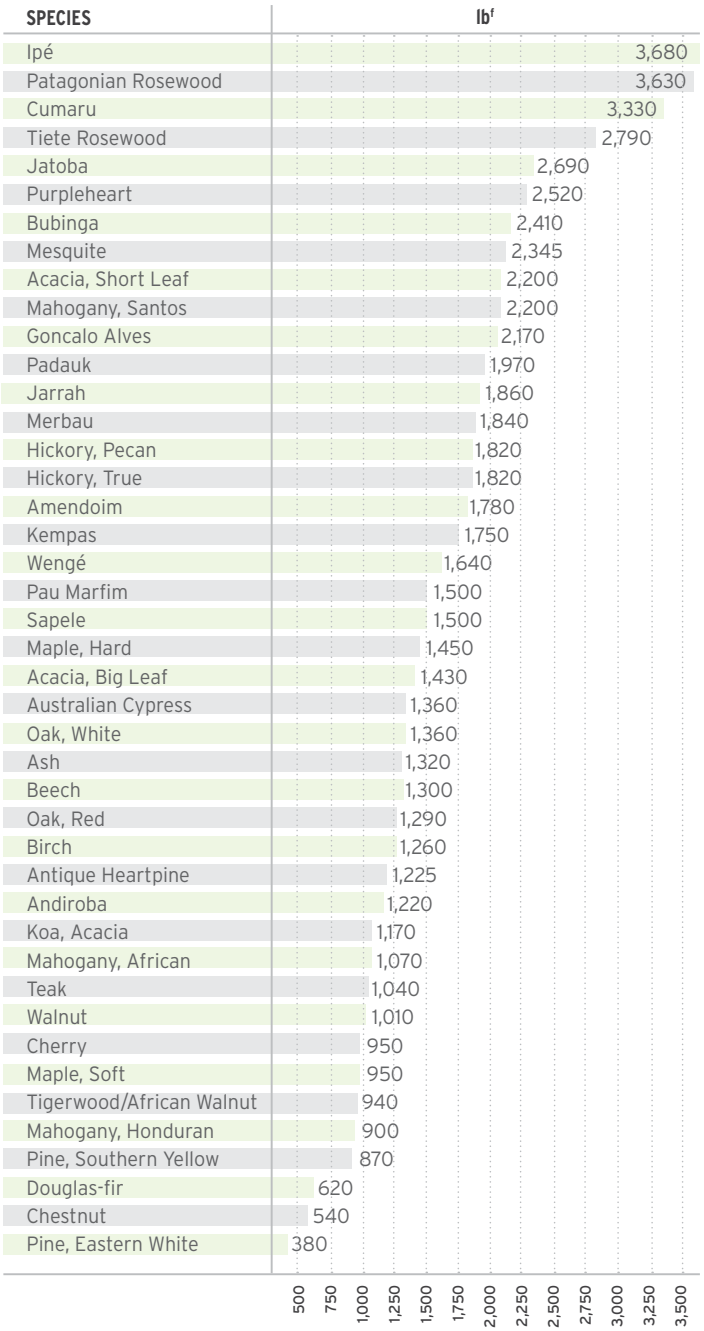
The Janka hardness test was originally developed as a modified Brinell hardness test (which is used for testing the hardness of metals) that also could be used for testing the hardness of solid wood. ASTM D143 is a test method that identifies how hard a species of solid wood is. This test method is the standard test method for small clear specimens of solid wood. This test involves measuring the force (in pounds) required to slowly embed a steel ball with a diameter of .444" to half its diameter into the wood sample. This value only represents the individual piece that was tested. The numbers referenced in the accompanying graph are derived by averaging a large sampling of tests from the same species.

Engineered Wood Flooring

Engineered wood flooring products are not tested using Janka, but may be tested in other ways. ASTM D1037 is a similar test method to ASTM D143, but it is used for wood-based fiber and particle panel materials rather than solid wood. This test incorporates the same measurement of force required to slowly embed the same steel ball with a diameter of .444" to half its diameter into the sample. The results of this test are very specific to the product being tested. Another hardness test method for engineered flooring, commonly used in Europe, is EN1534, which indicates how resistant an engineered flooring product is to indentation using the Brinell hardness scale.

There is a third ASTM test that more-directly applies to our industry. This is ASTM D2394, also known as the "Falling-Ball Indentation" test. This is an impact test, so it's mimicking the act of dropping something small but heavy onto the floor from various heights, and measuring how finished wood and wood-based flooring resist impacts from the dropped objects. This test involves dropping a 2" diameter, 1.18 lb. steel ball onto the flooring at 6" increments, up to 72." The depth of indentation after each drop is recorded and plotted against its associated drop height to get a curve of indentation. Like Janka, it can be an excellent comparison test; the maximum indentation depth and slope of the indentation curve can tell a lot about how easily the flooring product may indent under heavy use, or how they compare to other products.

JANKA HARDNESS (RATINGS FOR SOLID WOOD)



Specific Gravity (SG)

Specific gravity (SG) is a scale that indicates a wood's density as compared to water. SG for wood is determined by measuring the weight of the wood at a specific moisture content. The SG referenced in the accompanying chart is based on 12% MC, as published in USDA Wood Handbook, Wood as an Engineering Material, and in other publications. There always will be some variability of the specific gravity within any species of wood, which is why the values are indicated as averages.

Pinless moisture meter settings are dependent on material density and specific gravity. The numerical scale used to indicate specific gravity uses pure water as the comparison point (one cubic centimeter of water weighs one gram). Each wood species' ability to float or sink in water is a very rough method of determining its specific gravity. ASTM D2395 is the test method that covers the determination of the density and specific gravity (relative density) of wood and wood-based materials.

SPECIFIC GRAVITY (AT 12% MC)

SPECIES	SPECIFIC GRAVITY
Ipé	1.10
Patagonian Rosewood	1.03
Tiete Rosewood	0.94
Goncalo Alves	0.89
Mesquite	0.86
Jatoba	0.83
Mahogany, Santos	0.83
Cumaru	0.82
Wengé	0.81
Amendoim	0.80
Kempas	0.76
Jarrah	0.75
Acacia, Short Leaf	0.73
Pau Marfim	0.73
Bubinga	0.72
Hickory, True	0.72
Purpleheart	0.71
Oak, White	0.68
Hickory, Pecan	0.66
Merbau	0.65
Beech	0.64
Padauk	0.64
Koa, Acacia	0.63
Maple, Hard	0.63
Oak, Red	0.63
Birch	0.62
Ash	0.60
Sapele	0.60
Acacia, Big Leaf	0.59
Australian Cypress	0.59
Pine, Southern Yellow	0.59
Andiroba	0.57
Teak	0.57
Walnut	0.55
Maple, Soft	0.54
Tigerwood/Aftican Walnut	0.54
Mahogany, African	0.53
Cherry	0.50
Douglas-fir	0.48
Mahogany, Honduran	0.47
Chestnut	0.43
Pine, Eastern White	0.35

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

Average Dried Weight

Two primary factors affect the weight of wood products: the density of the basic wood structure, and the moisture content. The information used in this publication is based on wood at 12% MC. The average dried weight of wood is important to reference when estimating shipping costs and in estimation of structural load limitations in a facility that has specified wood flooring. The value should always be considered an approximation because of the natural variations in anatomy, moisture content, and ratio of heartwood to sapwood that occurs. The information included in the accompanying chart is given as pounds per cubic foot (lbs/ft_3) and in metric units as kilograms per cubic meter (kg/m_3).

AVERAGE DRIED WEIGHT (AT 12%MC)

SPECIES	lbs/ft³ (kg/m³)
Ipé	69 (1,105)
Cumaru	68 (1,089)
Patagonian Rosewood	64 (1,025)
Tiete Rosewood	59 (945)
Goncalo Alves	57 (913)
Jatoba	57 (913)
Mahogany, Santos	57 (913)
Bubinga	56 (897)
Purpleheart	56 (897)
Kempas	55 (881)
Wengé	54 (865)
Acacia, Short Leaf	52 (833)
Jarrah	52 (833)
Merbau	51 (817)
Amendoim	50 (801)
Hickory, True	50 (801)
Mesquite	50 (801)
Pau Marfim	50 (801)
Oak, White	47 (753)
Padauk	47 (753)
Hickory, Pecan	46 (737)
Beech	45 (721)
Maple, Hard	44 (705)
Oak, Red	44 (705)
Birch	43 (689)
Ash	42 (673)
Sapele	42 (673)
Andiroba	41 (657)
Australian Cypress	41 (657)
Pine, Southern Yellow	41 (657)
Teak	41 (657)
Walnut	41 (657)
Mahogany, African	40 (641)
Koa, Acacia	38 (609)
Maple, Soft	38 (609)
Mahogany, Honduran	37 (593)
Acacia, Big Leaf	36 (577)
Cherry	35 (561)
Tigerwood/African Walnut	34 (545)
Douglas-fir	32 (513)
Chestnut	30 (481)
Pine, Eastern White	25 (400)

10 20 30 40 50 60 70 80 90 100

WOOD SPECIES MECHANICAL PROPERTIES COMPARISON

DOMESTIC SPECIES	SHRINKAGE	DCC (TANGENTIAL)	HARDNESS	SG	WEIGHT	PHOTOSENSITIVITY
Ash	7.8%	0.00274	1,320 lb_f	0.60	42 lbs/ft^3	Low
Beech	11.9%	0.00431	1,300 lb_f	0.64	45 lbs/ft^3	Low-to-Moderate
Birch	9.5%	0.00338	1,260 lb_f	0.62	43 lbs/ft^3	Low-to-Moderate
Cherry	7.1%	0.00248	950 lb_f	0.50	35 lbs/ft^3	High
Chestnut	6.7%	0.00234	540 lb_f	0.43	30 lbs/ft^3	Low-to-Moderate
Douglas-fir	7.6%	0.00267	620 lb_f	0.48	32 lbs/ft^3	Moderate
Hickory, Pecan	8.9%	0.00315	1,820 lb_f	0.66	46 lbs/ft^3	Low
Hickory, True	12.6%	0.00411	1,820 lb_f	0.72	50 lbs/ft^3	Low
Maple, Hard	9.9%	0.00353	1,450 lb_f	0.63	44 lbs/ft^3	Low-to-Moderate
Maple, Soft	7.2%	0.00252	950 lb_f	0.54	38 lbs/ft^3	Low-to-Moderate
Mesquite	3.2%	0.00129	2,345 lb_f	0.86	50 lbs/ft^3	Low
Oak, Red (N/S)	8.6%/11.3%	0.00369	1,290 lb_f	0.63	44 lbs/ft^3	Low-to-Moderate
Oak, White	10.5%	0.00365	1,360 lb_f	0.68	47 lbs/ft^3	Low-to-Moderate
Pine, Southern Yellow	7.5%	0.00263	870 lb_f	0.59	41 lbs/ft^3	Moderate
Pine, Eastern White	6.1%	0.00212	380 lb_f	0.35	25 lbs/ft^3	Low-to-Moderate
Walnut	7.8%	0.00274	1,010 lb_f	0.55	41 lbs/ft^3	Moderate-to-High

IMPORTED SPECIES	SHRINKAGE	DCC (TANGENTIAL)	HARDNESS	SG	WEIGHT	PHOTOSENSITIVITY
Acacia, Big Leaf	7.8%	* Unavailable	1,430 lb_f	0.59	36 lbs/ft^3	Low-to-Moderate
Acacia, Short Leaf	7.0%	* Unavailable	2,200 lb_f	0.73	52 lbs/ft^3	Low-to-Moderate
Amendoim	6.0%	* Unavailable	1,780 lb_f	0.80	50 lbs/ft^3	Moderate
Andiroba	7.6%	0.00274	1,220 lb_f	0.57	41 lbs/ft^3	Moderate
Australian Cypress	2.8%	0.00162	1,360 lb_f	0.59	41 lbs/ft^3	Low
Bubinga	8.4%	* Unavailable	2,410 lb_f	0.72	56 lbs/ft^3	Moderate
Cumaru	7.7%	0.00212	3,330 lb_f	0.82	68 lbs/ft^3	Moderate
Goncalo Alves	7.8%	* Unavailable	2,170 lb_f	0.89	57 lbs/ft^3	Moderate
Ipé	8.0%	0.00280	3,680 lb_f	1.10	69 lbs/ft^3	Low-to-Moderate
Jarrah	9.4%	0.00396	1,860 lb_f	0.75	52 lbs/ft^3	Moderate-to-High
Jatoba	8.5%	0.00300	2,690 lb_f	0.83	57 lbs/ft^3	High
Kempas	6.7%	* Unavailable	1,750 lb_f	0.76	55 lbs/ft^3	Moderate
Koa, Acacia	6.2%	* Unavailable	1,170 lb_f	0.63	38 lbs/ft^3	Low-to-Moderate
Mahogany, African	5.7%	0.00201	1,070 lb_f	0.53	40 lbs/ft^3	Moderate
Mahogany, Honduran	4.3%	0.00238	900 lb_f	0.47	37 lbs/ft^3	Moderate
Mahogany, Santos	6.2%	0.00238	2,200 lb_f	0.83	57 lbs/ft^3	Moderate
Merbau	4.8%	0.00158	1,840 lb_f	0.65	51 lbs/ft^3	Moderate
Padauk	5.2%	0.00180	1,970 lb_f	0.64	47 lbs/ft^3	High
Patagonian Rosewood	7.6%	* Unavailable	3,630 lb_f	1.03	64 lbs/ft^3	Moderate
Pau Marfim	8.8%	0.00312	1,500 lb_f	0.73	50 lbs/ft^3	Low
Purpleheart	6.4%	0.00212	2,520 lb_f	0.71	56 lbs/ft^3	Moderate-to-High
Sapele	7.2%	0.00259	1,500 lb_f	0.60	42 lbs/ft^3	High
Teak	5.3%	0.00186	1,040 lb_f	0.57	41 lbs/ft^3	Moderate-to-High
Tiete Rosewood	7.0%	* Unavailable	2,790 lb_f	0.94	59 lbs/ft^3	Moderate
Tigerwood/African Walnut	5.9%	* Unavailable	940 lb_f	0.54	34 lbs/ft^3	Moderate
Wengé	6.6%	0.00201	1,640 lb_f	0.81	54 lbs/ft^3	Low-to-Moderate

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

WORKING PROPERTIES

Installation

Each species has unique and qualifying characteristics that should be taken into consideration when installing them into a floor or using them in a project.

Bits and Blades: Some species cut, rout, and shape easily. Other species (such as wood with interlocked or irregular grain) may be more difficult to cut, rout, or shape, resulting in tearout or splintering. All wood will eventually have a dulling effect on bits and blades. Some species contain natural mineral deposits such as silica, which can have a dulling effect on all cutting edges, shortening the life of the bit or blade. Resin and sap in some species can build-up pitch on the bits and blades, hindering their ability to make a clean cut.

Nailing: When nailing wood flooring, some species can be nailed without concerns, while others are so hard and brittle that the type, gauge, and pressure used to drive the fastener into it matters. Dense, heavy species normally offer higher nail-withdrawal resistance. These species also are more-difficult to drive a nail through without splitting or damaging the tongue. A lower-gauge fastener often is necessary for some of these species. Less-dense species allow the use of larger-gauge fasteners to compensate for their lower holding ability.

Gluing: Some species contain resin, oil, or sap that may adversely interfere with the ability of some adhesives to adhere to the wood. These species may require special attention such as wiping the wood with a solvent to remove resins, or abrading the surface to ensure adhesion.

Sanding

Just as with installing different species, each species also has unique and qualifying characteristics that should be taken into consideration when approaching the sanding process.

Abrasives: Many species require a completely different abrasive and grit progression when being sanded. The harder, more-dense species tend to hold onto the scratch from the abrasive more-so than other species. These species may not allow you to skip grits through the sanding process. It also may be necessary to finish sanding with a higher-grit abrasive than with other species. The type of abrasive mineral used can make a difference when sanding different species. These harder, more-dense species sometimes can respond better to a ceramic mineral abrasive as it leaves less-harsh scratches on the surface of the wood. Some wood species are highly resinous and tend to clog sandpaper. When working with such species, it may be necessary to use a coarser-grit abrasive than normal, or to change the paper more frequently than with other species.

Sanding Equipment: The type of sanding equipment used may differ based on the species. The angle of your cut, and the use of the equipment also may need to be adjusted based on the species being sanded. The drum pressure on the belt sander should be adjusted based on the species being sanded.

Finishing

Some species contain naturally occurring oils and extractives that may react with certain types of finishes. Some of these oils and extractives can inhibit drying, dramatically change the color of the wood, or both. Some species may weep natural oils for an extended period of time, possibly causing finish problems at a later date. It is recommended that such floors be sealed or coated immediately after the final sanding cut.

Some species (such as maple and pine) do not accept stain as evenly as other species. This is a physical property of the species itself and not considered a defect.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

Health and Safety

Wood Toxicity and Allergies

The majority of wood species have been reported to cause some level of allergic irritation or reaction to some individuals. The most-common irritants from wood include the dust produced from sanding and cutting. Exposure to excessive amounts of wood dust is considered to have an irritant effect on eyes, nose, and throat in addition to pulmonary function impairment, and is considered a human carcinogen. Exposure can result in cancer of the respiratory system, in the nasal pharyngeal passages, and in the lungs.

Some woods have been reported as sensitizers. Sensitizers are substances that sensitize the body, causing symptoms of allergic reactions from repeated exposure. The first exposure to the substance introduces the allergen, to which the body responds by producing antibodies. Each additional exposure to the substance produces a more-severe reaction.

The health effects associated with wood dust come not only from the wood dust itself, but also biological organisms such as mold and fungi that can grow on the wood, and chemicals such as formaldehyde, copper naphthanate, and pentachlorophenol used in the processing of some woods.

Respiratory protection and use of dust collection systems always are recommended and are critical to any jobsite.

Use Disposable Particulate Respirators when producing wood dust particles from processes such as sanding and cutting. Proper use of a disposable particulate respirator minimizes the effects of these airborne particulates, but does not protect against gases or vapors.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

SUSTAINABILITY

One of the many benefits of wood floors is that the raw material used to make them is sustainable and renewable. Under good forest management, the harvested wood is "replaced" either by natural or artificial reforestation efforts, ensuring availability of forests and timber for future generations. The word "green" is often loosely used to describe products that are environmentally friendly. The practice of greenwashing occurs when a company allocates more time and money into advertising a product as being "green," than they do reducing the product's environmental impact. For a product to be truly considered green, there must be defensible scientific evidence to support the claim. A popular approach is to conduct a Life Cycle Analysis (LCA) of the product. An LCA is a systematic approach of detailing the environmental impact over the entire life cycle of the product. Wood flooring, both solid and engineered, have LCAs that have been conducted, along with Industry Averaged Environmental Product Declarations (EPD), and are available through NWFA.

There are approximately 514 million acres of timberland in the United States. Net annual growth in United States commercial hardwood forests exceeds harvest and mortality by 33% each year and the volume of United States hardwood growing stock increased by more than 130%, from 5.2 billion m_3 in 1953 to 12 billion m_3 in 2012. The total annual growth of United States hardwood species in the United States is more than 272 million m_3. In part because of this forest regeneration, North American forests have the lowest risk of illegal timber in the world.

Every country has a government agency or department that regulates forest usage and grant long-term land leases to the lumber companies that must provide a complete managed forestry plan. The government must approve these plans beforehand, so by the time logging actually begins, there is documentation to verify how, when, and where harvest took place, and what has replaced it. Whether by poor management in the past, or lack of

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

long-term planning, some species still will become over-harvested. It is these issues that can produce shortages and environmental concerns. This is where specific regulations like the Lacey Act, CITES, and IUCN Red List (explained below) come into play.

The **Lacey Act** of 1900 is a conservation law in the United States that prohibits trade in wildlife, fish, and plants that have been illegally taken, possessed, transported, or sold. The 2008 Farm Bill amended the Lacey Act and extended its protections to a broad range of plants and plant products, making it unlawful to import into the United States any plant or plant product that was harvested illegally. To comply with the Lacey Act, an importer must declare the botanical identification of the product, the origin, and the amount or volume of the product in the shipment.

CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international treaty among governments with the goal of ensuring that international trade in wild animals and plants does not threaten the survival of the species. CITES was conceived in the spirit of such cooperation. The species covered by CITES are listed in three Appendices (I, II, and III), according to the degree of protection they need.

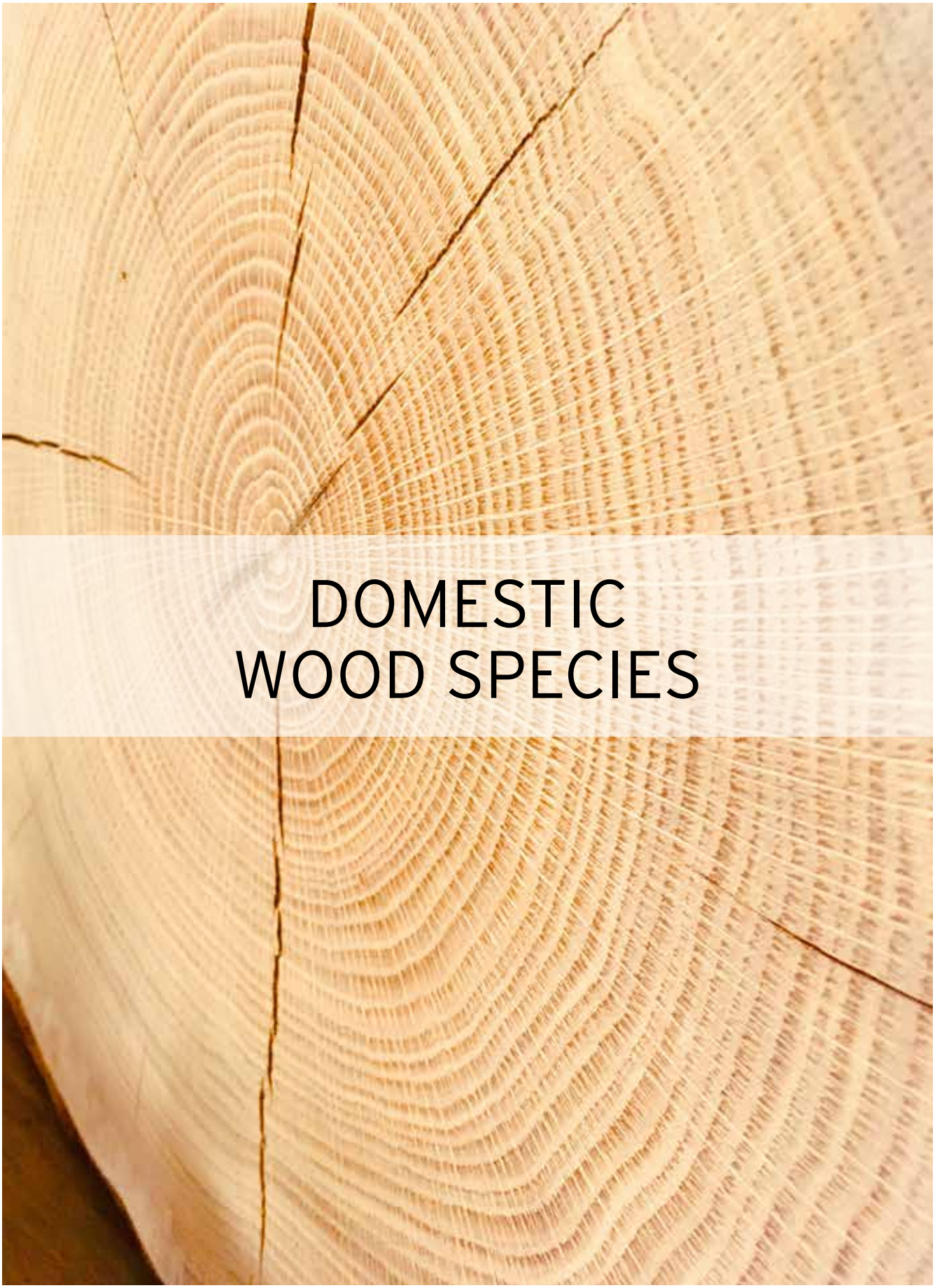
- **Appendix I** contains species threatened with extinction and commercial trade is prohibited. Even the transport of scientific specimens is highly controlled and monitored.
- **Appendix II** contains species that are threatened, but close watch over the trade is required to ensure they do not become endangered. Species in this Appendix are commercially valuable and actively traded according to officially determined quotas for export.
- **Appendix III** contains species that are protected in a specific country. That country has asked for CITES help to regulate the trade worldwide and control exports from the listing country.

The IUCN Red List (the International Union for Conservation of Nature's Red List of Threatened Species) is an indicator designed to convey the urgency of conservation issues to the public and policy makers, as well as to help the international community reduce species extinction. It uses criteria to evaluate the extinction risk of thousands of species and subspecies, which includes information about range, population size, habitat, ecology, use and/or trade, threats, and conservation actions.

The IUCN Red List categories classifies species that are at high risk of global extinction. It divides species into nine categories:

- Not Evaluated (**NE**)
- Data Deficient (**DD**)
- Least Concern (**LC**)
- Near Threatened (**NT**)
- Vulnerable (**VU**)
- Endangered (**EN**)
- Critically Endangered (**CR**)
- Extinct in the Wild (**EW**)
- Extinct (**EX**)

© 2023 NATIONAL WOOD FLOORING ASSOCIATION



DOMESTIC WOOD SPECIES

ASH *(Fraxinus americana)*

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

FAMILY: Oleaceae (olive)

OTHER COMMON NAMES: American ash, Biltmore ash, green ash, red ash, black ash, white ash.

APPEARANCE/COLOR: The heartwood of ash tends to be light to medium grey-brown, sometimes tinged with red. The sapwood can be very wide and tends to be beige or light brown, and not always clearly demarcated from the heartwood.

PHOTOSENSITIVITY: Low. Slightly ambers with age and exposure to sunlight and oxygen.

GRAIN: Ring-porous. The grain is bold, straight, regular, and uneven with moderately open with occasional wavy figuring. Sometimes confused with hickory; the zone of the large pores is more distinctive in ash, similar to that of oak. On quartersawn material, the rays are not apparent.

HARDNESS (JANKA): Averages 1,320 lbf

AVERAGE DRIED WEIGHT: 42 lbs/ft (675 kg/m^3)

SPECIFIC GRAVITY: Averages 0.60 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 7.8% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT (DCC): 0.00274 (tangential)

TOXICITY/ALLERGIES: Can cause skin and respiratory irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, with only a slight dulling effect on cutting edges. Responds well to bending. No known concerns with nailing, when the compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Sands satisfactorily when following the standard grit progression sequence. It may require a higher grit abrasive on the final passes than with other species to minimize visible scratches. Accepts stain well, but expect that the springwood will be pronounced when color is added. Finishes very nicely, with no known concerns.

SUSTAINABILITY: This wood species is not listed in the CITES Appendices, but five prominent species of ash trees (white, black, blue, green, and pumpkin) are reported by the IUCN Red List as Critically Endangered. A non-native beetle known as the Emerald Ash Borer (Agrilus planipennis) is responsible for the death of tens of millions of ash trees across the United States and Canada since its discovery in 2002.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

NWFA/NOFMA Clear Ash

NWFA/NOFMA Select Ash

NWFA/NOFMA No. 1 Common Ash

NWFA/NOFMA No. 2 Common Ash

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

ASH GRADING RULES

NWFA/NOFMA Clear Ash

- The face shall be practically free of defects.
- Will admit the following:
  - Small burls (less than 1/8" (.125") (3.18mm) in diameter).
  - Fine pin worm holes with no discoloration (one for every 3' (914.4 mm) in length); or in the absence of these, one thin light brown streak (3" (76.2 mm) long to be allowed for every 6' (1828.8 mm) of length or equivalent).
  - Brown heartwood is allowed as follows: 3/8" (.375") (9.53 mm) wide, the entire length or 1" (25.4 mm) wide, for one-third the length of the piece.
- Clear ash usually is chosen for its light color.

NWFA/NOFMA Select Ash

- The face shall contain mostly sapwood, unstained.
- Will admit the following:
  - Narrow streaks not running entire length of the piece.
  - Pin worm holes (up to three every 3' (914.4 mm) in length).
  - Imperfection in milling (torn grain) that will sand out.
  - One small tight knot (1/4" (.250") (6.35 mm) in diameter) to every 3' (914.4 mm) in length.
  - Small pith fleck (less than 1/4" (.250") (6.35 mm) in diameter).
  - An intermittent brown machine burn across the face, not exceeding 1/4" (.250") (6.35 mm) in width.
  - Unlimited cambium miners.
  - Brown heartwood is allowed as follows: 3/8" (.375") (9.53 mm) wide the entire length of the piece, or 1" (25.4 mm) wide for one-third the length of the piece.
  - Pieces with one-half (1/2) tongue, full length of the piece.
- Most defects are not visible after the floor has been installed and finished.

NWFA/NOFMA No. 1 Common Ash

- A floor with varying wood characteristics such as heavy streaks, stained sapwood, and sound knots typical of this grade. All defects must fill readily and be sound.
- Will admit the following:
  - Broken knots up to 1/2" (.500") (12.7 mm) in diameter.
  - Pith flecks less than 3/16" (.1875") (4.76 mm) in diameter.
  - Worm holes up to 3/16" (.1875") (4.76 mm) in diameter.
  - Checks and end splits less than 1/16" (.0625") (1.59 mm) wide and not extending through the piece.
  - Sticker stain.
- Will admit the following minor imperfections in machining:
  - Torn grain (not exceeding 25% of the surface area, less than 1/16" (.0625") (1.59 mm) in depth).
  - One dark machine burn across the face for every 3' (914.4 mm) of length, not exceeding 1/2" (.500") (12.7 mm) in width, 1/64" in depth.
  - One quarter (1/4) tongue, full length of the piece.

NWFA/NOFMA No. 2 Common Ash

- Defects of every characteristic admitted, but should lay a serviceable floor.
- Will not admit the following:
  - Soft rot.
  - Broken knots where the unsound portion extends through the piece.
  - Torn grain exceeding 3/16" (.1875") (4.76 mm) in depth.
  - Splits and open defects extending through the piece.
  - Shake.
  - Pith flecks that are soft if exceeding 1/4" (.250") (6.35mm) in diameter.
- Knot holes and defects that will fill readily are admitted.
- Occasional scant thickness (hit or miss) on the back of the flooring board the entire length of the piece admitted, providing there is full bearing across the board at some point within 3" of the ends.
- A limited number of pieces with no tongue admitted.

BEECH *(Fagus grandifolia)*

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

FAMILY: Fagaceae (beech)

OTHER COMMON NAMES: White beech, red beech, stone beech, winter beech.

APPEARANCE/COLOR: The heartwood of beech is mostly a light reddish-brown. The sapwood is generally a pale white or straw color, sometimes with a pink or brown hue.

PHOTOSENSITIVITY: Low-to-Moderate. Slightly ambers with age and exposure to sunlight and oxygen. When steamed, beech naturally darkens.

GRAIN: Diffuse-porous. Beech grain is straight, fine, and with a uniform texture. It can sometimes be interlocked. Growth rings are faint. On quartersawn material, the rays are clearly defined and numerous. The grain of American beech is more-coarse than European beech.

HARDNESS (JANKA): Averages 1,300 lbf

AVERAGE DRIED WEIGHT: 45 lbs/ft^3 (720 kg/m^3)

SPECIFIC GRAVITY: Averages 0.64 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 11.9% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Below average

DIMENSIONAL CHANGE COEFFICIENT: 0.00431 (tangential)

TOXICITY/ALLERGIES: Reported as a sensitizer. Can cause skin, eye, nose, and respiratory irritations, as well as nasopharyngeal cancer.

INSTALLATION: Cuts, routs, planes, and shapes well, with only a slight dulling effect on cutting edges, but it can bind on saw blades and burn when crosscutting. Responds well to steam bending. It is recommended to adjust the compressor psi, and use 18 gauge cleats to avoid splitting. Glue adheres well, with no known issues.

SAND/FINISH: Sands very satisfactorily following the standard grit progression sequence. A softer species that may respond better to higher grit progression sequences. Reduce the drum pressure on the belt sander to avoid removal of too much material on each pass. Final sanding with higher grit abrasives often is necessary to minimize visible scratches. Accepts stains and finishes very nicely, with no known concerns.

SUSTAINABILITY: This wood species is not listed in the CITES Appendices, and reported by the IUCN as a species of Least Concern.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

NWFA/NOFMA Clear Beech

NWFA/NOFMA Select & Better Beech

NWFA/NOFMA No. 1 Common Beech

NWFA/NOFMA No. 2 Common Beech

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

BEECH GRADING RULES

NWFA/NOFMA Clear Beech

- Clear beech is a special grade produced from all red-faced stock, and is selected specially for color.
- The color is a rich, soft tint, which lends this species individuality found only in beech.
- Pieces must have 95% red-faced characteristics.
- All NWFA/NOFMA Select & Better rules apply, except the following:
  - Streaks should be light brown.
  - Black spots, sticker stain/shadow, not admitted.

NWFA/NOFMA Select & Better Beech

- Shall have the face practically free of all defects, but the natural color of the wood shall not be considered a defect.
- The highest standard grade, combines appearance and durability.
- Will admit the following:
  - Variations in the natural color of the wood (with use of some finishes, slight shadows and color variation may appear).
  - An occasional small, firm pin knot, not exceeding 1/8" (.125") (3.18 mm) in diameter, provided it does not occur on edges or ends of the piece.
  - Occasional dark green or black spots or streaks not exceeding 1/4" (.250") (6.35 mm) wide and 3" (76.2 mm) long (or its equivalent), which may contain a tight check not exceeding 1/2" (.500") (12.7 mm) long, provided it is boxed within the piece.
  - Small burls.
  - Slightly torn grain or similar defect that readily can be removed by the ordinary method of sanding the floor after it is laid.
  - A slightly shallow place not exceeding 12" (304.8 mm) long on the underside of the flooring if it does not extend to either end of the piece.
  - Pieces with one half (1/2) tongue for no more than 25% of the length.
- The wood must be sound and free of shake.
- Bark streaks shall not be permitted.

NWFA/NOFMA No. 1 Common Beech

- A floor with varying wood characteristics and colors to include distinct color variations, numerous streaks, stained sapwood, sound knots, and checks.
- All defects must fill readily.
- Will admit the following:
  - Sound tight knots, provided they do not occur on edges or ends of pieces.
  - Slight imperfections in machining.
  - Distinct color variations.
  - Sticker stain/shadow.
  - Numerous dark green or black spots or streaks, provided they do not occur in combination with predominantly dark heartwood.
  - Slight checks not exceeding 3" (76.2 mm) in length (may be slightly open) and running parallel with and well inside the edges and ends of the pieces.
  - Dark spots or streaks with slight checks in the center.
  - Small rough spots (torn grain) that cannot be removed wholly by the ordinary method of sanding the floor after it is laid.
  - Slightly torn edges.
  - One quarter (1/4) tongue, full length of the piece.
  - Shallow or waney back, if piece has sufficient bearing of full thickness to support it in the floor.
  - Small bark streaks where bark is as sound as surrounding wood.
- The face shall be free of shake and wood must be sound.

NWFA/NOFMA No. 2 Common Beech

- Must be of such character as will lay and give a good serviceable floor. The wood must be firm, serviceable, and may contain all defects common to beech.
- Will not admit the following:
  - Knot holes exceeding 3/8" (.375") (9.53 mm) in diameter or unsound knots where the unsound portion exceeds 1" (25.4 mm) in diameter.
  - Voids on ends or edges.
  - Shake, heart checks, badly split ends and imperfections in manufacture that would materially impair the serviceability of the floor.
- Occasional scant thickness (hit or miss) on the back of the flooring board the entire length of the piece admitted, providing there is full bearing across the board at some point within three inches of the ends.
- A limited number of pieces with no tongue admitted.

BIRCH *(Betula alleghaniensis)*

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

FAMILY: Betulaceae (birch)

OTHER COMMON NAMES: Yellow birch, silver birch, grey birch, hard birch, curly birch, swamp birch, Canadian yellow birch. In the wood flooring industry, red birch often is sourced from the heartwood of yellow birch.

APPEARANCE/COLOR: The heartwood is light reddish-brown tinged with red. The sapwood is creamy yellow or pale white. Boards can vary greatly in grain and color.

PHOTOSENSITIVITY: Low. Slightly ambers with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. Birch has a fine, close-grained texture that generally is straight with distinct, inconspicuous growth rings. The grain also can be figured or wavy. Figured birch is sought after for decorative purposes.

HARDNESS (JANKA): Averages 1,260 lbf

AVERAGE DRIED WEIGHT: 43 lbs/ft^3 (690 kg/m^3)

SPECIFIC GRAVITY: Averages 0.62 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 9.5% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00338 (tangential)

TOXICITY/ALLERGIES: Reported as a sensitizer. Can cause skin and respiratory irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, with a moderate dulling effect on cutting edges. Responds well to bending. No known concerns with nailing, when the compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Sands very satisfactorily following the standard grit progression sequence. A softer species that may respond better to higher grit progression sequences. Reduce the drum pressure on the belt sander to avoid removal of too much material on each pass. Final sanding with higher grit abrasives often is necessary to minimize visible scratches. Accepts stains nicely, but can appear uneven based on graining in the individual boards. No known concerns finishing this species.

SUSTAINABILITY: This wood species is not listed in the CITES Appendices, nor on the IUCN Red List.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

NWFA/NOFMA Clear Red Birch

NWFA/NOFMA Select & Better Red Birch

NWFA/NOFMA No. 1 Common Red Birch

NWFA/NOFMA No. 2 Common Red Birch

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

NWFA/NOFMA Select & Better Yellow Birch

NWFA/NOFMA No. 1 Common Yellow Birch

NWFA/NOFMA No. 2 Common Yellow Birch

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

BIRCH GRADING RULES

NWFA/NOFMA Clear Red Birch

- Clear red birch is a special grade produced from all red-faced stock, and is selected specially for color.
- The color is a rich, soft tint, which lends this species individuality found only in birch.
- Pieces must have 95% red-faced characteristics.
- All NWFA/NOFMA Select & Better rules apply, except for the following:
  - Streaks should be light brown.
  - Black spots, sticker stain/shadow, not admitted.

NWFA/NOFMA Select & Better Yellow Birch and Red Birch

- Shall have the face practically free of all defects, but the natural color of the wood shall not be considered a defect.
- The highest standard grade, combines appearance and durability.
- Will admit the following:
  - Variations in the natural color of the wood (with use of some finishes, slight shadows and color variation may appear).
  - An occasional small, firm pin knot, not exceeding 1/8" (.125") (3.18 mm) in diameter, provided it does not occur on edges or ends of the piece.
  - Occasional dark green or black spots or streaks not exceeding 1/4" (.250") (6.35 mm) wide and 3" (76.2 mm) long (or its equivalent), which may contain a tight check not exceeding 1/2" (.500") (12.7 mm) long, provided it is boxed within the piece.
  - Small burls.
  - Slightly torn grain or similar defect that readily can be removed by the ordinary method of sanding the floor after it is laid.
  - A slightly shallow place not exceeding 12" (304.8 mm) long on the underside of the flooring if it does not extend to either end of the piece.
  - Pieces with one half (1/2) tongue for no more than 25% of the length.
- The wood must be sound and free of shake.
- Bark streaks shall not be permitted.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

NWFA/NOFMA No. 1 Common Yellow Birch and Red Birch

- A floor with varying wood characteristics and colors to include distinct color variations, numerous streaks, stained sapwood, sound knots, and checks.
- All defects must fill readily.
- Will admit the following:
  - Sound tight knots, provided they do not occur on edges or ends of pieces.
  - Slight imperfections in machining.
  - Distinct color variations.
  - Sticker stain/shadow.
  - Numerous dark green or black spots or streaks, provided they do not occur in combination with predominantly dark heartwood.
  - Slight checks not exceeding 3" (76.2 mm) in length (may be slightly open) and running parallel with and well inside the edges and ends of the pieces.
  - Dark spots or streaks with slight checks in the center.
  - Small rough spots (torn grain) that cannot be removed wholly by the ordinary method of sanding the floor after it is laid.
  - Slightly torn edges.
  - One quarter (1/4) tongue, full length of the piece.
  - Shallow or waney back, if piece has sufficient bearing of full thickness to support it in the floor.
  - Small bark streaks where bark is as sound as surrounding wood.
- The face shall be free of shake and wood must be sound.

NWFA/NOFMA No. 2 Common Yellow Birch and Red Birch

- Must be of such character as will lay and give a good serviceable floor. The wood must be firm, serviceable and may contain all defects common to birch.
- Will not admit the following:
  - Knot holes exceeding 3/8" (.375") (9.53 mm) in diameter or unsound knots where the unsound portion exceeds 1" (25.4 mm) in diameter.
  - Voids on ends or edges.
  - Shake, heart checks, badly split ends, and imperfections in manufacture that would materially impair the serviceability of the floor.
- Occasional scant thickness (hit or miss) on the back of the flooring board the entire length of the piece admitted, providing there is full bearing across the board at some point within three inches of the ends.
- A limited number of pieces with no tongue admitted.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

CHERRY, BLACK *(Prunus serotina)*

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

FAMILY: Rosaceae (rose)

OTHER COMMON NAMES: American cherry, rum cherry, wild cherry.

APPEARANCE/COLOR: The heartwood ranges from a light pinkish-red to a reddish-brown color. The sapwood can be a light brown to pale yellowish tone. Dark streaks are common. Boards can vary greatly in grain and color.

PHOTOSENSITIVITY: High. Darkens to a deep reddish-brown with age and exposure to sunlight and oxygen. Color change is drastic within the first 90 days after exposure to light. After 90 days, the darkening process will slow, but like all woods, it will never stop completely.

GRAIN: Semi-ring-porous to diffuse-porous. The grain normally is straight, with a fine and uniform texture. The texture is satiny, with some gum pockets. Quartersawn wood often shows distinctive ray patterns. There can be a great variety of color, and curly or wavy figure, within the species.

HARDNESS (JANKA): Averages 950 lbf

AVERAGE DRIED WEIGHT: 35 lbs/ft^3 (560 kg/m^3)

SPECIFIC GRAVITY: Averages 0.50 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 7.1% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00248 (tangential)

TOXICITY/ALLERGIES: Can cause respiratory irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, with virtually no dulling effect on cutting edges. Responds well to bending. No known concerns with nailing, when the compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Sands very easily following the standard grit progression sequence. A softer species that can show sander marks more than other species. Reduce the drum pressure on the belt sander to avoid removal of too much material on each pass. May require a higher grit abrasive on the final passes than with other species. Accepts stains well, but can appear uneven based on graining in the individual boards. Takes finishes nicely, with no known concerns.

SUSTAINABILITY: This wood species is not listed in the CITES Appendices, and is reported by the IUCN as being a species of Least Concern.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

NWFA/NOFMA Clear Black Cherry

NWFA/NOFMA Select Black Cherry

NWFA/NOFMA No. 1 Common Black Cherry

NWFA/NOFMA No. 2 Common Black Cherry

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

CHERRY GRADING RULES

NWFA/NOFMA Clear Black Cherry

- A flooring product selected for its rich red-brown coloration and minimal character marks. The face is composed of 100% naturally colored heartwood.
- Will admit the following:
  - Small tight checks.
  - A minimal number of slight edge defects (indentations).
  - Small burls.
  - Limited pin knots.
  - Fine pin worm holes.
  - A thin black streak, 3" (76.2 mm) long in 2' (609.6 mm) of length.
  - A sound gum pocket 1/16" (.0625") (1.59 mm) wide x 1" (25.4 mm) long per foot of length (304.8 mm).
  - Three-fourths (3/4) tongue, full length of the piece.

NWFA/NOFMA Select Black Cherry

- A flooring product with natural coloration variations found in heartwood and a small amount of contrasting sapwood, along with allowable characters.
- Will admit the following:
  - 1/2" (.500") (12.7 mm) wide bright sapwood entire length of piece or equivalent.
  - A small tight 1/4" (.250") (6.35mm) wide knot every 3' (914.4 mm) of length.
  - Slightly open shallow checks, 1/2" (.500") (12.7 mm) long per foot (304.8 mm) of length.
  - Edge defects (indentations) less than 1/16" (.0625") (1.59 mm) wide x 1/2" (.500") (12.7 mm) long for every 2' (609.6 mm) of length.
  - Intermittent machine burn.
  - Narrow black streaks not running the entire length.
  - A gum pocket 1/8" (.1250") (3.18 mm) wide x 1" (25.4 mm) long per foot (304.8 mm) of length.
  - A slight amount of scant thickness where ends are full thickness.
  - One-half (1/2) tongue, full length of the piece.

NWFA/NOFMA No. 1 Common Black Cherry

- A flooring product that may contain prominent color variation between the light sapwood and dark heartwood, along with prominent natural and machine-produced characters.
- Will admit the following:
  - Broken knots up to 1/2" (.500") (12.7 mm) wide with no loose pieces; must fill readily.
  - Numerous checks up to 1/16" (.0625") (1.59 mm) wide and not extending through the piece.
  - Edge defects (indentations) up to 3/32" (.0938") (2.38 mm) wide x 1 1/2" (38.1 mm) long in aggregate for every 3' (914.4 mm) of length.
  - Occasional solid machine burns.
  - A small area of rough face showing minor saw marks.
  - Unlimited sapwood.
  - Sapwood may be stained, splotchy, and include unlimited sticker-stain.
  - Up to 20" (508 mm) scant stock (hit or miss) for every 5' (1524 mm) of length, with full thickness within 3" (76.2 mm) of ends.
  - May have heavy steaks and dark discoloration up to 50%.
  - Open fillable gum pockets.
  - Worm holes 1/8" (.125") (3.18 mm) in diameter, one per foot (304.8 mm) of length.
  - Pin worm holes, six (6) per foot (304.8 mm) of length.
  - One area of torn grain up to 1/16" (.0625") (1.59 mm) deep per 3' (914.4 mm) of length.
  - One-quarter (1/4) tongue, full length of the piece.

NWFA/NOFMA No. 2 Common Black Cherry

- A flooring product that contains sound natural variations and manufacturing imperfections of the forest product; all imperfections and open characters must be fillable.
- Will admit the following:
  - Knots and knot holes where openings and loose areas do not extend through pieces.
  - Edge defect 1/4" (.250") (6.35mm) wide x 1/4" (.250") (6.35mm) wide if irregular, not to extend in depth through the tongue and groove engagement.
  - Dark machine burns not more than 3/64" (.046875") (1.19 mm) deep.
  - Prominent open checks not extending through the piece.
  - Incipient decay that is not softer than surrounding wood.
  - A small unplaned area with radiating saw marks.
  - Split ends with no movement across the split.
  - An area of torn grain up to 1/8" (.125") (3.18 mm) deep x 3" (76.2 mm) in length for the full width of the piece permitted for every 2' (609.6 mm) of length.
  - Angled grub worm holes 3/16" (.1875") (4.76 mm) wide x 1/2" (.500") (12.7 mm) long with all other worm holes if sound.
  - Unlimited dark discoloration and streaks to include stained sapwood and unlimited sticker stain.
  - Open gum pockets to 1/8" (.125") (3.18 mm) wide.
  - Occasional scant thickness (hit or miss) on the back of the flooring board the entire length of the piece, providing there is full bearing across the board at some point within three inches of the ends.
  - A limited number of pieces with no tongue.

CHESTNUT *(Castanea dentata)*

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

FAMILY: Fagaceae (beech)

OTHER COMMON NAMES: Wormy chestnut, sweet chestnut, American chestnut.

APPEARANCE/COLOR: The heartwood can be a light to medium greyish- to reddish-brown. The sapwood can be pale white to light brown.

PHOTOSENSITIVITY: Low. Slightly lightens with age and exposure to sunlight and oxygen.

GRAIN: Ring-porous. The grain is straight, spiraled, and/or interlocked with conspicuous growth rings with narrow rays. The texture is coarse or uneven.

HARDNESS (JANKA): Averages 540 lbf

AVERAGE DRIED WEIGHT: 30 lbs/ft^3 (480 kg/m^3)

SPECIFIC GRAVITY: Averages 0.43 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 6.7% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00234 (tangential)

TOXICITY/ALLERGIES: No adverse health effects have been reported.

INSTALLATION: Cuts, routs, planes, and shapes well, with a moderate dulling effect on cutting edges. Low bending strength unless steam is used. It is recommended to adjust the compressor psi, and use 18 gauge cleats, to avoid splitting. Glue adheres well, with no known issues.

SAND/FINISH: Sands very easily following the standard grit progression sequence. Accepts stains and finishes very nicely, with no known concerns.

SUSTAINABILITY: This species is not listed in the CITES Appendices, but is reported by IUCN Red List as Critically Endangered. American chestnut once was harvested from New England to northern Georgia in large quantities, and was among the largest, tallest, and fastest-growing forests in the United States. American chestnut was attacked by blight in the early 1920s wiping out nearly three billion mature trees. This blight was caused by an accidentally introduced Asian bark fungus. Efforts to reintroduce blight-resistant chestnut trees to their native habitat are being spearheaded by groups such as The American Chestnut Foundation (www.acf.org).

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

DOUGLAS-FIR *(Pseudotsuga menziesii)*

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

FAMILY: Pinaceae (pine)

OTHER COMMON NAMES: British Columbian pine, Oregon pine, Douglas spruce, Puget Sound pine, red fir.

APPEARANCE/COLOR: The heartwood can vary from yellowish-tan to light brown. The sapwood can be whitish to tan or pale yellow to a reddish-white. The color can vary based on age and location of the tree. The color transition is more gradual in faster-grown Douglas-fir trees.

PHOTOSENSITIVITY: Moderate. Deepens and ambers with age and exposure to sunlight and oxygen. Yellows become more yellow and reds become more red.

GRAIN: The grain normally is straight, with an occasional wavy or spiral texture. Older-growth Douglas-fir has a tighter grain pattern that exhibits a distinguishable contrast between earlywood and latewood.

HARDNESS (JANKA): Averages 620 lbf

AVERAGE DRIED WEIGHT: 32 lbs/ft^3 (510 kg/m^3)

SPECIFIC GRAVITY: Averages 0.48 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 7.6% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00267 (tangential)

TOXICITY/ALLERGIES: Can cause skin, nose, and respiratory irritation. May cause nausea. Splinters can take longer to heal, and can become infected more-so than other species.

INSTALLATION: Cuts, routs, planes, and shapes well, with only a slight dulling effect on cutting edges, but pitch can build quickly, reducing the blade's ability to make clean cuts. Responds well to bending. No known concerns with nailing, when the compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Sands very easily following the standard grit progression sequence. It is a softer wood that normally cuts very easily with higher grit abrasives. Reduce the drum pressure on the belt sander to avoid removal of too much material on each pass. The high resin and sap content found in Douglas-fir can clog paper easily requiring the use of more abrasives than other species. Age, and sun-related color change can run deep into the wood, and normally cannot be sanded out. Accepts stains and finishes very nicely, with no known concerns.

SUSTAINABILITY: This wood species is not listed in the CITES Appendices, nor on the IUCN Red List.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

HICKORY, PECAN *(Carya illinoinensis)*

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

FAMILY: Jugladaceae (walnut)

OTHER COMMON NAMES: Hickory-pecan, pecan nut, sweet pecan.

APPEARANCE/COLOR: The heartwood is reddish-brown with some dark brown stripes. The sapwood is white or creamy white with pinkish tones.

PHOTOSENSITIVITY: Low. Slightly ambers with age and exposure to sunlight and oxygen.

GRAIN: Ring-porous to semi-ring porous. The grain is open, and occasionally can be wavy or irregular with a medium texture.

HARDNESS (JANKA): Averages 1,820 lbf

AVERAGE DRIED WEIGHT: 46 lbs/ft^3 (735 kg/m^3)

SPECIFIC GRAVITY: Averages 0.66 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 8.9% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00315 (tangential)

TOXICITY/ALLERGIES: No adverse health effects have been reported.

INSTALLATION: Cuts, routs, planes, and shapes well, with only a slight dulling effect on cutting edges. The irregular grain can chip or tear when blades become dull. Can be somewhat brittle, and has a tendency to split the tongues when nailing, but can be avoided when compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Sands satisfactorily when following the standard grit progression sequence. It may require a higher grit abrasive on the final passes than with other species to minimize visible scratches. Accepts stains and finishes very nicely, with no known concerns.

SUSTAINABILITY: This wood species is not listed in the CITES Appendices, nor on the IUCN Red List.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

HICKORY, TRUE *(Carya spp.)*

Includes the four principal species: Pignut hickory (*C. glabra*), shellbark hickory (*C. laciniosa*), shagbark hickory (*C. ovata*), mockernut hickory (*C. tomentosa*).

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

FAMILY: Juglandaceae (walnut)

OTHER COMMON NAMES: Carolina hickory, red heart hickory, white hickory.

APPEARANCE/COLOR: The heartwood is tan or reddish. The sapwood is white to cream, with fine brown lines. Heartwood and sapwood often are sharply demarcated. The color can vary significantly.

PHOTOSENSITIVITY: Low. Slightly ambers with age and exposure to sunlight and oxygen.

GRAIN: Ring-porous. The grain is closed, with moderate definition. The grain can be somewhat rough-textured.

HARDNESS (JANKA): Averages 1,820 lbf

AVERAGE DRIED WEIGHT: 50 lbs/ft^3 (800 kg/m^3)

SPECIFIC GRAVITY: Averages 0.72 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 12.6% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Below average

DIMENSIONAL CHANGE COEFFICIENT: 0.00411 (tangential)

TOXICITY/ALLERGIES: No adverse health effects have been reported.

INSTALLATION: Cuts, routs, planes, and shapes well, with only a slight dulling effect on cutting edges. The irregular grain can chip or tear when blades become dull. Can be somewhat brittle, and has a tendency to split the tongues when nailing, but can be avoided when compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Sands satisfactorily when following the standard grit progression sequence. It may require a higher grit abrasive on the final passes than with other species to minimize visible scratches. Accepts stains and finishes very nicely, with no known concerns.

SUSTAINABILITY: This wood species is not listed in the CITES Appendices, nor on the IUCN Red List.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

NWFA/NOFMA Clear Red Hickory/Pecan

NWFA/NOFMA Clear White Hickory/Pecan

NWFA/NOFMA Select Hickory/Pecan

NWFA/NOFMA No. 1 Common Hickory/Pecan

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

NWFA/NOFMA No. 2 Common Hickory/Pecan

HICKORY/PECAN GRADING RULES

NWFA/NOFMA Clear Red Hickory/Pecan

- A special stock selected for its deep red/brown color with the minimal contrast of the lighter sapwood. Face of pieces shall be heartwood (95%).
- All NWFA/NOFMA select hickory/pecan grade rules apply.

NWFA/NOFMA Clear White Hickory/Pecan

- A special stock selected for its creamy color with the minimal contrast of the darker heartwood. The face of pieces shall be bright sapwood (95%).
- All NWFA/NOFMA select hickory/pecan grade rules apply, except:
  - Streaks should be light brown not exceeding 1/4" (.250") (6.35mm) wide and 3" (76.2 mm) long (or equivalent), one per 3' (914.4 mm) of length.
  - Black spots not allowed; sticker stain/shadow not allowed.

NWFA/NOFMA Select & Better Hickory/Pecan

- A combination of NWFA/NOFMA Clear Red, Clear White, and Select.
- NWFA/NOFMA Select grade rules apply for this grade.

NWFA/NOFMA Select Hickory/Pecan

- Shall have the face practically free of all defects, but the natural color of the wood shall not be considered a defect. The highest standard grade combines a nearly uniform appearance with exceptional durability.
- Will admit the following:
  - Variations in the natural color of the wood, heartwood, and sapwood.
  - An occasional small knot or bird peck not exceeding 1/4" (.250") (6.35mm) in diameter, provided it does not occur on edges or ends of the piece.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

- Dark streaks not exceeding 1/4" (.250") (6.35mm) wide and 3" (76.2 mm) long (or its equivalent, one to every 3' (914.4 mm) in length).
- Slight checks not exceeding 1/2" (.500") (12.7 mm) long, provided check is boxed within the piece.
- Small burls.
- Slight torn grain or slight intermittent machine burn, or similar defect that can be removed readily by the ordinary method of sanding the floor after it is laid.
- Slight scant back.
- Pieces with one-half (1/2) tongue, full length of the piece.

- The wood must be free from shake.
- Bark streaks shall not be permitted.

NWFA/NOFMA No. 1 Common Hickory/Pecan

- A floor with varying wood characteristics and colors to include heavy streaks, stained sapwood, sound knots, checks, and small splits. All defects must fill readily and be sound.
- Will admit the following:
  - Broken knots up to 1/2" (.500") (12.7 mm) in diameter.
  - Distinct color variations (predominantly dark, discolored pieces not allowed).
  - Sticker stain/shadow.
  - Numerous dark streaks or black spots.
  - Checks to 1/16" (.0625") (1.59 mm) in width, not exceeding 3" (76.2 mm) in length, and running parallel and well inside the edges.
  - Small end split 1/16" (.0625") (1.59 mm) wide x 1/2" (.500") (12.7 mm) in length showing no movement.
  - Bird pecks to 1/2" (.500") (12.7 mm) in diameter where bark is sound and as hard as surrounding wood.
  - Minor imperfections in machining.
  - Torn grain (less than 1/16" (.0625") (1.59 mm) deep in an area 2" (50.8 mm) wide x 2" (50.8 mm) wide).
  - Slightly torn edges.
  - An occasional dark machine burn 1/2" (.500") (12.7 mm) in width (no more than two per 3' (914.4 mm) of length).
  - Pieces with one-quarter (1/4) tongue, full length of the piece.

NWFA/NOFMA No. 2 Common Hickory/Pecan

- Must be of such character as will lay and give a good serviceable floor. The wood must be firm, and may contain defects of every character. This grade is intended to give a "rustic" appearance.
- Will not admit the following:
  - Knot holes exceeding 3/8" (.375") (9.53 mm) in diameter or unsound knots where the unsound portion exceeds 1" (25.4 mm) in diameter (the unsound portion cannot extend through the piece).
  - Shake, soft rot, splits, and open defects that extend through the piece or show movement.
  - Torn grain exceeding 1/4" (.250") (6.35mm) deep.
  - Edge splinters, and imperfections in manufacture that would materially impair the serviceability of the floor.
- Knot holes, bird pecks, worm holes, and the like that will fill readily are admitted.
- Occasional scant thickness (hit or miss) on the back of the flooring board the entire length of the piece are admitted, providing there is full bearing across the board at some point within three inches of the ends.
- A limited number of pieces with no tongue are admitted.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

Distinguishing True Hickory from Pecan

There are eight different species of hickory. Four species are known as "true hickory," and four are known as "pecan hickory." True hickory species are shellbark (*Carya laciniosa*), pignut (*Carya glabra*), mockernut (*Carya tomentosa*), and shagbark (*Carya ovata*). The pecan hickory species are pecan (*Carya illinoinensis*), bitternut (*Carya cordiformis*), nutmeg (*Carya myristiciformis*), and water (*Carya aquatica*).

Appearance:

In both true hickory and pecan hickory, there are often pronounced differentiations in color between spring wood and summer wood. In pecan, sapwood is usually graded higher than darker heartwood. Pecan and hickory are traditionally mixed by flooring mills.

Grain:

Pecan hickory is less dense and more variable. It also grows faster than most true hickory species. The quickest and easiest means of differentiating them is by observing the bands of parenchyma. In pecan-hickories, the bands are present in both the earlywood and latewood portions of the wood. In true-hickories, the bands of parenchyma are absent from the earlywood portion of the wood.

Another indicator of pecan-hickory is a tendency to be more semi-ring-porous rather than strictly ring-porous, with a more gradual transition from the larger earlywood pores to the smaller latewood pores.

Hickory-Pecan

Hickory-True

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

MAPLE, HARD *(Acer saccharum)*

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

FAMILY: Aceraceae (maple)

OTHER COMMON NAMES: Sugar maple, rock maple, white maple, black maple, sweet maple.

APPEARANCE/COLOR: The heartwood can be darker reddish-brown to brown. The sapwood ranges from nearly white to an off-white cream color. The sapwood more commonly is used than the heartwood. All types of maple can have a broad range in color variation.

PHOTOSENSITIVITY: Low. Slightly ambers with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain generally is straight, but may be wavy, with a fine, even texture. The grain also can be figured. Figured maple is sought after for decorative purposes. Some figuring may be caused by fungus, disease, or insect infestation (such as spalted maple and ambrosia), while other figured maple may be caused by abnormal growing conditions, such as birdseye, fiddleback, curly, quilted, and burl.

HARDNESS (JANKA): Averages 1,450 lbf

AVERAGE DRIED WEIGHT: 44 lbs/ft^3 (705 kg/m^3)

SPECIFIC GRAVITY: Averages 0.63 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 9.9% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00353 (tangential)

TOXICITY/ALLERGIES: Can cause skin and respiratory irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, with a moderate dulling effect on cutting edges. Responds well to bending. No known concerns with nailing, when the compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Can be challenging to sand due to its density, and requires extra caution with grit progression sequence. May require a higher grit abrasive on the final passes as sanding marks may become more apparent due to the tight grain, density, and light color of the species. The wood also may burnish easily, dulling abrasives quicker than with other species. Maple tends to stain uneven based on graining in the individual boards. Takes finishes nicely, with no known concerns.

SUSTAINABILITY: This wood species is not listed in the CITES Appendices, nor on the IUCN Red List.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

NWFA/NOFMA Clear Hard Maple

NWFA/NOFMA Select & Better Maple

NWFA/NOFMA No. 1 Common Maple

NWFA/NOFMA No. 2 Common Maple

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

MAPLE GRADING RULES

Much of the wood flooring industry relies on MFMA grading rules for hard maple.
A complete description of MFMA grading rules can be found here: www.maplefloor.org

NWFA/NOFMA Clear Hard Maple

- Special stock, selected for uniformity of color. It is almost ivory white and is the finest grade of hard maple flooring that can be produced.
- Sapwood/heartwood pieces must have 95% sapwood on the face.
- Pieces must be free from stain, and heartwood portion must be nearly white.
- All NWFA/NOFMA Select & Better rules apply, except:
  - Streaks should be light brown or light green, not exceeding 1/4" (.250") (6.35mm) wide and 3" (76.2 mm) long (or equivalent), one (1) per 3' (914.4 mm) in length.
  - Black spots and sticker stain/shadow are not admitted.

NWFA/NOFMA Select & Better Maple

- Shall have the face practically free of all defects, but the natural color of the wood shall not be considered a defect.
- The highest standard grade, combines appearance and durability.
- Will admit the following:
  - Variations in the natural color of the wood (with use of some finishes, slight shadows and color variation may appear).
  - An occasional small, firm pin knot, not exceeding 1/8" (.125") (3.18 mm) in diameter, provided it does not occur on edges or ends of the piece.
  - Occasional dark green or black spots or streaks not exceeding 1/4" (.250") (6.35 mm) wide and 3" (76.2 mm) long (or its equivalent), which may contain a tight check not exceeding 1/2" (.500") (12.7 mm) long, provided it is boxed within the piece.
  - Bird's eyes and small burls.
  - Slightly torn grain; or similar defect that readily can be removed by the ordinary method of sanding the floor after it is laid.
  - A slightly shallow place not exceeding 12" (304.8 mm) long on the underside of the flooring if it does not extend to either end of the piece.
  - Pieces with one half (1/2) tongue for no more than 25% of the length.
- The wood must be sound and free of shake.
- Bark streaks shall not be permitted.

NWFA/NOFMA No. 1 Common Maple

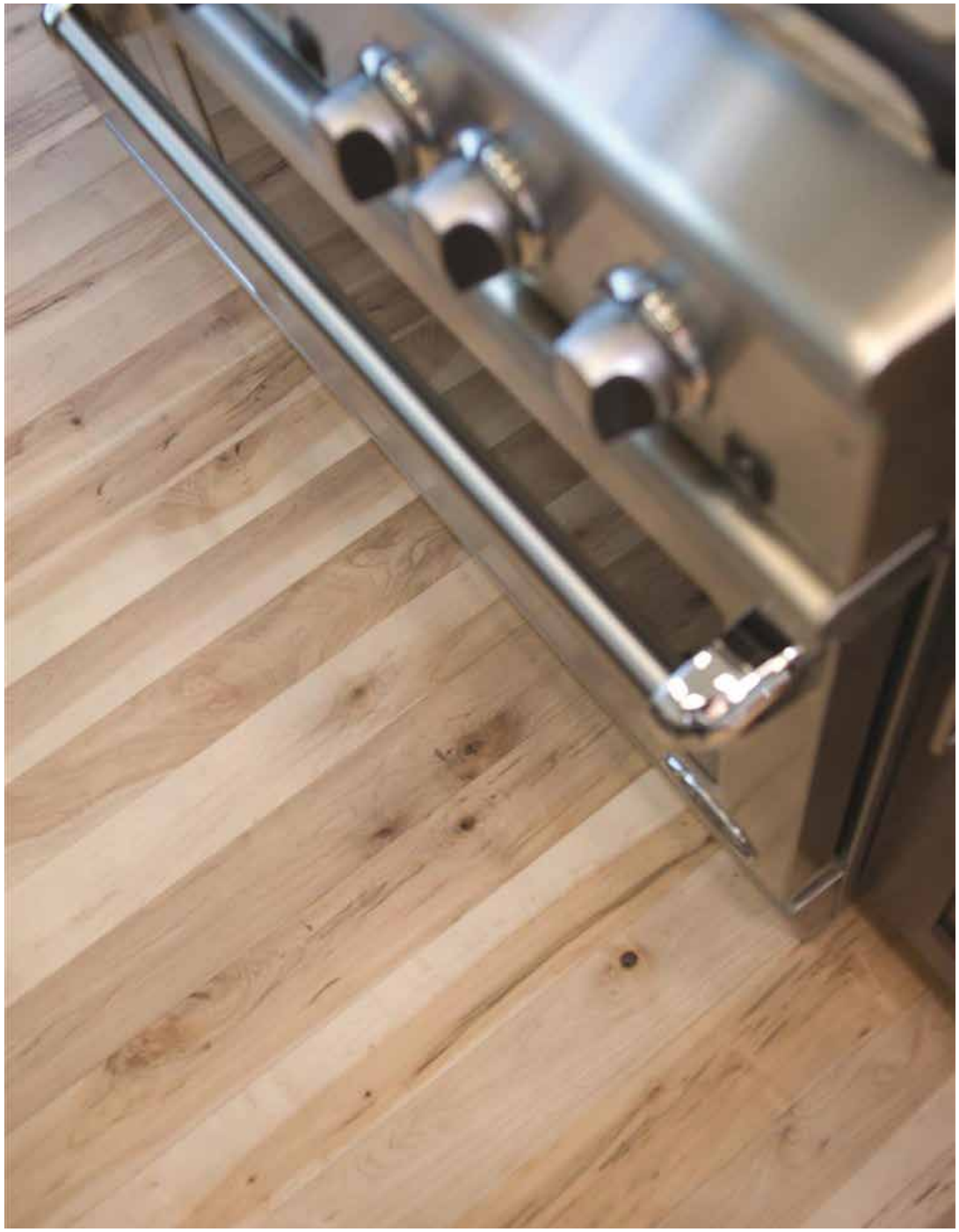
- A floor with varying wood characteristics and colors to include distinct color variations, numerous streaks, stained sapwood, sound knots, and checks.
- All defects must fill readily.
- Will admit the following:
  - Sound tight knots, provided they do not occur on edges or ends of pieces.
  - Slight imperfections in machining.
  - Distinct color variations.
  - Sticker stain/shadow.
  - Numerous dark green or black spots or streaks, provided they do not occur in combination with predominantly dark heartwood.
  - Slight checks not exceeding 3" (76.2 mm) in length (may be slightly open) and running parallel with and well inside the edges and ends of the pieces.
  - Dark spots or streaks with slight checks in the center.
  - Small rough spots (torn grain) that cannot be removed wholly by the ordinary method of sanding the floor after it is laid.
  - Slightly torn edges.
  - One quarter (1/4) tongue, full length of the piece.
  - Shallow or waney back, if piece has sufficient bearing of full thickness to support it in the floor.
  - Small bark streaks where bark is as sound as surrounding wood.
- The face shall be free of shake and wood must be sound.

NWFA/NOFMA No. 2 Common Maple

- Must be of such character as will lay and give a good serviceable floor. The wood must be firm, serviceable, and may contain all defects common to maple.
- Will not admit the following:
  - Knot holes exceeding 3/8" (.375") (9.53 mm) in diameter or unsound knots where the unsound portion exceeds 1" (25.4 mm) in diameter.
  - Voids on ends or edges.
  - Shake, heart checks, badly split ends, and imperfections in manufacture that would materially impair the serviceability of the floor.
- Occasional scant thickness (hit or miss) on the back of the flooring board the entire length of the piece admitted, providing there is full bearing across the board at some point within three inches of the ends.
- A limited number of pieces with no tongue admitted.

MAPLE, SOFT *(Acer spp.)*

Includes the two common species of soft maple: *A. saccharinum* and *A. rubrum*.



© 2023 NATIONAL WOOD FLOORING ASSOCIATION

FAMILY: Aceraceae (maple)

OTHER COMMON NAMES: Red maple, scarlet maple, water maple, swamp maple, silver maple.

APPEARANCE/COLOR: The heartwood can be a dark reddish-brown, and is slightly darker in overall color than hard maple, with more brown, red, or grey streaks throughout. The sapwood can be greyish-white to creamy-yellow. All types of maple can have a broad range in color variation.

PHOTOSENSITIVITY: Low. Slightly ambers with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain is closed, but generally is straight, with a fine, even texture. The grain also can be figured.

HARDNESS (JANKA): Averages 950 lbf

AVERAGE DRIED WEIGHT: 38 lbs/ft^3 (610 kg/m^3)

SPECIFIC GRAVITY: Averages 0.54 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 7.2% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00252 (tangential)

TOXICITY/ALLERGIES: Can cause respiratory irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, with a moderate dulling effect on cutting edges. Responds well to bending. No known concerns with nailing, when the compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Sands very easily following the standard grit progression sequence. A softer species that can show sander marks more than other species. Reduce the drum pressure on the belt sander to avoid removal of too much material on each pass. May require a higher grit abrasive on the final passes than with other species. Accepts stains well, but can appear uneven based on graining in the individual boards. Takes finishes nicely, with no known concerns.

SUSTAINABILITY: This wood species is not listed in the CITES Appendices, nor on the IUCN Red List.

Distinguishing Hard Maple from Soft Maple

Generally speaking, maple species can be placed into one of two categories: Hard maple and soft maple. The maple group contains nearly 150 species. Hard maple used in the wood flooring industry normally includes sugar maple (*Acer saccharum*) and black maple (*Acer nigrum*). Soft maple used in the wood flooring industry normally includes silver maple (*Acer saccharinum*), red maple (*Acer rubrum*), and bigleaf maple (*Acer macrophyllum*).

Growth Ring Differences:

Hard maple grows at a slower rate than soft maple. Because of this, the growth rings on hard maple will normally be tighter than the growth rings on a soft maple board.

Color Differences:

Hard maple usually has a lighter, more uniformed color, while soft maple is typically darker, sometimes carrying hues of brown, red, or even grey. All types of maple can have a broad range in color variation.

Weight:

Hard maple boards often are heavier than soft maple boards.

Testing:

By dabbing a small amount of iron sulfate to the maple board, you will get one of two reactions. On a hard maple board, iron sulfate will create a pale blue or green coloration on the board. On a soft maple board, the chemical will turn dark blue to black in color. This test only differentiates hard maple from some soft maple species, but not all. For example, bigleaf maple and black maple may give false negative results.

MESQUITE *(Prosopis juliflora)*

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

FAMILY: Fabaceae or Leguminosae (legume)

OTHER COMMON NAMES: Honey locust, honey mesquite, ironwood, algarroba Texas ironwood.

APPEARANCE/COLOR: The heartwood can be a deep and rich golden- to reddish- or chocolate-brown. The sapwood can be pale to yellowish/white to lemon-colored.

PHOTOSENSITIVITY: Low. Slightly darkens with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain is open, ranging from straight to wavy. The texture is fine to medium. In the quartersawn cut, the face displays narrow to wider rays. The wood may display ingrown bark and mineral streaks.

HARDNESS (JANKA): Averages 2,345 lbf

AVERAGE DRIED WEIGHT: 50 lbs/ft^3 (800 kg/m^3)

SPECIFIC GRAVITY: Averages 0.86 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 3.2% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Above average

DIMENSIONAL CHANGE COEFFICIENT: 0.00129 (tangential)

TOXICITY/ALLERGIES: Can cause skin irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, with a moderate dulling effect on cutting edges. It is recommended to adjust the compressor psi, and use 18 gauge cleats to avoid splitting. Glue adheres well, with no known issues.

SAND/FINISH: Sands satisfactorily when following the standard grit progression sequence. It may require a higher grit abrasive on the final passes than with other species to minimize visible scratches. Can be brought to a smooth finish, but does not take stains consistently. No known concerns with finishes.

SUSTAINABILITY: This wood species is not listed in the CITES Appendices, nor on the IUCN Red List.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

OAK, RED *(Quercus rubra)*

There are several species of oak that share many similar characteristics including: pin oak (*Q. palustris*), black oak (*Q. velutina*), southern red (*Q. falcata*), cherrybark (*Q. falcatavar*), scarlet oak (*Q. coccinea*), laurel oak (*Q. laurifolia*), willow oak (*Q. phellos*), and others.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

FAMILY: Fagaceae (beech)

OTHER COMMON NAMES: American red oak, northern red oak, southern red oak.

APPEARANCE/COLOR: Heartwood is light biscuit- to medium-brown with a reddish to pinkish cast. White to light brown sapwood isn't always sharply demarcated from the heartwood. Red oak can have a broad range in color variation.

PHOTOSENSITIVITY: Low. Lightens with age and exposure to sunlight and oxygen.

GRAIN: Ring-porous. Grain is straight, open, and medium to coarse, with an uneven texture. With quartersawn wood, there is less-pronounced figure and smaller rays than with white oak. Depending on the origin of the tree and variation in growing seasons, northern red oaks tend to have a tighter, more-uniform grain pattern than southern grown red oaks.

HARDNESS (JANKA): Averages 1,290 lbf

AVERAGE DRIED WEIGHT: 44 lbs/ft^3 (700 kg/m^3)

SPECIFIC GRAVITY: Averages 0.63 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, northern red oak may shrink up to 8.6% (tangential) of its given width, while southern red oak may shrink up to 11.3% of its given width.

DIMENSIONAL STABILITY IN-USE:

- Northern red oak = average
- Southern red oak = below average

DIMENSIONAL CHANGE COEFFICIENT:

- Northern Red Oak = 0.00369 (tangential)
- Southern Red Oak = 0.00350 (tangential)

TOXICITY/ALLERGIES: Reported as a sensitizer. Can cause skin, eye, nose, and respiratory irritations, as well as nasopharyngeal cancer.

INSTALLATION: Cuts, routs, planes, and shapes well, with a moderate dulling effect on cutting edges. Responds well to bending. No known concerns with nailing, when the compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Sands satisfactorily when following the standard grit progression sequence. Accepts stains and finishes very nicely, with no known concerns.

SUSTAINABILITY: This wood species is not listed in the CITES Appendices, nor on the IUCN Red List.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

NWFA/NOFMA Clear Red Oak

NWFA/NOFMA Select Red Oak

NWFA/NOFMA No. 1 Common Red Oak

NWFA/NOFMA No. 2 Common Red Oak

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

RED OAK GRADING RULES

NWFA/NOFMA Clear Red Oak

- A flooring product of mostly heartwood with a minimum number of character marks and discoloration, providing a uniform appearance while allowing for all heartwood natural color variations.
- Will admit the following:
  - 3/8" (.3750") (9.53 mm) wide bright sapwood entire length of the piece or equivalent if not more than 1" (25.4 mm) wide for 1/3 the length of piece.
  - Small burls and fine pin worm holes.
  - Equivalent characters such as small tight checks.
  - In the absence of these, one thin brown streak 3" (76.2 mm) long to be allowed every 6' (1828.8 mm) of piece.

NWFA/NOFMA Select Red Oak

- A flooring product with coloration variations produced by differences of natural heartwood and sapwood, along with characters described.
- Will admit the following:
  - Unlimited sound sapwood.
  - Slight imperfections in milling.
  - One small tight knot every 3' (914.4 mm) of piece.
  - Pin worm holes.
  - Burls and a reasonable amount of slightly open checks.
  - Brown streaks should not extend the entire length of a piece.
  - Two flag worm holes to every 8' (2438.4 mm) of the piece.
  - Slight imperfections in face work (torn grain).
  - An intermittent, brown machine burn across the face not exceeding 1/4" (.250") (6.35 mm) in width.
  - A slight quantity of bark on the back or sides.
  - Pieces with one-half (1/2) tongue, full length of the piece.
- Spot filling generally is required for open characters.

NWFA/NOFMA No. 1 Common Red Oak

- A flooring product that contains prominent variations in coloration and varying characters.
- Will admit the following:
  - Varying wood characteristics, such as flag worm holes, heavy streaks, checks, and worm holes.
  - Minor imperfections in machining.
  - Sticker stain.
  - An occasional dark machine burn across the face not exceeding 1/2" (.500") (12.7 mm) wide, 1/64" (.0156") (.40 mm) deep, and not more than two (2) to every 3' (914.4 mm) of length.
  - One-quarter (1/4) tongue, full length of the piece.
- Will not admit the following:
  - Broken knots exceeding 1/2" (.500") (12.7 mm) in diameter.
  - Large grub worm holes.
  - Splits extending through the piece.
  - Open characters such as checks and knot holes that are not sound and cannot be filled readily.
  - More than 20" (508 mm) scant stock in thickness for every 5' (1524 mm) of length.
  - Extremely dark pieces.

NWFA/NOFMA No. 2 Common Red Oak

- May contain sound natural variations of the forest product and manufacturing imperfections.
- The purpose of this grade is to furnish a floor suitable for homes, general utility use, or where character marks and contrasting appearance is desired.
- Will admit the following:
  - Knot holes and open characters that will fill readily.
  - Occasional scant thickness (hit or miss) on the back of the flooring board the entire length of the piece, providing there is full bearing across the board at some point within 3" of the ends.
  - A limited number of pieces with no tongue.
- Will not admit the following:
  - Shattered or rotten ends, large broken knots, excessive bad millwork, shake, advanced rot, and similar unsound defects.
  - Dark machine burns exceeding 3/64" (.0469") (1.19 mm) deep.

NWFA/NOFMA 1 1/4' (15") (381 mm) Shorts Red Oak

- Pieces 9" (228.6 mm) to 18" (457.2 mm) long may be bundled together and designated as NWFA/NOFMA 1 1/4' (15") (381 mm) Shorts.
- Pieces in Shorts bundles are graded using the same grading rules as pieces in standard bundles.
- Product can be graded and bundled as Clear, Select, No. 1 Common, No. 2 Common, or in combination grades (i.e., No 1 Common and Better).
- The average board length minimum standard for NWFA/NOFMA 1 1/4' (15") (381 mm) Shorts is 15" (381 mm), regardless of the width or grade of the product.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

OAK, WHITE *(Quercus alba)*

There are several species of oak that share many similar characteristics including: chestnut oak (*Q. prinus*), bur oak (*Q. macrocarpa*), post oak (*Q. stellate*), swamp oak (*Q. bicolor*), live oak (*Q. virginiana*), overcup oak (*Q. lyrata*), Oregon white oak (*Q. garryana*), English oak (*Q. robur*), and others.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

FAMILY: Fagaceae (beech)

OTHER COMMON NAMES: Eastern white oak, Arizona oak, stave oak, ridge white oak.

APPEARANCE/COLOR: The heartwood can vary from light, to medium brown, to pale yellow-brown or dark pale-brown, commonly with an olive cast. White to light brown sapwood isn't always demarcated from the heartwood. White oak can have a broad range in color variation.

PHOTOSENSITIVITY: Low. Lightens with age and exposure to sunlight and oxygen.

GRAIN: Ring-porous. The grain is straight, open, and medium to coarse in texture. With quartersawn wood, long, prominent ray patterns are common.

HARDNESS (JANKA): Averages 1,360 lbf

AVERAGE DRIED WEIGHT: 47 lbs/ft^3 (755 kg/m^3)

SPECIFIC GRAVITY: Averages 0.68 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 10.5% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Below average

DIMENSIONAL CHANGE COEFFICIENT: 0.00365 (tangential)

TOXICITY/ALLERGIES: Reported as a sensitizer. Can cause skin, eye, nose, and respiratory irritations, as well as nasopharyngeal cancer.

INSTALLATION: Cuts, routs, planes, and shapes well, with a moderate dulling effect on cutting edges. Responds well to bending. No known concerns with nailing, when the compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Sands satisfactorily when following the standard grit progression sequence. Accepts stains and finishes very nicely, with no known concerns. Tannic acid, very prominent in white oak, can react with some liquids. This often is used intentionally to create unique customized effects, but also can cause unintentional consequences with some types of finishes.

SUSTAINABILITY: This wood species is not listed in the CITES Appendices, nor on the IUCN Red List.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

NWFA/NOFMA Clear White Oak

NWFA/NOFMA Select White Oak

NWFA/NOFMA No. 1 Common White Oak

NWFA/NOFMA No. 2 Common White Oak

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

WHITE OAK GRADING RULES

NWFA/NOFMA Clear White Oak

- A flooring product of mostly heartwood with a minimum number of character marks and discoloration, providing a uniform appearance while allowing for all heartwood natural color variations.
- Will admit the following:
  - 3/8" (.3750") (9.53 mm) wide bright sapwood entire length of the piece or equivalent if not more than 1" (25.4 mm) wide for 1/3 the length of piece.
  - Small burls and fine pin worm holes.
  - Equivalent characters such as small tight checks.
  - In the absence of these, one thin brown streak 3" (76.2 mm) long to be allowed every 6' (1828.8 mm) of piece.

NWFA/NOFMA Select White Oak

- A flooring product with coloration variations produced by differences of natural heartwood and sapwood, along with characters described.
- Will admit the following:
  - Unlimited sound sapwood.
  - Slight imperfections in milling.
  - One small tight knot every 3' (914.4 mm) of piece.
  - Pin worm holes.
  - Burls and a reasonable amount of slightly open checks.
  - Brown streaks that do not extend the entire length of a piece.
  - Two flag worm holes to every 8' (2438.4 mm) of the piece.
  - Slight imperfections in face work (torn grain).
  - An intermittent, brown machine burn across the face not exceeding 1/4" (6.35 mm) in width.
  - A slight quantity of bark on the back or sides.
  - Pieces with one-half (1/2) tongue, full length of the piece.
- Spot filling generally is required for open characters.

NWFA/NOFMA No. 1 Common White Oak

- A flooring product that contains prominent variations in coloration and varying characters.
- Will admit the following:
  - Varying wood characteristics, such as flag worm holes, heavy streaks, checks, and worm holes.
  - Minor imperfections in machining.
  - Sticker stain.
  - An occasional dark machine burn across the face not exceeding 1/2" (.500") (12.7 mm) wide, 1/64" (.0156") (.40 mm) deep, and not more than two (2) to every 3' (914.4 mm) of length.
  - One-quarter (1/4) tongue, full length of the piece.
- Will not admit the following:
  - Broken knots exceeding 1/2" (.500") (12.7 mm) in diameter.
  - Large grub worm holes.
  - Splits extending through the piece.
  - Open characters such as checks and knot holes that are not sound and cannot be filled readily.
  - More than 20" (508 mm) scant stock in thickness for every 5' (1524 mm) of length.
  - Extremely dark pieces.

NWFA/NOFMA No. 2 Common White Oak

- May contain sound natural variations of the forest product and manufacturing imperfections.
- The purpose of this grade is to furnish a floor suitable for homes, general utility use, or where character marks and contrasting appearance is desired.
- Will admit the following:
  - Knot holes and open characters that will fill readily.
  - Occasional scant thickness (hit or miss) on the back of the flooring board the entire length of the piece, providing there is full bearing across the board at some point within 3" of the ends.
  - A limited number of pieces with no tongue.
- Will not admit the following:
  - Shattered or rotten ends, large broken knots, excessive bad millwork, shake, advanced rot, and similar unsound defects.
  - Dark machine burns exceeding 3/64" (.0469") (1.19 mm) deep.

NWFA/NOFMA 1 1/4' (15") (381 mm) Shorts White Oak

- Pieces 9" (228.6 mm) to 18" (457.2 mm) long may be bundled together and designated as NWFA/NOFMA 1 1/4' (15") (381 mm) Shorts.
- Pieces in Shorts bundles are graded using the same grading rules as pieces in standard bundles.
- Product can be graded and bundled as Clear, Select, No. 1 Common, No. 2 Common, or in combination grades (i.e., No. 1 Common and Better).
- The average board length minimum standard for NWFA/NOFMA 1 1/4' (15") (381 mm) Shorts is 15" (381 mm), regardless of the width or grade of the product.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

Distinguishing Red Oak from White Oak

Generally speaking, oak species can be placed into one of two categories: red oak or white oak. When purchasing red or white oak flooring, you actually may not be purchasing Quercus rubra or Quercus alba, but instead, you may be purchasing one of the oaks contained within the two broad red and white groupings. The red oak group contains several species of oak that share many similar characteristics, just as the white oak group contains several species of oak that share many similar characteristics. The general red oak group will share a similar pinkish cast, while the general white oak group will share a similar olive-colored cast.

Telling the difference between the two can be challenging. The following are a few identifiers to look for:

Color Differences (both red oak and white oak can have a broad range in color variation):

- Red oak color has more salmon, pink, and red undertones. Red oak heartwood is a light biscuit- to medium-brown with a reddish to pinkish cast. White to light-brown sapwood isn't always sharply demarcated from the heartwood.
- White oak tends to be a bit darker and has more beige, olive, and brownish hues. White oak heartwood can vary from light, to medium-brown, to pale yellow-brown or dark pale-brown, commonly with an olive cast. White to light brown sapwood isn't always demarcated from the heartwood.

Differentiating northern from southern oak:

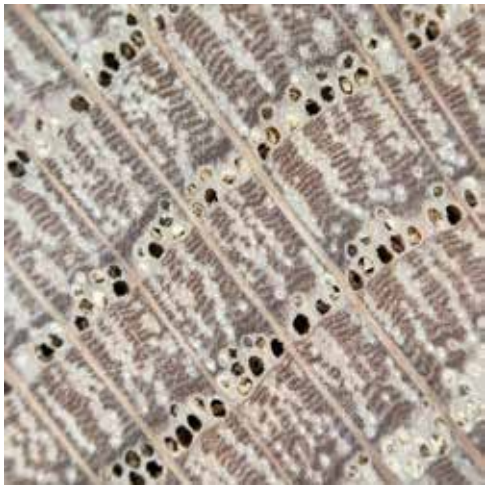
- Red oak: The colors in southern red oak can range from a very pronounced brown all the way to a light wheat color, and include both darker reds and lighter pinks. Southern red oak grows faster than Appalachian or northern, so it will have a wider, more pronounced grain pattern as the growth rings are much larger due to the longer growing season. Appalachian red oak can range from darker reds to pink to wheat. There are areas of the Appalachian region where the timber grows in soils above coal and oil producing areas where the volume of mineral streaks can be more prominent. The growth ring density is higher in Appalachian red oak as the growing season is shorter. Northern red oak is light red to pink, with the occasional wheat colored board, and offers more color consistency. Because of the short growing season, the grain is most consistent in true northern red oak flooring.
- White oak: The regional differences in white oak are less pronounced than in red oak. Southern white oak typically is darker and has more color variation. Appalachian white oak and northern white oak generally have very little difference in color consistency. The same fast-to-slow growth grain concerns are present in white oak, but are not nearly as pronounced as in red oak.

Differentiating red oak from white oak:

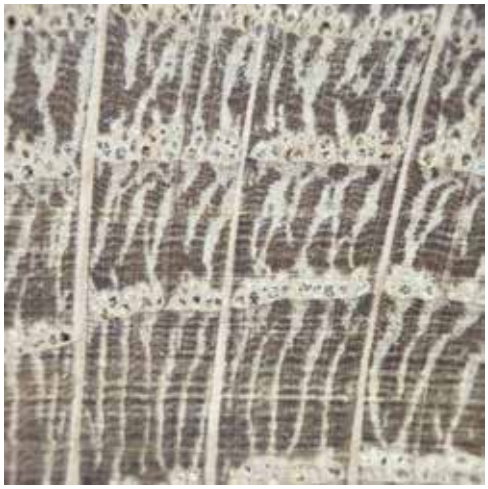
- A quick and fairly reliable way to tell red oak from white oak is simply by looking at the endgrain. When viewing the endgrain, the large earlywood pores found in red oak are open and empty. The pores of white oaks are plugged with tyloses. The presence of tyloses is perhaps the best and most reliable way to distinguish the two oaks from one another. Tyloses is why white oak works so well for wine and whiskey barrels. When viewing the endgrain, make sure that you're viewing the heartwood of the board in question. While white oak has abundant tyloses in the heartwood, it frequently is lacking in the sapwood section.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

Red Oak

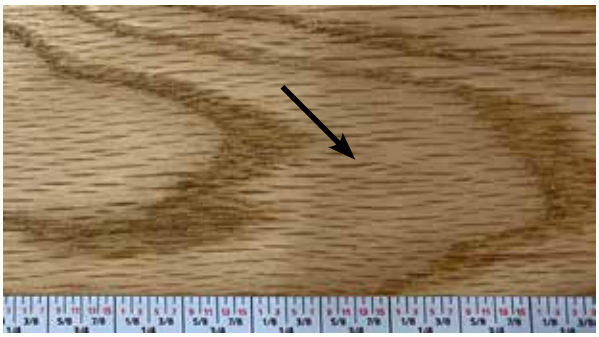


White Oak

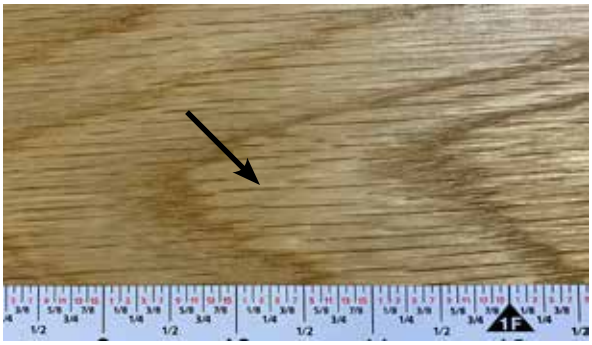


- When the endgrain is not available to view, you also can view the surface of plainsawn boards to identify whether it is red or white oak. The length of the rays will help in identification. Red oak almost always will have very short rays, usually between 1/8″ to 1/2″ long. White oak almost always has longer rays, frequently greater than 3/4″. White oak has a prominent ray fleck pattern in the quartersawn cut.

Red Oak



White Oak



- You also can distinguish red oak from white oak chemically. Sodium nitrite (NaNO2) as a reagent in a 10% solution of water, when applied to the heartwood of oak, will quickly distinguish red oak from white oak. Red oak will change color only slightly, and may produce a slight brown discoloration, where the heartwood of white oak will change color much more dramatically, turning a deep grey-to-black color.

White Oak Red Oak

PINE, EASTERN WHITE *(Pinus strobus)*

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

FAMILY: Pinaceae (pine)

OTHER COMMON NAMES: White pine, soft pine, northern white pine, Weymouth pine.

APPEARANCE/COLOR: The heartwood can be light brown with a slightly reddish tinge. The sapwood can be nearly white to a light yellow color.

PHOTOSENSITIVITY: Low-to-Moderate. Slightly ambers with age and exposure to sunlight and oxygen.

GRAIN: The grain normally is straight, with a uniform medium texture. The growth rings are inconspicuous.

HARDNESS (JANKA): Averages 380 lbf

AVERAGE DRIED WEIGHT: 25 lbs/ft^3 (400 kg/m^3)

SPECIFIC GRAVITY: Averages 0.35 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 6.1% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00212 (tangential)

TOXICITY/ALLERGIES: Can cause skin, nose, and respiratory irritations.

INSTALLATION: Very soft wood to work with, and can bruise easily. Cuts, routs, planes, and shapes well, with only a slight dulling effect on cutting edges, but pitch can build quickly, reducing the blade's ability to make clean cuts. Responds well to bending. No known concerns with nailing, when the compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Sands very easily following the standard grit progression sequence. It is an extremely soft wood that cuts very easily with higher grit abrasives. Reduce the drum pressure on the belt sander to avoid removal of too much material on each pass. The high resin and sap content can clog paper easily, requiring the use of more abrasives than other species. Age, and sun-related color change can run deep into the wood, and normally cannot be sanded out.

Accepts stains well, but can appear uneven based on graining in the individual boards. Finishes very nicely, with no known concerns.

SUSTAINABILITY: Eastern white pine is not listed in the CITES appendices, and is reported by the IUCN Red List as a species of Least Concern.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

PINE, SOUTHERN YELLOW *(Pinus spp.)*

Includes the four common species of southern yellow pine: longleaf pine (*P. palustris*), loblolly pine (*P. taeda*), shortleaf pine (*P. echinata*), and slash pine (*P. elliottii*).

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

Southern Yellow Pine

Heartpine

FAMILY: Pinaceae (pine)

OTHER COMMON NAMES: Southern yellow pines are part of a more-broad grouping of pine within the Pinus genus. When just the heartwood is used from the longleaf pine, it commonly is referred to as heartpine. Antique heartpine is from old-growth trees, and normally reclaimed from older material due to the lack of standing inventory today.

APPEARANCE/COLOR: The heartwood is known for its deep reddish-brown to orange colors. The sapwood is yellowish-white to tan. The sapwood usually is predominant in newer growth/younger plantation southern yellow pines, whereas the heartwood normally begins to form when the tree is about 20 years old. In older (200+ year old), slower-growth southern yellow pine trees, the heartwood can average more than 65% heartwood. This is referred to as "heartpine." The color can vary based on the age of the tree.

PHOTOSENSITIVITY: Moderate. Ambers with age and exposure to sunlight and oxygen. Yellows become more yellow and reds become more red.

GRAIN: The marked contrast between earlywood and latewood clearly is shown in the growth rings. The grain is closed, with high figuring. Grain patterns can range from clear and straight in flatsawn materials, to very linear and tight in vertical grain or bastard-sawn materials. The growth rings according to the 1904 standards were at least 8 growth rings per inch on average. By the time the 1924 standards were published, the growth rings were to be at least 6 per inch on average. The older, reclaimed heartpine can have twice that density.

HARDNESS (JANKA):

- Longleaf pine averages 870 lbf
- Heartpine averages 1,225 lbf

AVERAGE DRIED WEIGHT: 41 lbs/ft^3 (650 kg/m^3)

SPECIFIC GRAVITY: Averages 0.59 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 7.5% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00263 (tangential)

TOXICITY/ALLERGIES: Can cause skin and respiratory irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, with only a slight dulling effect on cutting edges, but pitch can build quickly (especially with heartpine), reducing the blade's ability to make clean cuts. Responds well to bending. No known concerns with nailing, when the compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Sands very easily following the standard grit progression sequence. It is a softer wood that cuts very easily with higher grit abrasives. Reduce the drum pressure on the belt sander to avoid removal of too much material on each pass. The high resin and sap content can clog paper easily, requiring the use of more abrasives than other species. Heartpine can have a higher resin content that may require starting at a lower grit, and on a steeper angle for the first cuts. Age and sun-related color change can run deep into the wood, and normally cannot be sanded out. Accepts stains well, but can appear uneven based on graining in the individual boards. Finishes very nicely, but may take extended dry times.

SUSTAINABILITY: Longleaf pine is not listed in the CITES Appendices, but is reported by the IUCN Red List as Vulnerable.

WALNUT, BLACK *(Juglans nigra)*

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

FAMILY: Juglandaceae (walnut)

OTHER COMMON NAMES: American black walnut, gunwood, Virginia walnut, eastern walnut.

APPEARANCE/COLOR: The heartwood ranges from light greyish-brown to dark chocolate-brown or even purplish-black. The nearly white to yellowish-grey or tan sapwood clearly is demarcated from the heartwood. The sapwood can be darkened slightly through a steaming process used during manufacturing.

PHOTOSENSITIVITY: Moderate-to-High. Lightens with age and exposure to sunlight and oxygen.

GRAIN: Semi-ring-porous. The grain normally is straight and open. It also can be irregular, curly, or wavy. Burls, crotches, and knots add the unique characteristics walnut often is known for.

HARDNESS (JANKA): Averages 1,010 lbf

AVERAGE DRIED WEIGHT: 41 lbs/ft^3 (655 kg/m^3)

SPECIFIC GRAVITY: Averages 0.55 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 7.8% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00274 (tangential)

TOXICITY/ALLERGIES: Reported as a sensitizer. Can cause skin, eye, and respiratory irritations, as well as nasopharyngeal cancer.

INSTALLATION: Cuts, routs, planes, and shapes well, with only a slight dulling effect on cutting edges. Responds well to bending. No known concerns with nailing, when the compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Sands very easily following the standard grit progression sequence. A softer species that can show sander marks more than other species. Reduce the drum pressure on the belt sander to avoid removal of too much material on each pass. May require a higher grit abrasive on the final passes than with other species. Accepts stains well, and often is applied to minimize long-term effects of the inherent lightening properties walnut is prone to. Takes finishes nicely, with no known concerns.

SUSTAINABILITY: This wood species is not listed in the CITES Appendices, nor on the IUCN Red List.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

NWFA/NOFMA Clear Walnut

NWFA/NOFMA Select Walnut

NWFA/NOFMA No. 1 Common Walnut

NWFA/NOFMA No. 2 Common Walnut

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

WALNUT GRADING RULES

NWFA/NOFMA Clear Walnut

- A flooring product selected for its dark rich coloration and minimal character marks. The face is 100% true heartwood coloration.
- Will admit the following:
  - One (1) small tight knot up to 1/4" (.250") (6.35mm) in diameter every 3' (914.4 mm) of length.
  - Small tight checks.
  - A minimal number of slight edge defects (indentations).
  - Small burls and fine unstained pinworm holes or a thin brown streak 3" (76.2 mm) long in 2' (609.3 mm) of length.
  - Three-quarters (3/4) tongue, full length of the piece.

NWFA/NOFMA Select Walnut

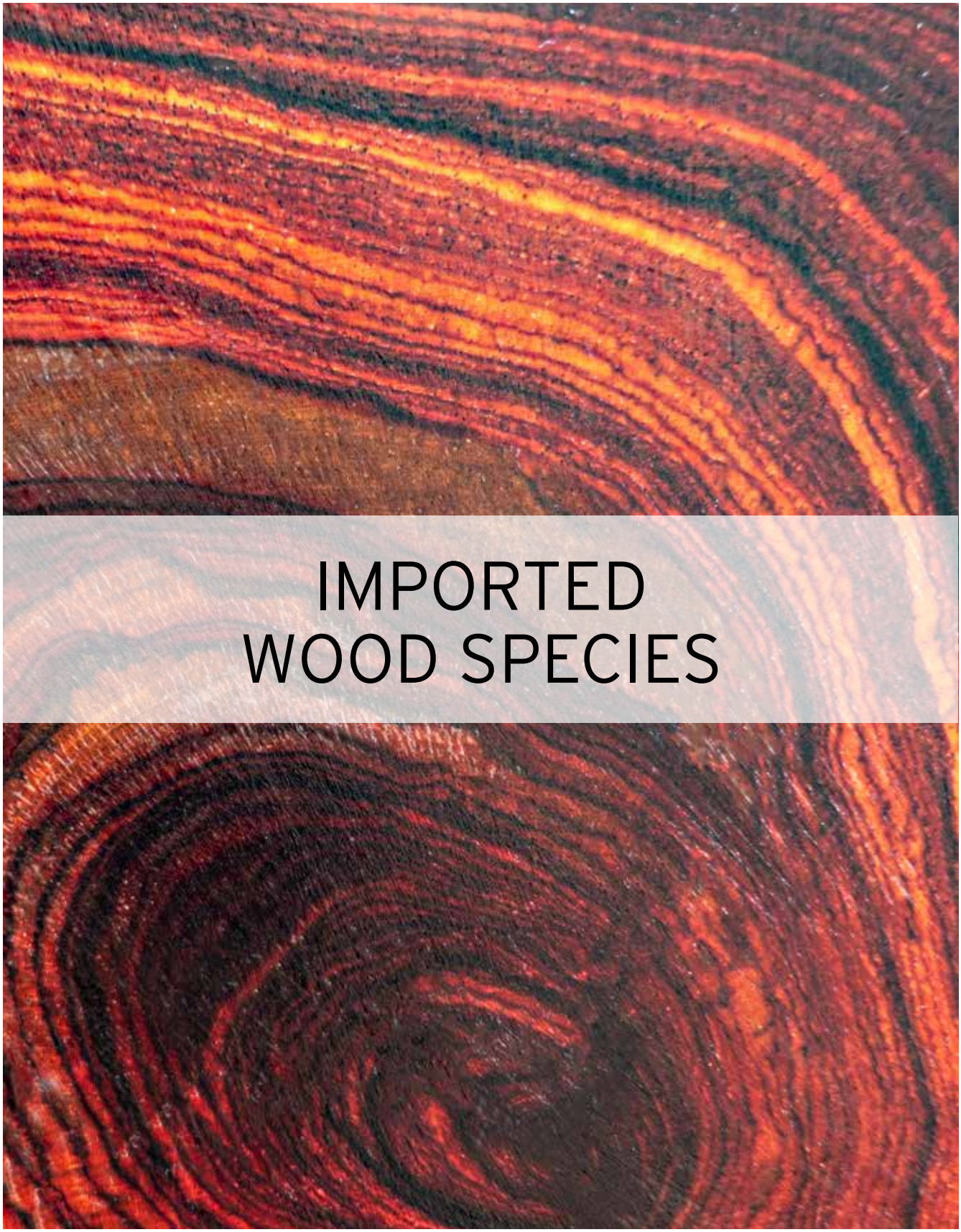
- A flooring product with natural coloration variations found in heartwood and steamed dark sapwood. The steamed sapwood should not show a prominent color contrast to the heartwood.
- Will admit the following:
  - Broken knots up to 3/8" (.375") (9.53 mm) in diameter with no loose pieces
  - Narrow slightly open checks.
  - Edge defects (indentations) up to 1/16" (.0625") (1.59 mm) wide x 1/2" (.500") (12.7 mm) long in aggregate for every 2' (609.6 mm) of length.
  - Intermittent machine burn.
  - Torn grain (must sand out).
  - Pinworm holes two (2) per foot (304.8 mm) of length and/or two (2) flag worm holes per 8' (2438.4 mm) of length.
  - A slight amount of scant thickness where ends are full thickness.
  - One-half (1/2) tongue, full length of the piece.

NWFA/NOFMA No. 1 Common Walnut

- A flooring product that may contain prominent color variation between the light sapwood and dark heartwood, along with prominent natural and machine-produced characters.
- Will admit the following:
  - Broken knots, if the unsound open area does not extend through the piece.
  - Numerous checks up to 1/16" (.0625") (1.59 mm) wide.
  - Edge defects (indentations) up to 3/32" (.09375") (2.38 mm) wide x 1 1/2" (38.1 mm) long, in aggregate for every 3' (914.4 mm) of length.
  - Occasional solid machine burns.
  - Rough face showing minor saw marks.
  - Heartwood coloration must be 25% of piece.
  - Sapwood may be stained, blotchy, or speckled.
  - Worm holes up to 1/8" (.125") (3.18 mm) in diameter, one (1) per foot (304.8 mm) of length.
  - Pin worm holes up to six (6) per foot (304.8 mm) of length.
  - Small area of torn grain to 1/16" (.0625") (1.59 mm) deep.
  - Up to 20" (508 mm) of scant stock (hit or miss) per 5' (1524 mm) of length and have full thickness within 3" (76.2 mm) of ends.
  - One-quarter (1/4) tongue, full length of the piece.

NWFA/NOFMA No. 2 Common Walnut

- A flooring product that contains sound, natural variations and manufacturing imperfections of the forest product. All imperfections and open characters must be fillable.
- Will admit the following:
  - Knots and knot holes where openings do not extend through piece.
  - Edge defect 1/4" (.250") (6.35 mm) wide x 1/4" (.250") (6.35 mm) wide if irregular and will hold filler, not to extend in depth through the tongue and groove engagement.
  - Dark machine burns not more than 3/64" (.0469") (1.19 mm) deep.
  - Prominent open checks not extending through piece.
  - Incipient decay that is not softer than surrounding wood.
  - A small unplaned area radiating saw marks.
  - Split ends with no movement across the split.
  - An area of torn grain up to 1/8" (.125") (3.18 mm) deep x 3" (76.2 mm) in length for the full width of the piece permitted for every 2' (609.6 mm) in length.
  - Angled grub worm holes 3/16" (.1875") (4.76 mm) wide x 1/2" (.500") (12.7 mm) long, along with all other worm holes if sound.
  - Unlimited sapwood.
  - Occasional scant thickness (hit or miss) on the back of the flooring board the entire length of the piece, providing there is full bearing across the board at some point within three inches of the ends.
  - A limited number of pieces with no tongue.



IMPORTED WOOD SPECIES

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

ACACIA, BIG LEAF *(Acacia mangium)*

FAMILY: Fabaceae or Leguminosae (legume)

OTHER COMMON NAMES: Long-leaf acacia, black wattle, hickory wattle, brown salwood.

APPEARANCE/COLOR: The heartwood can appear olive-brown to gray-brown, with darker streaks. The sapwood is narrow and pale yellow to light brown.

PHOTOSENSITIVITY: Low-to-Moderate. Slightly ambers with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain is interlocked, but appears straight on the plainsawn surface. The texture is medium.

HARDNESS (JANKA): Averages 1,430 lbf

AVERAGE DRIED WEIGHT: 36 lbs/ft^3 (585 kg/m^3)

SPECIFIC GRAVITY: Averages 0.59 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 7.8% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: Unknown

TOXICITY/ALLERGIES: Can cause skin and respiratory irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, with only minimal dulling effect on cutting edges. No known concerns with nailing, when the compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Sands very easily following the standard grit progression sequence. Accepts stains and finishes very nicely, with no known concerns.

SUSTAINABILITY: Big leaf acacia is not listed in the CITES Appendices, and is reported by the IUCN Red List as a species of Least Concern.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

ACACIA, SHORT LEAF *(Acacia confusa)*

FAMILY: Fabaceae or Leguminosae (legume)

OTHER COMMON NAMES: Small-leaf acacia, acacia walnut, Asian walnut, Formosa koa, acacia petit.

APPEARANCE/COLOR: The heartwood can be dark to light brown with pinkish-red tones. Sapwood can be whitish-gray to light yellow, and clearly is demarcated.

PHOTOSENSITIVITY: Low-to-Moderate. Slightly darkens with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain is interlocked, with a moderately fine and uniform texture.

HARDNESS (JANKA): Averages 2,200 lbf

AVERAGE DRIED WEIGHT: 52 lbs/ft^3 (840 kg/m^3)

SPECIFIC GRAVITY: Averages 0.73 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 7.0% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: Unknown

TOXICITY/ALLERGIES: Can cause skin and respiratory irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, with only minimal dulling effect on cutting edges. No known concerns with nailing, when the compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Sands very easily following the standard grit progression sequence. Accepts stains and finishes very nicely, with no known concerns.

SUSTAINABILITY: Short leaf acacia is not listed in the CITES Appendices, and is reported by the IUCN Red List as a species of Least Concern.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

AMENDOIM *(Pterogyne nitens)*

FAMILY: Fabaceae or Leguminosae (legume)

OTHER COMMON NAMES: Brazilian oak, Pau fava.

APPEARANCE/COLOR: The heartwood is a light to medium reddish-brown, sometimes with darker stripes. The sapwood is pale yellowish-brown and isn't always clearly distinguished from heartwood.

PHOTOSENSITIVITY: Moderate. Slightly darkens with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain is straight to interlocked, with a medium texture.

HARDNESS (JANKA): Averages 1,780 lbf

AVERAGE DRIED WEIGHT: 50 lbs/ft^3 (800 kg/m^3)

SPECIFIC GRAVITY: Averages 0.80 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 6.0% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: Unknown

TOXICITY/ALLERGIES: Can cause skin and respiratory irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, but can have a dulling effect on cutting edges due to a naturally high silica content. Responds well to steam-bending. No known concerns with nailing, when the compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Sands very easily following the standard grit progression sequence. Accepts stains and finishes very nicely, with no known concerns.

SUSTAINABILITY: Amendoim is not listed in the CITES Appendices, but is reported by the IUCN as being Near Threatened.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

ANDIROBA *(Carapa guianensis)*

FAMILY: Meliaceae (mahogany)

OTHER COMMON NAMES: Crabwood, royal mahogany, carapa.

APPEARANCE/COLOR: The heartwood is pale reddish-brown to dark brown. Sapwood is a lighter pink or pale brown, not demarcated clearly from heartwood. Quartersawn surfaces with interlocked grain can exhibit a ribbon-like appearance.

PHOTOSENSITIVITY: Moderate. Slightly darkens to a medium to dark brown with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain is uniform, straight, and sometimes wavy or interlocked. It has a fine to medium texture.

HARDNESS (JANKA): Averages 1,220 lbf

AVERAGE DRIED WEIGHT: 41 lbs/ft^3 (660 kg/m^3)

SPECIFIC GRAVITY: Averages 0.57 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 7.6% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00274 (tangential)

TOXICITY/ALLERGIES: Can cause skin, eye, and respiratory irritation.

INSTALLATION: Can be challenging to work with due to its density. Moderate dulling effect on cutting edges. Grain tear-out can occur with figured-grain. It is important to move slow when cutting, routing, planing, or shaping this species. The hardness of this species makes it difficult to drive a fastener through. The air compressor psi will need to be adjusted to avoid tongue splitting, and to ensure adequate seating in the nailing pocket. 18 gauge cleats work best when nailing this wood. Glue adheres well, with no known issues.

SAND/FINISH: Can be challenging to sand due to its density, and requires extra caution with grit progression sequence. May require a higher grit abrasive on the final passes than with other species. Accepts stains and finishes very nicely, with no known concerns.

SUSTAINABILITY: Andiroba is not listed in the CITES Appendices, and is reported by the IUCN Red List as being a species of Least Concern.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

AUSTRALIAN CYPRESS *(Callitris glaucophylla)*

FAMILY: Cupressaceae (cypress)

OTHER COMMON NAMES: White cypress pine, coast cypress pine, sand cypress.

APPEARANCE/COLOR: The heartwood can be a honey-gold to brown with dark brown longitudinal streaks and darker knots throughout. The sapwood varies from pale straw to pinkish-tan.

PHOTOSENSITIVITY: Low. Slightly ambers with age and exposure to sunlight and oxygen.

GRAIN: The grain usually is straight. The texture is rather fine and lustrous with a greasy feel. It usually has many tight, small, dark brown knots throughout.

HARDNESS (JANKA): Averages 1,360 lbf

AVERAGE DRIED WEIGHT: 41 lbs/ft^3 (650 kg/m^3)

SPECIFIC GRAVITY: Averages 0.59 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 2.8% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Above average

DIMENSIONAL CHANGE COEFFICIENT: 0.00162 (tangential)

TOXICITY/ALLERGIES: Can cause skin, eye, nose, and respiratory irritations, as well as less-common effects such as boils and swelling.

INSTALLATION: Moderate dulling effect on blades, but pitch will build-up quickly, reducing the blade's ability to make clean cuts. Very brittle species and has a tendency to fracture or split when nailing. It is recommended to adjust the compressor psi, and use 18 gauge cleats to avoid splitting. The oils in this species may adversely affect how well adhesives will bond to the wood. It may be necessary to tack with a solvent (denatured alcohol) or slightly roughen the surface, prior to applying adhesive.

SAND/FINISH: Sands very easily following the standard grit progression sequence. Reduce the drum pressure on your belt sander to avoid removal of too much material on each pass. The high resin and sap content found in Australian cypress can clog paper easily requiring the use of more abrasives than other species. The knots are extremely hard and must be addressed during the sanding process. Failure to isolate the knots during sanding may result in a wavy appearance. The final pass using a hardplate, planetary, or oscillating sander normally is done with a higher grit abrasive than with other species, in an effort to minimize visible scratches.

Stains and finishes very nicely, but the resins and saps can affect finish dry times and adhesion. It normally is recommended to seal each floor, room by room, to minimize sap bleedback from affecting the coatings.

SUSTAINABILITY: Australian cypress is not listed in the CITES appendices, and is reported by the IUCN Red List as a species of Least Concern.

BUBINGA *(Guibourtia* spp.*)*

Includes the three principal species: *G. demeusei, G. pellegriniana,* and *G. tessmannii.*

FAMILY: Fabaceae or Leguminosae (legume)

OTHER COMMON NAMES: African rosewood, kevazingo, akume.

APPEARANCE/COLOR: The heartwood can range from pink to red to red/brown, with dark purple or black streaks. The sapwood is a lighter grayish-white, straw, ivory, or streaked ivory-white color.

PHOTOSENSITIVITY: Moderate. Darkens with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain is straight to interlocked, with a uniform fine- to medium-texture. Bubinga is known for its occasional figured graining patterns, including pommelé, flaming, waterfall, quilting, mottle, etc.

HARDNESS (JANKA): Averages 2,410 lbf

AVERAGE DRIED WEIGHT: 56 lbs/ft^3 (890 kg/m^3)

SPECIFIC GRAVITY: Averages 0.72 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 8.4% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: Unknown

TOXICITY/ALLERGIES: Can cause skin irritations.

INSTALLATION: Can be challenging to work with due to its density. Moderate dulling effect on cutting edges due to a naturally high silica content. Grain tear out can occur with figured grain. It is important to move slow when cutting, routing, planing, or shaping this species. Does not bend well. It is recommended to adjust the compressor psi, and use 18 gauge cleats to avoid splitting. The oils in this species may adversely affect how well adhesives will bond to the wood. It may be necessary to tack with a solvent (denatured alcohol) or slightly roughen the surface, prior to applying adhesive.

SAND/FINISH: A very hard and very dense wood, which makes it challenging to sand, and requires extra caution with grit progression. Do not skip grits when sanding this wood. The final pass using a hardplate, planetary, or oscillating sander normally is done with a higher grit abrasive than with other species, in an effort to minimize visible scratches. Finishes and stains often require extended dry-times on this species. Occasionally, white spots or specks that were not noticeable before finishing may become apparent once the floor is coated, or after the floor has aged.

SUSTAINABILITY: The three Guibourtia species yielding bubinga are listed on CITES Appendix II. Additionally, of the three bubinga species, two of them (G. pellegriniana and G. tessmannii) are on the IUCN Red List as Endangered, while the third, G. demeusei, is listed as Near Threatened.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

CUMARU *(Dipteryx odorata)*

FAMILY: Fabaceae or Leguminosae (legume)

OTHER COMMON NAMES: Brazilian teak, tonka, southern chestnut, Brazilian chestnut.

APPEARANCE/COLOR: The heartwood can vary from red-brown or purple-brown with light yellow-brown or yellow-green streaks. The sapwood is yellowish-brown. The wood can vary significantly in color.

PHOTOSENSITIVITY: Moderate. Darkens and becomes more uniform in color with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain can vary from straight to very irregular or interlocked. It has a fine-to-medium texture with a waxy or oily feel.

HARDNESS (JANKA): Averages 3,330 lbf

AVERAGE DRIED WEIGHT: 68 lbs/ft^3 (1,085 kg/m^3)

SPECIFIC GRAVITY: Averages 0.82 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 7.7% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00212 (tangential)

TOXICITY/ALLERGIES: No adverse health effects have been reported.

INSTALLATION: Fairly high dulling effect on blades. Difficult to cut, rout, plane, and shape due to hardness and interlocked grain. Does not respond well to bending. Very hard species and has a tendency to fracture or split when nailing. It is recommended to adjust the compressor psi, and use 18 gauge cleats to avoid splitting. The oils in this species may adversely affect how well adhesives will bond to the wood. It may be necessary to tack with a solvent (denatured alcohol) or slightly roughen the surface, prior to applying adhesive.

SAND/FINISH: A very hard and very dense wood, which makes it challenging to sand, and requires extra caution with grit progression. Do not skip grits when sanding this wood. The final pass using a hardplate, planetary, or oscillating sander normally is done with a higher grit abrasive than with other species, in an effort to minimize visible scratches. This species naturally contains silica, which can dull the abrasives. This wood stains and finishes very nicely; however, the oils in this species can react with some finishes. It is recommended to sand and prepare one room at a time, then apply a sealer immediately to avoid bleedback of the natural oils in this wood. It may be helpful to tack the floor with denatured alcohol prior to any finish application. Finishes and stains often require extended dry-times on this species. Occasionally white spots or specks that were not noticeable before finishing may be apparent once the floor is coated or after the floor has aged.

SUSTAINABILITY: Cumaru is under consideration to be added to CITES Appendix II, and is reported by the IUCN Red List as being Data Deficient.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

GONCALO ALVES
(*Astronium graveolens* and *A. fraxinifolium*)

FAMILY: Anacardiaceae (cashew)

OTHER COMMON NAMES: Zebrawood, tigerwood, zorrowood, kingwood, gateado.

APPEARANCE/COLOR: The heartwood normally is medium red- to golden-brown with irregular brown to black streaks. The sapwood is light brown to gray.

PHOTOSENSITIVITY: Moderate. Darkens with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain usually is straight, wavy, or interlocked, with a uniform texture.

HARDNESS (JANKA): Averages 2,170 lbf

AVERAGE DRIED WEIGHT: 57 lbs/ft^3 (905 kg/m^3)

SPECIFIC GRAVITY: Averages 0.89 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 7.8% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: Unknown

TOXICITY/ALLERGIES: Reported as a sensitizer. Can cause skin, eye, and respiratory irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, but can have a dulling effect on cutting edges. No known concerns with nailing, when the compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Can be challenging to sand due to its density, and requires extra caution with grit progression sequence. May require a higher grit abrasive on the final passes than with other species. Accepts stains and finishes very nicely, but due to the natural oils in this species, some finishes and stains may require extended dry-times.

SUSTAINABILITY: Goncalo Alves is not listed in the CITES appendices, and is reported by the IUCN Red List as being a species of Least Concern.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

IPÉ *(Handroanthus* spp.*)*

FAMILY: Bignoniaceae (trumpetvine)

OTHER COMMON NAMES: Brazilian walnut, ipé tabaco, guayacan, lapacho, ironwood, surinam greenheart.

APPEARANCE/COLOR: The heartwood generally is an olive-brown to dark brown, but may have some reddish undertones, or some yellow undertones. The sapwood can be yellowish-gray to a grayish-brown and is demarcated clearly from the heartwood. Dark, contrasting streaks are often present. The pores frequently appear as fine yellow dots or lines.

PHOTOSENSITIVITY: Low-to-Moderate. Fades and becomes more uniform in color with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain can vary from straight to very irregular or interlocked. It may be fine to medium in texture.

HARDNESS (JANKA): Averages 3,680 lbf

AVERAGE DRIED WEIGHT: 69 lbs/ft^3 (1,100 kg/m^3)

SPECIFIC GRAVITY: Averages 1.10 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 8.0% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average. Dry climates will take an extended period of time to find EMC.

DIMENSIONAL CHANGE COEFFICIENT: 0.00280 (tangential)

TOXICITY/ALLERGIES: The dust and yellow lapachol powder can cause skin, eye, and respiratory irritations.

INSTALLATION: Can be challenging to work with due to its density. Has a dulling effect on cutting edges. It is important to move slow when cutting, routing, planing, or shaping this species. Does not bend well. The hardness of this species makes it very difficult to drive a fastener through. It is recommended to adjust the compressor psi, and use 18 gauge cleats to avoid splitting. Pre-drilling and hand-nailing is common. The oils in this species may adversely affect how well adhesives will bond to the wood. It may be necessary to tack with a solvent (denatured alcohol) or slightly roughen the surface, prior to applying adhesive.

SAND/FINISH: A very hard and very dense wood, which makes it challenging to sand, and requires extra caution with grit progression. Do not skip grits when sanding this wood. The final pass using a hardplate, planetary, or oscillating sander normally is done with a higher grit abrasive than with other species, in an effort to minimize visible scratches. It is recommended to sand and prepare one room at a time, then apply a sealer immediately, to avoid bleedback of the natural oils and powders in this wood. This wood stains and finishes very nicely; however, the yellow dots and lines in the open grain of this species (known as lapachol powder) can react with some finishes. In order to reduce this lapachol powder, wiping the floor with denatured alcohol may be necessary. Finishes and stains often require extended dry-times on this species.

SUSTAINABILITY: Ipé is under consideration to be added to CITES Appendix II, and is reported by the IUCN Red List as a species of Least Concern, although some species of ipé are listed as Endangered, and some as Critically Endangered.

JARRAH *(Eucalyptus marginata)*

FAMILY: Myrtaceae (myrtle)

OTHER COMMON NAMES: Western Australian mahogany, swan river mahogany.

APPEARANCE/COLOR: The heartwood is uniformly pinkish to dark red, often a rich, dark red mahogany hue. The sapwood is pale yellow to pink. Frequent black streaks are common.

PHOTOSENSITIVITY: Moderate-to-High. Deepens to a brownish-red with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain tends to be interlocked or wavy, with a medium to coarse texture with occasional ingrown wavy grain.

HARDNESS (JANKA): Averages 1,860 lbf

AVERAGE DRIED WEIGHT: 52 lbs/ft^3 (835 kg/m^3)

SPECIFIC GRAVITY: Averages 0.75 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 9.4% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00396 (tangential)

TOXICITY/ALLERGIES: Can cause eye and respiratory irritations.

INSTALLATION: Moderate dulling effect on blades. It cuts, routs, planes, and shapes well, but due to hardness and interlocked grain, tear-out can occur. Responds well to bending. Very hard species and has a tendency to fracture or split when nailing. It is recommended to adjust the compressor psi, and use 18 gauge cleats to avoid splitting. Pre-drilling and hand-nailing is common. No known issues with gluing, but the oils in this species may adversely affect how well adhesives will bond to the wood. It may be necessary to tack with a solvent (denatured alcohol) or slightly roughen the surface, prior to applying adhesive.

SAND/FINISH: A very hard and very dense wood, which makes it challenging to sand, and requires extra caution with grit progression. Do not skip grits when sanding this wood. The final pass using a hardplate, planetary, or oscillating sander normally is done with a higher grit abrasive than with other species, in an effort to minimize visible scratches. It is recommended to sand and prepare one room at a time, then apply a sealer immediately, to avoid bleedback of the natural oils and powders in this wood. Finishes and stains often require extended dry-times on this species. Red color can bleed into some finishes, which can be a problem when mixing species.

SUSTAINABILITY: Jarrah is not listed in the CITES appendices, but is reported by the IUCN Red List as Near Threatened.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

JATOBA/BRAZILIAN CHERRY
(Hymenaea courbaril)

FAMILY: Fabaceae or Leguminosae (legume)

OTHER COMMON NAMES: Brazilian cherry, courbaril, West Indian locust, jutaby, guapinol, algarrobo, copal, jatai vermelho.

APPEARANCE/COLOR: The heartwood varies from salmon red to light orange-brown to a darker russet or reddish-brown. The sapwood can be white, gray to yellow or pink, and is demarcated clearly from the heartwood. Dark, contrasting streaks often are present.

PHOTOSENSITIVITY: High. Darkens to a deep reddish-brown with age and exposure to sunlight and oxygen. Color change is drastic within the first 90 days after exposure to light. After 90 days, the darkening process will slow, but likes all woods, it never will stop completely.

GRAIN: Diffuse-porous. The grain mostly is interlocked, with a medium to coarse texture.

HARDNESS (JANKA): Averages 2,690 lbf

AVERAGE DRIED WEIGHT: 57 lbs/ft^3 (910 kg/m^3)

SPECIFIC GRAVITY: Averages 0.83 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 8.5 % (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00300 (tangential)

TOXICITY/ALLERGIES: Can cause skin irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, but has a moderate dulling effect on cutting edges. Responds well to bending. It is recommended to adjust the compressor psi, and use 18 gauge cleats to avoid splitting. Glue adheres well, with no known issues.

SAND/FINISH: A very hard and very dense wood, which makes it challenging to sand, and requires extra caution with grit progression. Do not skip grits when sanding this wood. The final pass using a hardplate, planetary, or oscillating sander normally is done with a higher grit abrasive than with other species, in an effort to minimize visible scratches. Finishes and stains often require extended dry-times on this species. Occasionally, white spots or specks that were not noticeable before finishing may become apparent once the floor is coated, or after the floor has aged. These spots are calcium carbonate and are a naturally occurring part of the species.

SUSTAINABILITY: Jatoba is not listed in the CITES appendices, and is reported by the IUCN Red List as a Species of Least Concern.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

KEMPAS *(Koompassia malaccensis)*

FAMILY: Fabaceae or Leguminosae (legume)

OTHER COMMON NAMES: Impas, tualang.

APPEARANCE/COLOR: The heartwood is orange-red to pink-brown with yellowish streaks. The sapwood is white to pale yellow and is demarcated clearly from the heartwood.

PHOTOSENSITIVITY: Moderate. Deepens to a dark reddish-brown or yellowish-red with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain is interlocked and often spiral or wavy, with a coarse texture.

HARDNESS (JANKA): Averages 1,750 lbf

AVERAGE DRIED WEIGHT: 55 lbs/ft^3 (880 kg/m^3)

SPECIFIC GRAVITY: Averages 0.76 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 6.7% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: Unknown

TOXICITY/ALLERGIES: Can cause eye and respiratory irritations.

INSTALLATION: Can be challenging to work with due to its density. Has a severe dulling effect on cutting edges. Brittleheart (stone-like streaks of brittle areas within the wood) occasionally is present, and is known to cause dulling of blades when cutting, routing, planing, or shaping. This wood also is slightly acidic and can be corrosive to metals. Does not bend well. The hardness of this species makes it very difficult to drive a fastener through. It is recommended to adjust the compressor psi, and use 18 gauge cleats to avoid splitting. Pre-drilling and hand-nailing is common. Glue adheres well, with no known issues.

SAND/FINISH: A very hard and very dense wood, which makes it challenging to sand, and requires extra caution with grit progression. Do not skip grits when sanding this wood. The final pass using a hardplate, planetary, or oscillating sander normally is done with a higher grit abrasive than with other species, in an effort to minimize visible scratches.

Accepts stains and finishes very nicely, with no known concerns.

SUSTAINABILITY: Kempas is not listed in the CITES appendices, and is reported by the IUCN Red List as Lower Risk/Conservation Dependent.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

KOA *(Acacia koa)*

FAMILY: Fabaceae or Leguminosae (legume)

OTHER COMMON NAMES: Acacia koa, Hawaiian mahogany, koa-ka.

APPEARANCE/COLOR: The heartwood varies from a light reddish-brown to gray-brown color with a pinkish hue, often veined with black-to reddish contrasting bands of color among the growth rings. The sapwood is yellow-white to pale pink, and is demarcated clearly from the heartwood. Color can vary significantly.

PHOTOSENSITIVITY: Low. Slightly deepens with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain tends to be slightly interlocked or wavy, with a medium to coarse texture.

HARDNESS (JANKA): Averages 1,170 lbf

AVERAGE DRIED WEIGHT: 38 lbs/ft^3 (610 kg/m^3)

SPECIFIC GRAVITY: Averages 0.63 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 6.2% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: Unknown

TOXICITY/ALLERGIES: Can cause eye and respiratory irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, with a moderate dulling effect on cutting edges. No known concerns with nailing, when the compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Sands very easily following the standard grit progression sequence. Accepts stains and finishes very nicely, with no known concerns.

SUSTAINABILITY: Koa is not listed in the CITES appendices, and is reported by the IUCN Red List as a species of Least Concern.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

MAHOGANY, AFRICAN
(*Khaya* spp.)

FAMILY: Meliaceae (mahogany)

OTHER COMMON NAMES: Khaya, Ivory Coast mahogany, Gold Coast mahogany.

APPEARANCE/COLOR: The heartwood can vary from pale pinkish-brown to dark reddish-brown. The sapwood is not always distinct from the heartwood, but may display a creamy white to yellowish color. This species is also naturally lustrous with a light-refracting optical phenomenon known as chatoyancy.

PHOTOSENSITIVITY: Moderate. Darkens to a deep, rich reddish-brown with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain is straight, but typically is interlocked. It has a medium to coarse texture.

HARDNESS (JANKA): Averages 1,070 lbf

AVERAGE DRIED WEIGHT: 40 lbs/ft^3 (640 kg/m3)

SPECIFIC GRAVITY: Averages 0.53 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 5.7% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Above average

DIMENSIONAL CHANGE COEFFICIENT: 0.00201 (tangential)

TOXICITY/ALLERGIES: Reported as a sensitizer. Can cause eye and skin irritations, as well as nasopharyngeal cancer.

INSTALLATION: The softness of this species makes it very easy to work with. Cuts, routs, planes, and shapes well, with only a slight dulling effect on cutting edges. Responds well to bending. It is recommended to adjust the compressor psi, and use 18 gauge cleats to avoid splitting. Glue adheres well, with no known issues.

SAND/FINISH: Sands very easily following the standard grit progression sequence. Reduce the drum pressure on the belt sander to avoid removal of too much material on each pass. Accepts stains and finishes very nicely, with no known concerns.

SUSTAINABILITY: African Mahogany is listed in CITES Appendix II, and is reported by the IUCN Red List as a Vulnerable species.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

MAHOGANY, HONDURAN
(Swietenia macrophylla)

FAMILY: Meliaceae (mahogany) family

OTHER COMMON NAMES: American mahogany, Brazilian mahogany, Cuban mahogany, big leaf mahogany, true mahogany, genuine mahogany.

APPEARANCE/COLOR: The heartwood can vary from reddish- pinkish- or salmon-colored, to a yellowish hue. The sapwood is a yellowish to whitish color. Color can vary significantly. This species is also naturally lustrous with a light refracting optical phenomenon known as chatoyancy.

PHOTOSENSITIVITY: Moderate. Darkens to a deep red or brown with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain can vary from straight, to interlocked, to irregular or wavy. It is not uncommon to find figured Mahogany displaying curly, wavy, fiddleback characteristics. It is a fine to course texture, but normally uniform.

HARDNESS (JANKA): Averages 900 lbf

AVERAGE DRIED WEIGHT: 37 lbs/ft^3 (590 kg/m^3)

SPECIFIC GRAVITY: Averages 0.47 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried it may shrink up to 4.3% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Above Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00238 (tangential)

TOXICITY/ALLERGIES: Reported as a sensitizer. Can cause eye and skin irritations, as well as nausea, giddiness, and hypersensitivity pneumonitis.

INSTALLATION: The softness of this species makes it very easy to work with. Cuts, routs, planes, and shapes well, with only a slight dulling effect on cutting edges. Responds well to bending. It is recommended to adjust the compressor psi, and use 18 gauge cleats to avoid splitting. Glue adheres well, with no known issues.

SAND/FINISH: Sands very easily following the standard grit progression sequence. Reduce the drum pressure on your belt sander to avoid removal of too much material on each pass. Accepts stains and finishes very nicely, with no known concerns.

SUSTAINABILITY: Honduran Mahogany is listed in the CITES Appendix II, and is reported by the IUCN Red List as Vulnerable.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

MAHOGANY, SANTOS *(Myroxylon balsamum)*

FAMILY: Fabaceae or Leguminosae (legume). Although it is called "mahogany," it is not in the mahogany family.

OTHER COMMON NAMES: Balsamo, oleo vermelho, balsam of Peru.

APPEARANCE/COLOR: The heartwood can range from light orange/brown with yellowish overtones to a burgundy or dark reddish/purplish-brown. The white sapwood is demarcated sharply from the heartwood.

PHOTOSENSITIVITY: Low. Slightly darkens, and color variations even out with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain is mostly interlocked, medium to fine texture. The interlocked grain gives a striped figuring pattern in quartersawn boards.

HARDNESS (JANKA): Averages 2,200 lbf

AVERAGE DRIED WEIGHT: 57 lbs/ft^3 (915 kg/m^3)

SPECIFIC GRAVITY: Averages 0.83 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 6.2% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00238 (tangential)

TOXICITY/ALLERGIES: Can cause skin and respiratory irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, but can have a severe dulling effect on cutting edges. It is recommended to adjust the compressor psi, and use 18 gauge cleats to avoid splitting. The oils in this species may adversely affect how well adhesives will bond to the wood. It may be necessary to tack with a solvent (denatured alcohol) or slightly roughen the surface, prior to applying adhesive.

SAND/FINISH: A very hard and very dense wood, which makes it challenging to sand, and requires extra caution with grit progression. Do not skip grits when sanding this wood. The final pass using a hardplate, planetary, or oscillating sander normally is done with a higher grit abrasive than with other species, in an effort to minimize visible scratches. This wood finishes very nicely, but does not stain well. Due to the density of this wood, extended dry-times may be necessary. The red dust can stain fabric or wall treatments.

SUSTAINABILITY: Santos mahogany is not listed in the CITES appendices, and is reported by the IUCN Red List as a species of Least Concern.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

MERBAU *(Intsia bijuga)*

FAMILY: Fabaceae or Leguminosae (legume)

OTHER COMMON NAMES: Ipil, lumpa.

APPEARANCE/COLOR: Heartwood is yellowish to orange-brown. The sapwood is whitish-gray to yellowish-brown, and is demarcated clearly from the heartwood. Small yellow mineral deposits are found throughout the wood. There can be moderate to high color variation within this species.

PHOTOSENSITIVITY: Moderate. Turns brown or dark red-brown with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain is straight to interlocked or wavy, which may form a ribbon figure. Merbau has a medium to coarse texture.

HARDNESS (JANKA): Averages 1,840 lbf

AVERAGE DRIED WEIGHT: 51 lbs/ft^3 (815 kg/m^3)

SPECIFIC GRAVITY: Averages 0.65 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 4.8% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Above average

DIMENSIONAL CHANGE COEFFICIENT: 0.00158 (tangential)

TOXICITY/ALLERGIES: Can cause skin and respiratory irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, but has a moderate dulling effect on cutting edges. Responds well to bending. It is recommended to adjust the compressor psi, and use 18 gauge cleats to avoid splitting. Glue adheres well, with no known issues.

SAND/FINISH: A very hard and very dense wood, which makes it challenging to sand, and requires extra caution with grit progression. Do not skip grits when sanding this wood. The final pass using a hardplate, planetary, or oscillating sander normally is done with a higher grit abrasive than with other species, in an effort to minimize visible scratches. It is recommended to sand and prepare one room at a time, then apply a sealer immediately, to avoid bleedback of the natural oils and powders in this wood. The yellow deposits in the grain are water soluble and can stain. The wood takes stain and finishes well. No other known issues with finish application.

SUSTAINABILITY: Jarrah is not listed in the CITES appendices, but is reported by the IUCN Red List as Near Threatened.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

PADAUK
(Pterocarpus soyauxii)

FAMILY: Fabaceae or Leguminosae (legume)

OTHER COMMON NAMES: African padauk, African coralwood, barwood, muenge, vermillion.

APPEARANCE/COLOR: The heartwood is vivid orange-red to blood-red. The sapwood is cream to grayish-white. Very uniform in color.

PHOTOSENSITIVITY: High. Darkens to reddish- or purple-brown, or even black with red streaks with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain usually is straight, but can be interlocked or slightly wavy, with a moderately coarse texture.

HARDNESS (JANKA): Averages 1,970 lbf

AVERAGE DRIED WEIGHT: 47 lbs/ft^3 (745 kg/m^3)

SPECIFIC GRAVITY: Averages 0.64 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 5.2% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Above average

DIMENSIONAL CHANGE COEFFICIENT: 0.00180 (tangential)

TOXICITY/ALLERGIES: Reported as a sensitizer. Can cause skin, eye, and respiratory irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, with only a slight dulling effect on cutting edges. Responds well to bending. No known concerns with nailing, when the compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: A very hard and very dense wood, which makes it challenging to sand, and requires extra caution with grit progression. Do not skip grits when sanding this wood. The final pass using a hardplate, planetary, or oscillating sander normally is done with a higher grit abrasive than with other species, in an effort to minimize visible scratches. It is recommended to sand and prepare one room at a time, then apply a sealer immediately, to avoid bleedback of the natural oils and powders in this wood. Accepts stains and finishes very nicely, with no known concerns. Red color can bleed into some finishes, which can be a concern when mixing species.

SUSTAINABILITY: Padauk is listed in CITES Appendix II, and is not listed on the IUCN Red List.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

PATAGONIAN ROSEWOOD
(Anadenanthera colubrina)

FAMILY: Fabaceae or Leguminosae (legume)

OTHER COMMON NAMES: Curupay, cebil, curupaú.

APPEARANCE/COLOR: The heartwood is pale to medium reddish-brown, frequently with darker brown to black streaks throughout. Sapwood is a pale yellow to pinkish-brown.

PHOTOSENSITIVITY: Moderate. Darkens with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain is irregular and/or interlocked, with a fine uniform texture.

HARDNESS (JANKA): Averages 3,630 lbf

AVERAGE DRIED WEIGHT: 64 lbs/ft^3 (1,025 kg/m^3)

SPECIFIC GRAVITY: Averages 1.03 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 7.6% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: Unknown

TOXICITY/ALLERGIES: Can cause skin irritations.

INSTALLATION: Has a pronounced dulling effect on blades. It cuts, routs, planes, and shapes well, but due to hardness and irregular grain, tear-out can occur. It is recommended to adjust the compressor psi, and use 18 gauge cleats to avoid splitting. Glue adheres well, with no known issues.

SAND/FINISH: A very hard and very dense wood, which makes it challenging to sand, and requires extra caution with grit progression. Do not skip grits when sanding this wood. The final pass using a hardplate, planetary, or oscillating sander normally is done with a higher grit abrasive than with other species, in an effort to minimize visible scratches. It is recommended to sand and prepare one room at a time, then apply a sealer immediately, to avoid bleedback of the natural oils and powders in this wood. Finishes and stains often require extended dry-times on this species.

SUSTAINABILITY: Patagonian rosewood is not listed in the CITES Appendices, and is reported by the IUCN Red List as being a species of Least Concern.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

PAU MARFIM/BRAZILIAN MAPLE
(Balfourodendron riedelianum)

FAMILY: Rutaceae (citrus)

OTHER COMMON NAMES: Guatambu, pau liso, ivorywood.

APPEARANCE/COLOR: There is no apparent difference between the sapwood and the heartwood. Colors can range from near-white through pale yellowish-brown or cream to lemon. It also can have a gray tinge and some darker streaks.

PHOTOSENSITIVITY: Low. Slightly ambers with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The wood is straight-grained or irregular, and sometimes is interlocked, with fine to very-fine uniform texture.

HARDNESS (JANKA): Averages 1,500 lbf

AVERAGE DRIED WEIGHT: 50 lbs/ft^3 (800 kg/m^3)

SPECIFIC GRAVITY: Averages 0.73 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 8.8% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00312 (tangential)

TOXICITY/ALLERGIES: Can cause skin and respiratory irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, but can have a severe dulling effect on cutting edges, which can cause tear-out. It is recommended to adjust the compressor psi, and use 18 gauge cleats to avoid splitting. Glue adheres well, with no known issues.

SAND/FINISH: A very hard and very dense wood, which makes it challenging to sand, and requires extra caution with grit progression. Do not skip grits when sanding this wood. The final pass using a hardplate, planetary, or oscillating sander normally is done with a higher grit abrasive than with other species, in an effort to minimize visible scratches. Some finishes and stains may require extended dry-times.

SUSTAINABILITY: Pau Marfim is not listed in the CITES appendices, but is reported by the IUCN Red List as Endangered.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

PURPLEHEART
(Peltogyne paniculata)

FAMILY: Fabaceae or Leguminosae (legume) family

OTHER COMMON NAMES: Amaranth, violetwood, morado.

APPEARANCE/COLOR: The heartwood is purple to brown with some grey. The sapwood is sharply demarcated from the heartwood with an off-white to cream color. Minerals can cause uneven coloring.

PHOTOSENSITIVITY: Moderate-to-High. Darkens to a deep-brown color with an underlying hint of purple with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain is usually straight or wavy/irregular, with a medium to fine texture.

HARDNESS (JANKA): Averages 2,520 lbf

AVERAGE DRIED WEIGHT: 56 lbs/ft^3 (905 kg/m^3)

SPECIFIC GRAVITY: Averages 0.71 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried it may shrink up to 6.4% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00212 (tangential)

TOXICITY/ALLERGIES: Reported as a sensitizer. Can cause skin and eye irritations, as well as nausea.

INSTALLATION: Cuts, routs, planes, and shapes well, and can have a moderate dulling effect on blades. It can be very challenging to work with due to its hardness and gummy resins. Responds well to bending. No known concerns with nailing, when the compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Sands satisfactorily when following the standard grit progression sequence. It may require a higher grit abrasive on the final passes than with other species to minimize visible scratches. It is recommended to sand and prepare one room at a time, then apply a sealer immediately, to avoid bleedback of the natural oils and powders in this wood.

Accepts stains and finishes very nicely, with no known concerns.

SUSTAINABILITY: This wood species is not listed in the CITES Appendices, nor on the IUCN Red List.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

SAPELE *(Entandrophragma cylindricum)*

FAMILY: Meliaceae (mahogany)

OTHER COMMON NAMES: Scented mahogany, sapele mahogany.

APPEARANCE/COLOR: The heartwood is pink to reddish-brown. The sapwood can be white, to pale yellow and is demarcated clearly from the heartwood.

PHOTOSENSITIVITY: High. Deepens to a dark red-brown or even purple-brown, with a high golden luster with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain mostly is interlocked, and often wavy. Quartersawn cuts often showcase a ribbon-stripe pattern. Sapele also is known for its figure, such as fiddleback and quilted patterns.

HARDNESS (JANKA): Averages 1,500 lbf

AVERAGE DRIED WEIGHT: 42 lbs/ft^3 (670 kg/m^3)

SPECIFIC GRAVITY: Averages 0.60 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 7.2% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00259 (tangential)

TOXICITY/ALLERGIES: Can cause skin and respiratory irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, with a moderate dulling effect on cutting edges, but the interlocked grain can cause minor tear-out. No known concerns with nailing, when the compressor psi is set appropriately, but the wood can become discolored or stained with exposure to iron fasteners. Glue adheres well, with no known issues.

SAND/FINISH: Sands satisfactorily when following the standard grit progression sequence. It may require a higher grit abrasive on the final passes than with other species to minimize visible scratches. Due to the natural oils in this species, some finishes and stains may require extended dry-times.

SUSTAINABILITY: Sapele is not listed in the CITES appendices, but is reported by the IUCN Red List as Vulnerable.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

TEAK *(Tectona grandis)*

FAMILY: Lamiaceae (mint)

OTHER COMMON NAMES: Burmese teak, Thai teak, Indian teak.

APPEARANCE/COLOR: The heartwood is golden to medium, or dark brown. The sapwood can be a light cream or yellowish color, and is demarcated clearly from the heartwood.

PHOTOSENSITIVITY: Moderate-to-High. Fades and becomes more uniform in the golden-brown color with age and exposure to sunlight and oxygen.

GRAIN: Ring-porous or semi-ring-porous. The grain usually is straight, and occasionally can be wavy or interlocked, with an uneven, coarse texture.

HARDNESS (JANKA): Averages 1,040 lbf

AVERAGE DRIED WEIGHT: 41 lbs/ft^3 (655 kg/m^3)

SPECIFIC GRAVITY: Averages 0.57 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 5.3% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Above average

DIMENSIONAL CHANGE COEFFICIENT: 0.00186 (tangential)

TOXICITY/ALLERGIES: Reported as a sensitizer. Can cause skin, eye, and respiratory irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, but can have a severe dulling effect on cutting edges, due to the high silica content in this wood. Use of tungsten-carbide-tipped blades works best when cutting teak. No known concerns with nailing, when the compressor psi is set appropriately. Glue adheres well, with no known issues.

SAND/FINISH: Sands very easily following the standard grit progression sequence. Abrasives can become clogged, requiring frequent replacement of paper. Do not skip grits when sanding this wood to avoid leaving scratches from coarse abrasives. Reduce the drum pressure on the belt sander to avoid removal of too much material on each pass. The final pass using a hardplate, planetary, or oscillating sander normally is done with a higher grit abrasive than with other species, in an effort to minimize visible scratches. This wood can stain and finish nicely, but it is recommended to sand and prepare one room at a time, then apply a sealer immediately, to avoid bleedback of the natural oils and powders in this wood. Finishes and stains often require extended dry-times on this species.

SUSTAINABILITY: This wood species is not listed in the CITES Appendices, but is reported by the IUCN Red List as Endangered.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

TIETE ROSEWOOD
(Guibourtia hymenaeifolia)

FAMILY: Fabaceae or Leguminosae (legume)

OTHER COMMON NAMES: Patagonian cherry, sirari.

APPEARANCE/COLOR: Orange to pinkish-brown, with a very uniform color and appearance.

PHOTOSENSITIVITY: Moderate. Darkens and reddens with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain is straight, with a medium to fine uniform texture.

HARDNESS (JANKA): Averages 2,790 lbf

AVERAGE DRIED WEIGHT: 59 lbs/ft^3 (945 kg/m^3)

SPECIFIC GRAVITY: Averages 0.94 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 7.0% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: Unknown

TOXICITY/ALLERGIES: Can cause skin irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, but can have a moderate dulling effect on cutting edges, due to the high silica content in this wood. Grain tear out can occur with figured grain. It is important to cut slow with this species. Does not bend well. It is recommended to adjust the compressor psi, and use 18 gauge cleats to avoid splitting. The oils in this species may adversely affect how well adhesives will bond to the wood. It may be necessary to tack with a solvent (denatured alcohol) or slightly roughen the surface, prior to applying adhesive.

SAND/FINISH: A very hard and very dense wood, which makes it challenging to sand, and requires extra caution with grit progression. Do not skip grits when sanding this wood. The final pass using a hardplate, planetary, or oscillating sander normally is done with a higher grit abrasive than with other species, in an effort to minimize visible scratches. It is recommended to sand and prepare one room at a time, then apply a sealer immediately, to avoid bleedback of the natural oils and powders in this wood. Finishes and stains often require extended dry-times on this species. Occasionally, white spots or specks that were not noticeable before finishing may become apparent once the floor is coated, or after the floor has aged.

SUSTAINABILITY: Tiete rosewood is not listed in the CITES Appendices, nor on the IUCN Red List.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

TIGERWOOD/AFRICAN WALNUT
(Lovoa trichilioides)

FAMILY: Meliaceae (mahogany)

OTHER COMMON NAMES: Tigerwood, lovoa wood, benin walnut, congowood.

APPEARANCE/COLOR: Heartwood is bronze orange-brown with black streaks. The narrow sapwood is white or pale-brown and is demarcated clearly from the heartwood.

PHOTOSENSITIVITY: Moderate. Darkens to a deep reddish-brown with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain usually is interlocked, but straight, with a fine uniform texture. Quartersawn cuts can produce attractive spiral ribbon striped figuring.

HARDNESS (JANKA): Averages 940 lbf

AVERAGE DRIED WEIGHT: 34 lbs/ft^3 (540 kg/m^3)

SPECIFIC GRAVITY: Averages 0.54 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 5.9% (tangentially) of its given width.

DIMENSIONAL STABILITY IN-USE: Above average

DIMENSIONAL CHANGE COEFFICIENT (DCC): Unknown

TOXICITY/ALLERGIES: Can cause skin, eye, and respiratory irritations.

INSTALLATION: Cuts, routs, planes, and shapes well, with only a slight dulling effect on cutting edges. Can split when nailing. It is recommended to adjust the compressor psi, and use 18 gauge cleats to avoid splitting. Glue adheres well, with no known issues.

SAND/FINISH: A very soft species that may respond better to higher grit progression sequences. Final sanding with higher grit abrasives often is necessary to minimize visible scratches. Accepts stains and finishes very nicely, with no known concerns.

SUSTAINABILITY: African walnut is not listed in the CITES appendices, and is reported by the IUCN Red List as a species of Least Concern.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

WENGÉ *(Millettia laurentii)*

FAMILY: Fabaceae or Leguminosae (legume)

OTHER COMMON NAMES: Panga panga, kiboto, jambire.

APPEARANCE/COLOR: The heartwood is medium to dark brown, sometimes with a reddish or yellowish hue with both black and paler veins. The sapwood can be whitish or pale yellow, and is demarcated clearly from the heartwood.

PHOTOSENSITIVITY: Low-to-Moderate. Lightens with age and exposure to sunlight and oxygen.

GRAIN: Diffuse-porous. The grain usually is straight, with an uneven medium to coarse texture. There is very little contrast between quartersawn and plainsawn cuts.

HARDNESS (JANKA): Averages 1,640 lbf

AVERAGE DRIED WEIGHT: 54 lbs/ft^3 (870 kg/m^3)

SPECIFIC GRAVITY: Averages 0.81 (at 12% MC)

SHRINKAGE VALUE: When going from green (30% MC) to oven-dried, it may shrink up to 6.6% (tangential) of its given width.

DIMENSIONAL STABILITY IN-USE: Average

DIMENSIONAL CHANGE COEFFICIENT: 0.00201 (tangential)

TOXICITY/ALLERGIES: Reported as a sensitizer. Can cause skin, eye, and respiratory irritations. Splinters can take longer to heal and can become infected.

INSTALLATION: Cuts, routs, planes, and shapes well, with a moderate dulling effect on cutting edges. Non-carbide blades will dull quickly due to the effect of the natural oils that harden quickly within the wood. Responds well to bending. It is recommended to adjust the compressor psi, and use 18 gauge cleats to avoid splitting. Glue adheres well, with no known issues.

SAND/FINISH: Sands satisfactorily when following the standard grit progression sequence. It may require a higher grit abrasive on the final passes than with other species to minimize visible scratches. Accepts stain well. Finishes very nicely, but the larger pores and grains can result in an inconsistent final coat.

SUSTAINABILITY: Wengé (*Millettia laurentii*) is listed in the CITES appendix II, and is reported by the IUCN Red List as Endangered.

© 2023 NATIONAL WOOD FLOORING ASSOCIATION

SOURCES AND CREDITS

Technical Standards Committee

- Brett Miller – NWFA Staff Liaison
- Charlie Peterson – CP Wood Floors
- Hank Adams – Bison Hardwood
- Joe Audino – Rode Brothers
- Kevin Mullany – Benchmark Wood Floors
- Steve Marley – Johnson Hardwood
- Tony Miraldi – Somerset Hardwood Flooring

Resources and Reviewers

- A Guide to Useful Woods of the World; James Flynn and Charles Holder ©2001
- Aacer Flooring
- Alex C. Wiedenhoeft, PhD, Forest Service, Forest Products Laboratory
- Allegheny Mountain Hardwood Flooring
- Appalachian Hardwood Manufacturers, Inc.
- CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora)
- Danzer Veneer Americas
- Goodwin® Company – Fine Antique Wood
- Graf Custom Hardwood
- Hardwood Floors of Hillsboro
- Hardwood Floors magazine (article by Rick Bergman & Steve Hubbard)
- Hurst Hardwoods LLC
- John Forbes, NWFA/NOFMA
- Kjell Nymark, NWFA
- LaCrosse Hardwood Flooring
- MFMA (Maple Flooring Manufacturers Association)
- NELMA (Northeastern Lumber Manufacturers Association)
- NHLA (National Hardwood Lumber Association)
- Owens Flooring LLC
- Samuel V. Glass, PhD, Forest Service, Forest Products Laboratory
- Seneca Creek Associates & National Association of Foresters
- Sheoga Hardwood Flooring & Paneling Inc.
- Smith Flooring Inc.
- Snow Country Hardwoods Inc.
- SPIB (Southern Pine Inspection Bureau)
- The IUCN Red List (the International Union for Conservation of Nature's Red List of Threatened Species)
- The Wood Handbook; Nick Gibbs ©2012
- Tropical Timbers of the World; Martin Chudnoff ©1984
- Understanding Wood, A Craftsman's Guide to Wood Technology; R. Bruce Hoadley, ©2000
- Wagner Meters
- WD Flooring
- Wood Handbook; Wood as an Engineering Material; US Department of Agriculture; Forest Products Lab ©2021
- Wood Identification & Use; Terry Porter ©2011
- WOOD!; Eric Meier ©2016
- World Woods in Color; William Lincoln ©1986
- WWPA (Western Wood Products Association)

Publication Editors

- Anita Howard, NWFA
- Brett Miller, NWFA

NWFA Photography, Artwork, Layout & Design

- Brett Miller, NWFA
- Julie Conway, Graphic Designer
- Rhonda M. May, NWFA

Photo and Artwork Credits (provided by NWFA unless noted below):

- Allegheny Mountain Hardwood Flooring (pg. 65)
- Appalachian Hardwood Manufacturers, Inc. (cover)
- BigstockPhotos ©nisara, image ID: 278786542 (pg. 23)
- BigstockPhotos ©Orla, image ID: 9695642 (bottom left pg. 3)
- BigstockPhotos ©Radistka, image ID: 261471847 (upper left pg. 3)
- BigstockPhotos ©zlikovec, image ID: 134593076 (middle right pg. 3)
- Carlisle Wide Plank Floors (pg. 57, pg. 61, pg. 75)
- Epic Hardwood Floors (pg. 47)
- Goodwin® Company – Fine Antique Wood (pg. 77)
- Graf Custom Hardwood (pg. 69)
- Hull Forest Products, Inc. (pg. 35, pg. 41, bottom pg. 56)
- Indusparquet USA (pg. 86)
- Lauzon Hardwood (pg. 31)
- Mirage (François Roy)
- Mullican Flooring (pg. 51)
- Olde Wood Ltd. (pg. 45, pg. 46)
- Pacific Hardwood Co. Inc. (pg. 63)
- Peachey Wood Products (pg. 79)
- Shamrock Plank Flooring (pg. 49)
- Shutterstock ©Muskoka Stock Photos, image ID: 213229048 (pg. 3)
- Shutterstock ©mypokcik, image ID: 1502070860 (pg. 2)
- Shutterstock ©Piper VanOrd, image ID: 1630168279 (back cover)
- Shutterstock © pzRomashka, image ID: 36223132 (pg. 24)
- Shutterstock ©sophiecat, image ID: 1900742272 (pg. 3)
- Shutterstock ©Thichaa, image ID: 1504055132 (pg. 83)
- The Wood Database; Eric Meier (pg. 84, pg. 87, pg. 96, pg. 98)
- Wickham Hardwood Flooring (pg. 27)

nwfa
National Wood
Flooring Association

PH Toll-free: 800.422.4556 | Local: 636.519.9663 | nwfa.org