NATIONAL WOOD FLOORING ASSOCIATION TECHNICAL PUBLICATION No. A200

Price: $30

National Wood Flooring Association

WOOD SPECIES

USED IN WOOD FLOORING

3rd Edition

APPEARANCE

PHYSICAL PROPERTIES

WORKABILITY

RELATIVE COST

AVAILABILITY

CONTENTS

WOOD SPECIES USED IN WOOD FLOORING

WOOD SPECIES
USED IN WOOD FLOORING
Introduction: An Overview of Wood Properties

Wood is a dynamic medium. Like all organic materials, it has character and quirks, responds to its environment, and changes over time. Because of its "personality," wood should be treated with understanding and a certain amount of care. For wood flooring professionals, knowing about the properties of wood in general, as well as those of individual wood species, is critical to proper installation. For consumers, it's important to have realistic expectations about how wood will perform. Most wood used for flooring is essentially a byproduct of more expensive wood-consuming industries (furniture manufacture, for example), so it is usually not the highest grade of lumber. However, it is quite economical in comparison.

This publication provides an overview of the mechanical and physical properties of wood, followed by more detailed information on several species used in flooring. In selecting the species described, the aim has been to offer a fair sampling of some of today's most popular woods. Other species may be included in later editions of this publication.

Note: The samples chosen to illustrate each species were selected to be as representative as possible. However, there are many variations within each species, and the methods used in sanding and finishing also affect the final appearance of a given species. Also, the samples were photographed only a few days after being sanded and finished. Some species, such as domestic cherry, will change color significantly over time (see page 8). Therefore, the appearance of any installation may vary from the samples shown in this publication.

The character of wood

As a flooring material, wood is superior to vinyl or carpet, both practically and aesthetically. A solid wood floor is more than a covering; it adds strength and stability to the floor system. A one-inch thickness of wood has the same insulating value as 15 inches of concrete. Wood is durable and long-lasting — occasional sanding and refinishing essentially results in a brand-new floor. Wood floors don't retain mildew or absorb dust, simplifying cleaning.

Perhaps the most appealing characteristics of wood flooring, though, are its attractive appearance and natural warmth. A beautiful wood floor can enliven a drab room, enhance any architectural style, complement furniture and design schemes, and add value to any home or building.

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 mechanical properties such as dimensional stability, durability, and ease in finishing; and finally, availability and cost.

Properties affecting appearance

Many different factors, from the nature of the living tree to the way the lumber is sawed, affect the way the finished floor will look.

HEARTWOOD, SAPWOOD: Heartwood is the older, harder, central portion of a tree. It usually contains deposits of various materials that frequently give it a darker color than sapwood. It is denser, less permeable and more durable than the surrounding sapwood.

Sapwood is the softer, younger, outer portion of a tree that lies between the cambium (formative layer just under the bark) and the heartwood. It is more permeable, less durable and usually lighter in color than the heartwood.

The relative amounts of heartwood and sapwood in a flooring batch may affect the way it accepts stain and finish and, therefore, the finished appearance of the floor. In general, quartersawn and riftsawn flooring will contain less sapwood than plainsawn flooring (see "Types of saw cut," next page), and will tend to have a straighter grain and more uniform appearance.

WOOD GRAIN AND TEXTURE: "Grain" and "texture" are loosely used to describe similar properties of wood. Grain is often used in reference to annual growth rings, as in "fine" or "coarse" grain; it also is used to indicate the direction of fibers, as in straight, spiral and curly grain. The direction of the grain, as well as the amount of figuring in the wood, can affect the way it is sanded and sawed.

Grain also is described as being either "open" or

"closed," referring to the relative size of the pores, which affects the way a wood accepts stain and finishes.

Texture usually refers to the finer structure of the wood, rather than to the annual rings. It is sometimes used to combine the concepts of density and degree of contrast between spring wood and summer wood in the annual growth rings.

Wood grain terminology

Annual rings: Most species grown in temperate climates produce visible annual growth rings that show the difference in density and color between wood formed early and that formed late in the growing season. The inner part of the growth ring, formed first, is called "spring wood"; the outer part, formed later in the season, is called "summer wood."

Spring wood is characterized by cells having relatively large cavities and thin walls. Summer wood cells have smaller cavities and thicker walls, and consequently are more dense than those in spring wood. 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 results in part from differences in growth-ring formation. And within species, natural variations in growth ensure the unique character and beauty of each piece of wood.

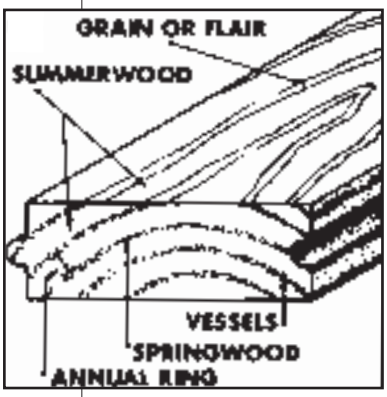


Figure: The pattern produced in a wood surface by annual growth rings, rays, knots and deviations from regular grain.

Medullary Rays: Medullary rays extend radially from the core of the tree toward the bark. They vary in height from a few cells in some species, to four or more inches in the oaks; they're responsible for the flake effect common in quartersawn lumber in certain species.

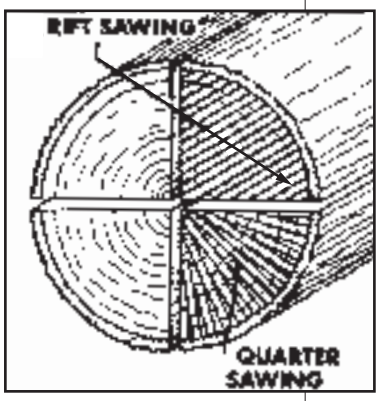
Flat Grain: Easily recognized by its parabolic (arched) effect. Lumber is considered "flat-grained" when the annual growth rings make an angle of less than 45 degrees with the wide surface of the board.

Vertical or Edge Grain: Generally more dimensionally stable than flat grain because it is more likely to change in height than in width with changes in moisture. Lumber is considered "vertical-grained" when the annual growth rings make an angle of 45 to 90 degrees with the wide surface of the board.

(Note: In hardwoods, plainsawn lumber generally contains mostly flat-grained wood, while quartersawn lumber is nearly all vertical-grained. In softwood lumber, the terms "flat-grained" and "vertical-grained" are used instead of the terms "plainsawn" and "quartersawn," respectively. See "Types of saw cut" below.)

Interlocked Grain: Grain in which the fibers may slope in a right-handed direction for several years, in a left-handed direction for several years, back to right-handed, and so on. A high degree of interlocked grain may make a wood difficult to machine.

TYPES OF SAW CUT: Lumber is either plainsawn, quartersawn or riftsawn.



Plainsawing is the most common and least expensive method of sawing; most wood flooring is cut this way. Plainsawn lumber is obtained by making the first saw cut on a tangent to the circumference of the log and remaining cuts parallel to the first. This method is the most economical, because it provides the widest boards and results in the least waste.

Since most of the lumber produced by plainsawing is flat-grained, with some vertical-grained wood included, plainsawn lumber will tend to contain more variation within and among boards than quartersawn lumber, in which nearly all of the wood is vertical-grained. Also, since flat-grained wood is less dimensionally stable than vertical-grained, plainsawn lumber will tend to expand and contract more across the width of the boards than quartersawn lumber.

Other physical differences to consider when choosing plainsawn lumber rather than quartersawn:

- Figure patterns resulting from the annual rings and some other types of figures are usually brought out more conspicuously by plainsawing.
- Shakes and pitch pockets, when present, extend through fewer boards.

In quartersawing, lumber is produced by first quartering the log and then sawing perpendicular to the growth rings. Quartersawing produces relatively narrow boards, nearly all vertical-grained, and creates more waste, making quartersawn lumber more expensive than plainsawn. However, much quartersawn wood is obtained by culling the vertical-grained wood that naturally results from plainsawing.

Other physical factors to keep in mind when choosing quartersawn lumber over plainsawn:

- It twists and cups less.
- It surface-checks and splits less during sea-

soning and in use.

• Raised grain produced by separation in the annual growth rings does not appear as pronounced.

• It wears more evenly.

• Figuring due to pronounced rays, interlocked and wavy grain are brought out more conspicuously.

• Sapwood appears only at the edges, and is limited to the width of the log's sapwood.

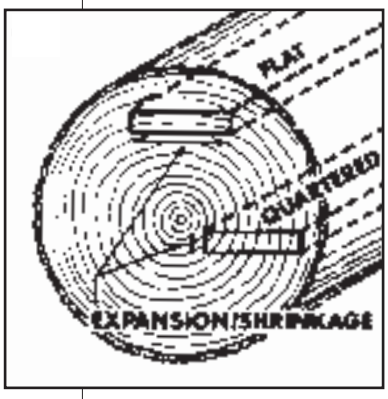
Riftsawing is similar to quartersawing, with many of the same advantages and limitations. It accentuates the vertical grain and minimizes the flake effect common in quartersawn oak. The angle of the cut is changed slightly so that fewer saw cuts are parallel to the medullary rays, which are responsible for the flake effect. Riftsawing creates more waste than quartersawing, making it generally more expensive.

Mechanical properties

MOISTURE CONTENT AND DIMENSIONAL STABILITY: Moisture plays a large part in how wood behaves, both during the machining process and after installation. Installers would do well to study moisture's effect on wood in some detail; however, a brief discussion is included here. (For more information, see the NWFA *Technical Manual A100: Water and Wood*.)

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. In trees, moisture content may be as much as 200 percent of the weight of wood substance. After harvesting and milling, the wood will be dried to the proper moisture content for its end use.

Wood is dimensionally stable when the moisture content is above the fiber saturation point (usually about 30 percent moisture content). Below that, wood changes dimension when it gains or loses moisture.



The ideal moisture content for flooring installation can vary from an extreme of 4 to 18 percent, depending on the wood species, the geographic location of the end product and the time of year. Most oak flooring, for example, is milled at 6 to 9 percent. Before installation, solid wood flooring should be acclimated to the area in which it is to be used, then tested with a moisture meter to ensure the proper moisture content.

(Note: Engineered flooring tends to be more dimensionally stable than solid flooring and may not require acclimation prior to installation—check with the manufacturer of the flooring for that product's recommendations.)

Different woods exhibit different moisture stability factors, but they generally shrink and swell the most in the direction of the annual 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.

The individual species descriptions that follow include an indication of dimensional stability, from "below average" to "excellent." For a comparison of the relative dimensional stability of several species, refer to the chart on page 8. Keep in mind that the shrinkage values come from laboratory testing, and some woods shown to be relatively stable in the lab have demonstrated significant movement on actual job sites.

For wood flooring professionals, it's important to inform end users about the normal behavior of wood in relation to moisture. Most solid wood flooring will contract during periods of low humidity (during the heating season, for example), sometimes leaving noticeable cracks between boards. To minimize this effect, users should stabilize the environment of the building through temperature and humidity control.

HARDNESS AND DURABILITY: Probably the most important strength property for wood used in flooring applications is its side hardness, also known as Janka hardness. Side hardness represents the resistance of wood to wear, denting and marring. It is measured by the load required to embed a 0.444-inch steel ball to one-half its diameter in the wood. Janka hardness ratings are generally based on an average of tests on both tangential and radial (plainsawn and quartersawn) samples. A comparison chart of the Janka hardness ratings for each of the species described in this chapter appears on page 7. Also, the individual species descriptions include a percentage comparison to indicate each species' hardness relative to Northern red oak.

INSTALLATION AND NAILING: When nailing some of the denser woods with hand or air nailers, installers may encounter splitting tongues, as well as failure to secure the fastener even after repeated attempts. This can sometimes be corrected by changing the angle of the nail's point of entry. On certain exceptionally dense species, pilot holes may have to be drilled to ease nailing. Blunting the ends of fasteners may also help prevent splitting. With pneumatic nailers, the air pressure may need to be adjusted to reduce splintering or tongue breakage.

Though dense, heavy woods normally offer higher nail-withdrawal resistance, less dense species allow the use of more and larger-diameter fasteners to compensate for their lower holding ability. When nailing imported species, check with the supplier for the recommended fastener.

Take precautions while working with some woods, especially exotic species. Splinters should be removed immediately, as some species have been known to cause an adverse reaction in some people.

SANDING: 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 of sandpaper than normal, or to change the sandpaper more often than with other species.

Also, the wood dust created by sanding some species tends to cause an allergic reaction in some people. This is more likely to occur with imported species than with domestic. However, even North American oak has been known to cause a skin rash or respiratory difficulties in some people. Where applicable, known tendencies to cause allergic reactions are noted.

As a precaution, flooring mechanics should wear respirators (with a rating of at least N95/NIOSH-approved) and eye protection when sanding. To test for possible allergic reaction to a species, perform a skin-patch test by placing a small amount of wood dust under a round adhesive bandage on the inside of the forearm. If serious skin irritation is present when the bandage is removed after 24 hours, consider not working with that species.

For more information on sanding, see the NWFA *Technical Manual B200: Sanding and Finishing of Hardwood Floors*.

FINISHING: Many finish formulations are undergoing continual change as their manufacturers move to comply with evolving environmental regulations, making hard-and-fast finishing rules difficult to come by.

Some woods, especially imports, contain oils and chemical compounds that may adversely react with certain types of finishes to inhibit drying, dramatically change the color of the wood, or both. Some imported 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.

Water-based urethanes tend to leave wood lighter in color. Non-ambering urethanes are often recommended for finishing white, stenciled or pastel floors. Water-based finishes tend to adhere well to most woods, including exotics, whereas some solvent-based finishes have adhesion, drying or color change problems with woods such as teak, Brazilian walnut, purpleheart, padauk and wenge.

For floors that are to be stained to alter the natural color of the wood, flooring professionals should be aware that some species (hard maple, pine and fir, for example) do not accept stain as readily or as evenly as other species.

A grain filler is sometimes used for wood species with large pores, such as oak and walnut, if a smooth finish is desired.

When working with a new species for the first time, installers should test stains and finishes on a small sample of flooring before attempting an installation and also check with the finish manufacturer.

For more information on finishing, see the NWFA *Technical Manual B200: Sanding and Finishing of Hardwood Floors*.

Availability

Just as every individual wood species is dynamic and prone to change in response to its environment, so too is the market for all wood flooring species. Availability estimates were obtained through interviews with industry sources and reflect market conditions during 2010.

EASILY AVAILABLE:

Brazilian cherry (jatoba)
Hard maple
Red oak
Southern yellow pine
White oak

READILY AVAILABLE:

Ash
Australian cypress
Bamboo
Beech
Birch
Black cherry
Black walnut, American
Brazilian walnut (ipé)
Cork
Douglas fir
Hickory/pecan

MODERATELY AVAILABLE:

Brazilian maple
Brazilian teak (cumaru)
Iroko
Jarrah
Padauk
Santos mahogany
Sapele
Spotted gum
Sydney blue gum
Tasmanian oak
Teak, Thai/Burmese

LIMITED AVAILABILITY:

Antique heart pine
Bubinga
Merbau
Mesquite
Purpleheart
Wenge

RELATIVE HARDNESS OF SELECTED WOOD FLOORING SPECIES

(Ranked by Janka hardness rating)

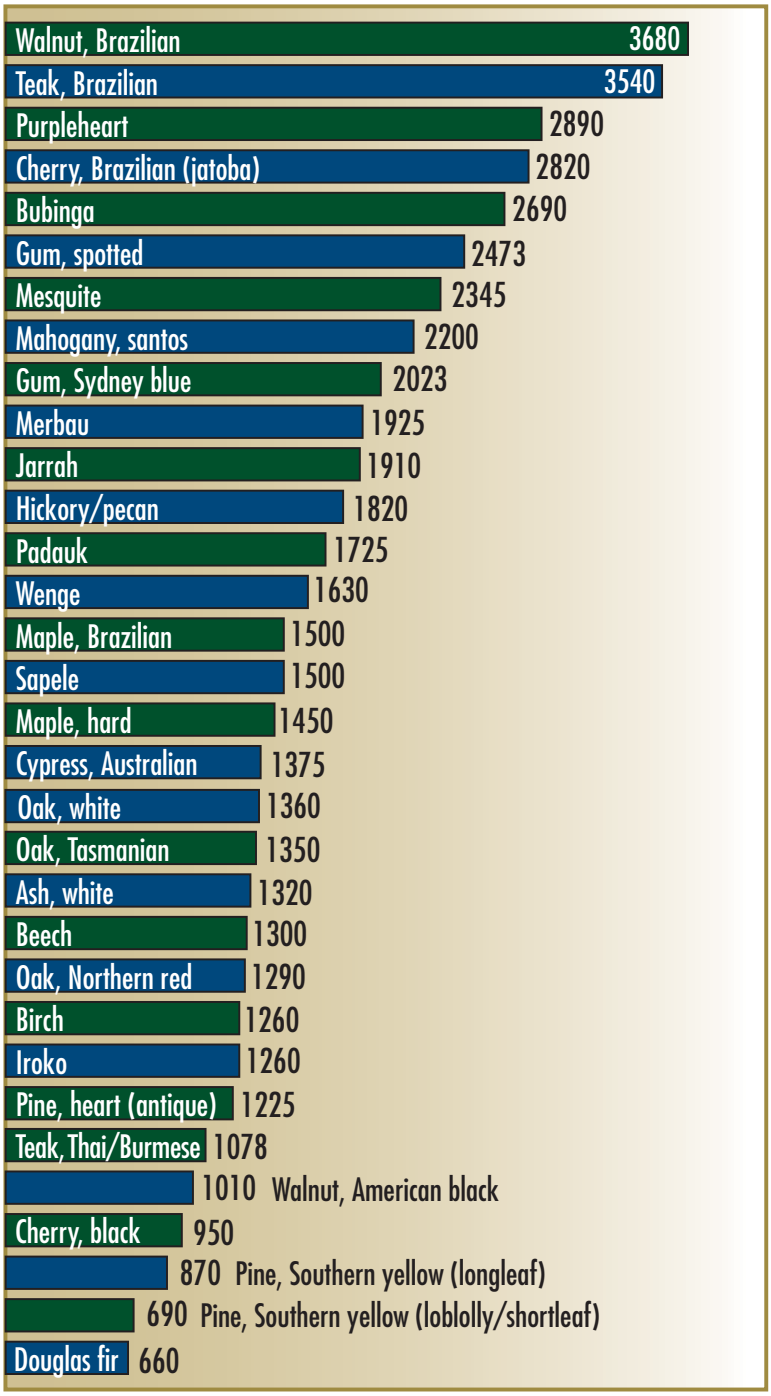
The Janka (or side) hardness test measures the force required to embed a .444-inch steel ball to half its diameter in wood. It is one of the best measures of the ability of a wood species to withstand denting and wear. By the same token, it also is a good indicator of how hard or easy a species is to saw or nail. Northern red oak, for example, has a Janka hardness rating of 1290. Spotted gum, with a rating of 2473, is nearly twice as hard. If you're accustomed to working with red oak and decide to tackle a job with spotted gum, you can expect it to be much harder to cut and nail.

A rating is not included for bamboo, as bamboo flooring varies greatly between different manufacturers' products and between vertical and horizontal construction. Likewise, a rating is not included for cork flooring.

• Source: Hardness ratings for most species taken from the U.S. Dept. of Agriculture, Forest Service, Forest Products Laboratory, Center for Wood Anatomy Research Web site www2.fpl.fs.fed.us/TechSheets/techmenu.html. Bubinga value taken from Wood Handbook: Wood as an Engineering Material (Forest Products Society, 1999). Padauk and Brazilian maple values were provided by Wood Flooring International. Spotted gum, Sydney blue gum and Tasmanian oak values were provided by Boral Timber. The heart pine rating was provided by Mountain Lumber. The mesquite rating was provided by Mesquite Products of Texas.

• Douglas fir rating is an average of ratings for Coast, Interior West and Interior North species.

• Values for Brazilian cherry, purpleheart and Thai/Burmese teak represent average values.



While Janka values give a general sense of hardness, many other factors also contribute to a wood floor's durability, including the type of cut (i.e. plainsawn, quartersawn), denseness of cell structure, and finish used.

RELATIVE STABILITY OF SELECTED WOOD FLOORING SPECIES

(Ranked by percentage of tangential shrinkage from green to ovendry moisture content)

The numbers in the chart reflect the percentage of tangential shrinkage from green to ovendry moisture content for the various species. Tangential change values normally will reflect changes in plainsawn wood. Quartersawn wood usually will be more dimensionally stable than plainsawn.

These percentages are listed only as a means of comparison of stability between the species. As these values represent change from green to ovendry, actual percentage change on job sites will be drastically less.

Although some tropical woods such as Australian cypress, merbau and wenge appear in this chart to have excellent moisture stability compared to domestic oak, actual installations of many of these woods have demonstrated significant movement in use. To avoid problems later, extra care should be taken to inform potential users of these tendencies prior to purchase.

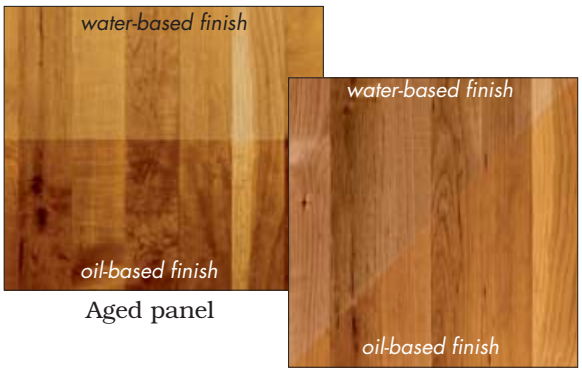
Several species listed in this book are not included in the chart. This data currently is not available for Tasmanian oak, Sydney blue gum and spotted gum. Due to its composited construction, cork is not included, and due to its engineered construction, bamboo is not included. Also, due to the many different species and ages of the wood classified as antique heart pine, that wood is not listed.

• *Source: Stability ratings taken from the U.S. Dept. of Agriculture, Forest Service, Forest Products Laboratory, Center for Wood Anatomy Research Web site www2.fpl.fs.fed.us/TechSheets/techmenu.html.*
• *Douglas fir rating is an average of ratings for Coast, Interior West and Interior North species.*
• *Pine rating is an average of ratings for loblolly, longleaf, shortleaf and slash species.*

COLOR CHANGES IN WOOD FLOORING

Whether finished or unfinished, wood changes color over time due to oxidation and exposure to light. Some species darken in color over time, while others lighten. There is no set value for "color fastness" of a species, so contractors and their customers need to be aware of how much change they should expect from the species they choose. Certain species, including American cherry, Brazilian cherry and many imported species, are especially notorious for their tendency to change in color. A demonstration of this change is shown below. The panels on the left for each species show how the wood had aged since originally being sanded and finished for this publication in 1994. The panels on the right are the same panels as they appear now after being freshly sanded and finished in 2004. It is important to note that all panels shown on the following pages are shown freshly sanded and finished. Some color change is to be expected for all species, and a drastic change can be expected for some.

American cherry



Aged panel

Same panel freshly sanded

Brazilian cherry

Aged panel

Same panel freshly sanded

ASH, WHITE

Fraxinus americana

Appearance

COLOR: Heartwood is light tan to dark brown; sapwood is creamy white. Similar in appearance to white oak, but frequently more yellow.
GRAIN: Bold, straight, moderately open grain with occasional wavy figuring. Can have strong contrast in grain in plainsawn boards.
VARIATIONS WITHIN SPECIES AND GRADES: Sometimes confused with hickory; the zone of large pores is more distinctive in ash, similar to that of red oak.

Properties

HARDNESS/JANKA: 1320.
DIMENSIONAL STABILITY: Above average.

Workability

NAILING: No known problems.
SANDING: Sands satisfactorily if the correct sanding sequence is followed.

Suggested Sequence
First Cut: 50 at a 7 to 15 degree angle to the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 80 or 100
Hard Plate: 100
Screen: 80 or 100

FINISHING: May be difficult to stain.

Origin

North America.

Availability

Readily available.

BEECH

Fagus grandifolia

Appearance

COLOR: Heartwood is mostly reddish brown; sapwood is generally pale white.
GRAIN: Mostly closed, straight grain; fine, uniform texture. Coarser than European beech.
VARIATIONS WITHIN SPECIES AND GRADES: Only one species is native to the United States. Moderate to high color variation between boards.

Properties

HARDNESS (JANKA): 1300.
DIMENSIONAL STABILITY: Below average.

Workability

NAILING: Has a tendency to split the tongues.
SANDING: Sands satisfactorily if correct sanding sequence is followed.

Suggested Sequence
First Cut: 50 or 60 at a 7 to 15 degree angle to the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 80 or 100
Hard Plate: Not recommended
First Screen: 80 or 100
Second Screen: 120 or 150
FINISHING: May be difficult to stain.

Origin

North America.

Availability

Readily available.

BIRCH

Betula spp.

Appearance

COLOR: In yellow birch (*B. alleghaniensis*), sapwood is creamy yellow or pale white; heartwood is light reddish brown tinged with red. In sweet birch (*B. lenta*), sapwood is light colored and heartwood is dark brown tinged with red.
GRAIN: Medium figuring, straight, closed grain, even texture. Occasional curly grain or wavy figure in some boards.
VARIATIONS WITHIN SPECIES AND GRADES: Yellow birch, sweet birch, paper birch. Paper birch (*B. papyrifera*) is softer and lower in weight and strength than yellow or sweet birch. However, yellow birch is most commonly used for flooring. Boards can vary greatly in grain and color.

Properties

SIDE HARDNESS/JANKA: Yellow: 1260.
DIMENSIONAL STABILITY: Average.

Workability:

NAILING: No known problems.
SANDING: Sands satisfactorily if the correct sanding sequence is followed.

Suggested Sequence

First Cut: 50 at a 7 to 15 degree angle to the grain
Second Cut: 80 straight with the grain
Third Cut: 120
Hard Plate: 100 or 120
First Screen: 100
Second Screen: 100

FINISHING: May be difficult to stain.

Origin

North America.

Availability

Readily available.

CHERRY, BLACK

Prunus serotina

Appearance

COLOR: Heartwood is light to dark reddish brown, lustrous; sapwood is light brown to pale with a light pinkish tone. Some flooring manufacturers steam lumber to bleed the darker heartwood color into the sapwood, resulting in a more uniform color. Color darkens significantly with age.
GRAIN: Fine, frequently wavy, uniform texture. Distinctive flake pattern on true quartersawn surfaces. Texture is satiny, with some gum pockets.
VARIATIONS WITHIN SPECIES AND GRADES: Significant color variation between boards.

Properties

HARDNESS (JANKA): 950.
DIMENSIONAL STABILITY: Above average.

Workability

NAILING: No known problems.
SANDING: Sands satisfactorily if the correct sanding sequence is followed.

Suggested Sequence
First Cut: 60 at a 7-15 degree angle with the grain
Second Cut: 80 straight with the grain
Third Cut: 100
Hard Plate: Not recommended
Screen: 80 or 100

FINISHING: No known problems.

Origin

North America.

Availability

Readily available.

DOUGLAS FIR

Pseudotsuga menziesii

Appearance

COLOR: Heartwood is yellowish tan to light brown. Sapwood is tan to white. Heartwood may be confused with that of Southern yellow pine. Radical color change upon exposure to sunlight.
GRAIN: Normally straight, with occasional wavy or spiral texture. Nearly all fir flooring is vertical-grain or riftsawn clear-grade material.
VARIATIONS WITHIN SPECIES AND GRADES: Wood varies greatly in weight and strength. Young trees of moderate to rapid growth have reddish heartwood and are called red fir. The narrow-ringed wood of old trees may be yellowish-brown and is known as yellow fir.

Properties

HARDNESS (JANKA): 660.
DIMENSIONAL STABILITY: Above average.

Workability

NAILING: No known problems.
SANDING: Sands satisfactorily if the correct sanding sequence is followed.

Suggested Sequence
First Cut: 60 at a 7-15 degree angle with the grain
Second Cut: 80 straight with the grain
Third Cut: 100 or 120
Hard Plate: Not recommended
Screen: 100 or 120

FINISHING: Some boards develop a slight pinkish to bright salmon color when finished with some products. Because of tendency toward color change, care must be taken to avoid oversanding when refinishing an existing floor. May be difficult to stain.
COMMENTS: Sometimes milled as vertical end-grain block, which is significantly harder than plainsawn.

Origin

North America.

Availability

Readily available.

HICKORY/PECAN

Carya spp.

Appearance

COLOR: Pecan heartwood is reddish brown with dark brown stripes; sapwood is white or creamy white with pinkish tones. Hickory heartwood is tan or reddish; sapwood is white to cream, with fine brown lines.
GRAIN: Pecan is open, occasionally wavy or irregular. Hickory is closed, with moderate definition; somewhat rough-textured.
VARIATIONS WITHIN SPECIES AND GRADES: In both hickory and pecan, 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.

Properties

HARDNESS (JANKA): 1820. Pecan is slightly softer than true hickories.
DIMENSIONAL STABILITY: Average.

Workability

NAILING: Has a tendency to split the tongues.
SANDING: Difficult to sand because of density, and because light color makes sander marks show more than on darker woods.

Suggested Sequence

First Cut: 40 or 50 at a 7-15 degree angle with the grain
Second Cut: 50 or 60 straight with the grain
Third Cut: 80 or 100
Hard Plate: 100
Screen: 80 or 100

FINISHING: May be difficult to stain.

Origin

North America.

Availability

Readily available.

MAPLE, SUGAR/HARD

Acer saccharum

Appearance

COLOR: Heartwood is creamy white to light reddish brown; sapwood is pale to creamy white.
GRAIN: Closed, subdued grain, with medium figuring and uniform texture. Occasionally shows quilted, fiddleback, curly or bird's-eye figuring. Figured boards often culled during grading and sold at a premium.
VARIATIONS WITHIN SPECIES AND GRADES: Black maple (*B. nigrum)* is also hard; other species are classified as soft.

Properties

HARDNESS (JANKA): 1450.
DIMENSIONAL STABILITY: Average.

Workability

NAILING: No known problems.
SANDING: Extra care must be taken during sanding and finishing, as sanding marks and finish lines are more obvious due to maple's density and light color. The species also burnishes, dulling fine paper and screens and making it difficult to cut out previous scratches.

Suggested Sequence
First Cut: 50 at a 7 to 15 degree angle to the grain
Second Cut: 80 straight with the grain
Third Cut: 120
Hard Plate: 100 or 120
First Screen: 100
Second Screen: 100

FINISHING: Takes neutral finish well. May be difficult to stain.

Origin

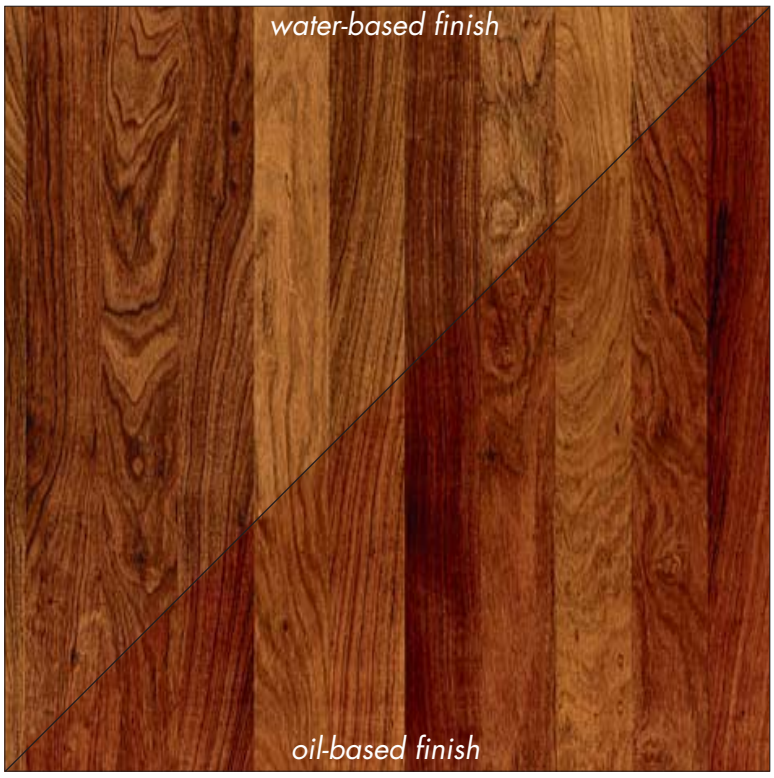
North America.

Availability

Easily available. Figured grains have limited availability.

MESQUITE

Prosopis glandulosa



Appearance

COLOR: Light brown to dark reddish brown.
GRAIN: High in character, with ingrown bark and mineral streaks. Most commonly used in flooring as end-grain block, which has small irregular cracks radiating across the grain.
VARIATIONS WITHIN SPECIES AND GRADES: One grade; moderate color variations.

Properties

HARDNESS (JANKA): 2345.
DIMENSIONAL STABILITY: Excellent.

Workability

NAILING: Splits tongues easily.
SANDING: Plainsawn can be sanded to a smooth surface. End-grain requires a coarser abrasive to flatten; it is recommended that it be flattened by sanding at a 45-degree angle to the grain.

Suggested Sequence
First Cut: 40 or 50 at a 7-15 degree angle with the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 80 or 100
Hard Plate: 100
First Screen: 80 or 100
Second Screen: 120

FINISHING: No known problems.
COMMENTS: End-grain block usage results in a hard, high-wear surface. Produces only shorter-length boards.

Origin

North America.

Availability

Limited availability.

OAK, RED

Quercus spp.

Appearance

COLOR: Heartwood and sapwood are similar, with sapwood lighter in color; most pieces have a reddish tone. Slightly redder than white oak.
GRAIN: Open, slightly coarser (more porous) than white oak. Plainsawn boards have a plumed or flared grain appearance; riftsawn has a tighter grain pattern, low figuring; quartersawn has a flake pattern, sometimes called tiger rays or butterflies.
VARIATIONS WITHIN SPECIES AND GRADES: More than 200 subspecies in North America; great variation in color and grain, depending on the origin of the wood and differences in growing seasons. Northern, Southern and Appalachian red oak all can be divided into upland and lowland species. Because they grow more slowly, upland species have a more uniform grain pattern than lowland species, with more growth rings per inch.

Properties

HARDNESS (JANKA): Northern: 1290, Southern: 1060.
DIMENSIONAL STABILITY: Northern: average, Southern: below average.

Workability

NAILING: No known problems.
SANDING: Sands satisfactorily if the correct sanding sequence is followed.

Suggested Sequence

First Cut: 50 at a 7-15 degree angle with the grain
Second Cut: 80 straight with the grain
Third Cut: 100
Hard Plate: 100
Screen: 100 or 120

FINISHING: Stains well and demonstrates strong stain contrast. Red oak generally works better than white oak for bleached floors because it is more porous, and because tannins in white oak can discolor the floor.

Origin

North America.

Availability

Easily available.

OAK, WHITE

Quercus spp.

Appearance

COLOR: Heartwood is light brown; some boards may have a pinkish tint or a slight grayish cast. Sapwood is white to cream.
GRAIN: Open, with longer rays than red oak. Occasional crotches, swirls and burls. Plainsawn boards have a plumed or flared grain appearance; riftsawn has a tighter grain pattern, low figuring; quartersawn has a flake pattern, sometimes called tiger rays or butterflies.
VARIATIONS WITHIN SPECIES AND GRADES: Considerable variation among boards in color and grain texture, but variations not as pronounced as in red oak.

Properties

HARDNESS (JANKA): 1360.
DIMENSIONAL STABILITY: Average.

Workability

NAILING: No known problems.
SANDING: Sands satisfactorily if the correct sanding sequence is followed.

Suggested Sequence
First Cut: 50 or 60 at a 7-15 degree angle with the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 80 or 100
Hard Plate: 100
Screen: 80 or 100

FINISHING: During the finishing process, tannins at the surface can react with some liquids to turn the wood green or brown. This effect tends to be more pronounced with products that have a high water content, such as wood bleach and water-based finishes. Stains very well and accepts stain evenly.

Origin

North America.

Availability

Easily available.

PINE, ANTIQUE HEART

Pinus spp.

Appearance

COLOR: Heartwood is yellow after cutting and turns deep pinkish tan to warm reddish brown within weeks due to high resin content. Sapwood remains yellow, with occasional blue-black sap stain.
GRAIN: Dense, with high figuring. Plainsawn is swirled; rift- or quartersawn is primarily pinstriped. Curly or burl grain is rare.
VARIATIONS WITHIN SPECIES AND GRADES: Moderate color variation.

Properties

HARDNESS (JANKA): 1225.
DIMENSIONAL STABILITY: Values can vary greatly due to the variety of species and ages used.

Workability

NAILING: No known problems.
SANDING: Tendency to clog paper due to high resin content. Abrasives will need to be changed frequently during sanding. Beginning with a coarse grade may be helpful.

Suggested Sequence
First Cut: 40 at a 7-15 degree angle with the grain
Second Cut: 50 straight with the grain
Third Cut: 80
Hard Plate: Not recommended
Screen: 80

FINISHING: May be difficult to stain. To reduce the wood's tendency to repel finish coats, surface resins may be removed with a 100 percent pure (not recycled) solvent that is compatible with the finish to be used (do not use water).

Origin

North America. Often recovered from structural timbers in pre-1900 warehouses and factories, or as sunken logs from river bottoms.

Availability

Limited.

PINE, SOUTHERN YELLOW

Pinus spp.

Appearance

COLOR: Heartwood varies from light yellow/orange to reddish brown or yellowish brown; sapwood is light tan to yellowish white.
GRAIN: Closed, with high figuring; patterns range from clear to knotty.
VARIATIONS WITHIN SPECIES AND GRADES: Longleaf pine (*P. palustris*), shortleaf pine (*P. echinata*), loblolly pine (*P. taeda*), slash pine (*P. elliottii*). All have many of the same characteristics as Douglas fir. Old-growth lumber in these varieties has substantially higher density and is more stable than second-growth material.

Properties

HARDNESS (JANKA): Loblolly and shortleaf 690; longleaf 870.
DIMENSIONAL STABILITY: Above average.

Workability

NAILING: No known problems.
SANDING: Resin in wood tends to clog abrasives; frequent sandpaper changes are required.

Suggested Sequence
First Cut: 50 at a 7-15 degree angle with the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 80 or 100
Hard Plate: Not recommended
Screen: 80 or 100

FINISHING: May be difficult to stain. To reduce the wood's tendency to repel finish coats, surface resins may be removed with a 100 percent pure (not recycled) solvent that is compatible with the finish to be used (do not use water).
COMMENTS: Generally manufactured for flooring with no end-match; sometimes flooring is "distressed" to create an antique look.

Origin

North America.

Availability

Easily available.

WALNUT, AMERICAN BLACK

Juglans nigra

Appearance

COLOR: Heartwood ranges from a deep, rich dark brown to a purplish black. Sapwood is nearly white to tan. Difference between heartwood and sapwood color is great; some flooring manufacturers steam lumber to bleed the darker heartwood color into the sapwood, resulting in a more uniform color.
GRAIN: Mostly straight and open, but some boards have burled or curly grain. Arrangement of pores is similar to hickories and persimmon, but pores are smaller in size.
VARIATIONS WITHIN SPECIES AND GRADES: Great variety of color and figure within species, as well as variation in color among boards, especially in lower grades and from material that isn't steamed prior to kiln-drying.

Properties

HARDNESS (JANKA): 1010.
DIMENSIONAL STABILITY: Average.

Workability

NAILING: No known problems.
SANDING: Sands satisfactorily.
Suggested Sequence
First Cut: 60 at a 7-15 degree angle with the grain
Second Cut: 80 straight with the grain
Third Cut: 100
Hard Plate: Not recommended
First Screen: 80 or 100
Second Screen: 100 or 120
FINISHING: No known finishing problems.
COMMENTS: Frequently used as a highlight material for borders or other inlay techniques.

Origin

North America.

Availability

Readily available.

BAMBOO

Phyllostachys spp.

Appearance

COLOR: Typically available in light (manila/yellow tones) or dark (tannish brown) shades. Colors vary between manufacturers.
GRAIN: Distinctive grain pattern shows nodes from the bamboo stalks.
VARIATIONS WITHIN GRADES: Available either horizontally or vertically laminated. Horizontal construction tends to show nodes more prominently.

Properties

HARDNESS (JANKA): Bamboo is a grass. Janka values vary widely between various manufacturers and between horizontal and vertical construction.
DIMENSIONAL STABILITY: Engineered construction.

Workability

NAILING: No known problems.
SANDING: Due to its unique, fibrous structure, bamboo should not be sanded across the grain or at a 45-degree angle to the grain. Its light color tends to show swirl marks, other sanding marks and finish imperfections, much as a light maple floor can.

Suggested Sequence
First Cut: 60 at a 7-15 degree angle with the grain
Second Cut: 80 straight with the grain
Third Cut: 100 or 120
Hard Plate: Not recommended
First Screen: 100 or 120
Second Screen: 150

FINISHING: All surface-type finishes have been used successfully with bamboo. Darker colors may tend to show lap marks—moving quickly during application and applying finish quickly around cut-in areas can minimize this effect. Filling is recommended.
COMMENTS: Mostly available factory-finished. Because the product is rigid, installers should pay careful attention to the flatness of the subfloor.

Origin

Asia. The majority is made in China from Phyllostachys pubescens (common name: Moso); however, some is made from different bamboo species grown in countries such as Vietnam.

Availability

Readily available.

BUBINGA

Guibourtia demeusei

Appearance

COLOR: Pink, red or red/brown with purple streaks or veins; changes from pinkish rose when freshly milled to burgundy red when aged.
GRAIN: Fine; straight or interlocked, can be highly figured.
VARIATIONS WITHIN SPECIES AND GRADES: Quartered exhibits flame figure; flatsawn has rosewood graining.

Properties

HARDNESS (JANKA): 2690.
DIMENSIONAL STABILITY: Average.

Workability

NAILING: Tends to split tongues. Pre-drilling and hand-nailing may be preferred.
SANDING: Sands satisfactorily if correct sanding sequence is followed.

Suggested Sequence
First Cut: 50 at a 7-15 degree angle with the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 100
Hard Plate: 100
First Screen: 80
Second Screen: 100 or 120

FINISHING: Test all products before using them on the actual floor. Oil-modified finished will require a lengthy dry time. **(See finishing comments on page 6.)**
COMMENTS: Dust has been known to cause contact dermatitis.

Origin

Africa.

Availability

Limited availability.

CHERRY, BRAZILIAN

Jatoba

Hymenaea courbaril

Appearance

COLOR: Sapwood is gray-white; heartwood is salmon red to orange-brown when fresh and becomes russet or reddish brown when seasoned; often marked with dark streaks.
GRAIN: Mostly interlocked; texture is medium to rather coarse.
VARIATIONS WITHIN SPECIES AND GRADES: Moderate to high color variation.

Properties

HARDNESS (JANKA): Average of 2820.
DIMENSIONAL STABILITY: Average. However, actual installations have shown significant movement. Longer-than-normal acclimation time is recommended.

Workability

NAILING: Due to hardness it is very important that the angle of penetration be adjusted carefully. If using a pneumatic nailer, the air pressure should be adjusted.
SANDING: Scratches are easily seen—each sanding must carefully remove the scratches from the previous cut, or sanding marks will be visible in the finish.

Suggested Sequence

First Cut: 50 at a 7-15 degree angle with the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 100
Hard Plate: 100
First Screen: 80
Second Screen: 100 or 120

FINISHING: 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. These are spots of calcium carbonate and are a naturally occurring part of the species.
(See finishing comments on page 6.)

Origin

South America.

Availability

Easily available.

CORK

Quercus suber

Appearance

COLOR: Varies from light to dark; many colors available depending on manufacturer.
GRAIN: Distinctive look unlike wood—cork is actually the bark of a type of oak.
VARIATIONS WITHIN SPECIES AND GRADES: Many patterns available depending on manufacturer.

Properties

HARDNESS (JANKA): Varies.
DIMENSIONAL STABILITY: Cork reacts quickly, sometimes within hours, to changes in moisture. (Typical dimensional stability measurements do not apply to cork's composite construction.)

Workability

NAILING: Cork is installed using adhesive.
SANDING: Use the finest grit possible to flatten the floor. The following sequences are recommended for use only with a multi-disc sander or a hardplate on a buffer. If the edger is used, fine sandpaper (100/120/150) should be backed with a maroon pad. Small orbital sanders or hand-sanding are recommended for corners and wall lines, as hand-scrapers may gouge the cork.

Suggested Sequence
First Cut: 100
Second Cut: 120
Third Cut: Not recommended
Hard Plate: 120 or 150
First Screen: 120
Second Screen: 120

FINISHING: All surface-type finishes are successfully used on cork (choose a finish that will bend as the cork compresses). Oil-and-wax also is used frequently.
COMMENTS: Pay particular attention to subfloor preparation, as cork is very sensitive to moisture, and also transfers any imperfections in the subfloor to the surface appearance.

Origin

Spain and Portugal.

Availability

Readily available.

CYPRESS, AUSTRALIAN

Callitris glauca

Appearance

COLOR: Cream-colored sapwood; heartwood is honey-gold to brown with darker knots throughout.
GRAIN: Closed.
VARIATIONS WITHIN SPECIES AND GRADES: High degree of color variability.

Properties

HARDNESS (JANKA): 1375.
DIMENSIONAL STABILITY: Excellent. However, actual installations have demonstrated significant movement.

Workability:

NAILING: Can be brittle (like Brazilian cherry); splits tongues easily.
SANDING: Tendency to clog paper due to high resin content. Hardplating and screening may leave swirls; screening more than twice may be necessary. The knots are extremely hard and may cause wave in the floor. A 12-by-18-inch oscillating sander is recommended as the final screening to minimize the scratch pattern.

Suggested Sequence
First Cut: 50 at a 7-15 degree angle with the grain
Second Cut: 60 straight with the grain
Third Cut: 80 or 100
Hard Plate: 100 or 120
First Screen: 100
Second Screen: 120 or 150

FINISHING: Knots may cause drying problems with some finishes. **(See finishing comments on page 6.)**
COMMENTS: Potential for respiratory/allergic recations.

Origin

Australia.

Availability

Readily available.

GUM, SPOTTED

Corymbia maculata (formerly Eucalyptus maculata)

Appearance

COLOR: Heartwood is light to dark brown, sapwood is pale and may be as wide as 3.12 inches (8 cm).
GRAIN: Interlocked, moderately coarse. Frequent presence of wavy grain produces "fiddleback" grain. Slightly greasy; gum veins are common.

Properties

HARDNESS (JANKA): 2473.
DIMENSIONAL STABILITY: Data not available.

Workability

NAILING: Pre-drilling and hand-nailing may be preferred.
SANDING: No known problems.

Suggested Sequence

First Cut: 50 at a 7-15 degree angle with the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 100
Hard Plate: 120
First Screen: 100
Second Screen: 120
FINISHING: No known problems.

Origin

Australia.

Availability

Moderately available.

GUM, SYDNEY BLUE

Eucalyptus saligna

Appearance

COLOR: Wide range from pinks to burgundy reds; regrowth timber may be a pale straw color with pink highlights. Colors mute over time and darken to a medium brown-red.

Properties

HARDNESS (JANKA): 2023.
DIMENSIONAL STABILITY: Data not available.

Workability

NAILING: Pre-drilling and hand-nailing may be preferred.
SANDING: No known problems.

Suggested Sequence

First Cut: 50 at a 7-15 degree angle with the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 100
Hard Plate: 120
First Screen: 100
Second Screen: 120

FINISHING: No known finishing problems.

Origin

Australia.

Availability

Moderately available.

IROKO

Kambala

Chlorophora excelsa

Appearance

COLOR: Light to medium brown when newly installed; has a significant color change and turns to brown/dark brown over time.
GRAIN: Interlocked medium to coarse texture.
VARIATIONS WITHIN SPECIES AND GRADES: Dramatic difference between quartersawn and flatsawn products.

Properties

HARDNESS (JANKA): 1260.
DIMENSIONAL STABILITY: Excellent.

Workability

NAILING: No known problems.
SANDING: No known problems.

Suggested Sequence

First Cut: 50 at a 7-15 degree angle with the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 100
Hard Plate: 120
First Screen: 100
Second Screen: 120

FINISHING: Staining and/or bleaching this species may be difficult. No finish compatibility problems are known.
COMMENTS: Dust is known to cause both contact dermatitis and respiratory reactions.

Origin

Africa.

Availability

Moderately available.

JARRAH

Eucalyptus marginata

Appearance

COLOR: Heartwood is uniformly pinkish to dark red, often a rich, dark red mahogany hue, turning a deep brownish red with age and exposure; sapwood is pale. Frequent black streaks with occasional in-grown grain.
GRAIN: Frequently interlocked or wavy. Texture is even and moderately coarse.
VARIATIONS WITHIN SPECIES AND GRADES: Moderate to high color variation.

Properties

HARDNESS (JANKA): 1910.
DIMENSIONAL STABILITY: Below average.

Workability

NAILING: No known problems.
SANDING: Sands well, but dust can stain fabric and wall treatments.

Suggested Sequence

First Cut: 50 at a 7-15 degree angle with the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 100
Hard Plate: 120
First Screen: 100
Second Screen: 120

FINISHING: Red color can bleed into some finishes—a problem when mixing species.
COMMENTS: Resistant to termites and fungus.

Origin

Australia.

Availability

Moderately available.

MAHOGANY, SANTOS

Myroxylon balsamum

Appearance

COLOR: Dark reddish brown.
GRAIN: Striped figuring in quartersawn selections; texture is even and very fine.
VARIATIONS WITHIN SPECIES AND GRADES: Moderate color variation.

Properties

HARDNESS (JANKA): 2200.
DIMENSIONAL STABILITY: Above average.

Workability

NAILING: No known problems.
SANDING: Sands satisfactorily.

Suggested Sequence

First Cut: 40 or 50 at a 7-15 degree angle with the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 100
Hard Plate: 100
First Screen: 80
Second Screen: 100 or 120

FINISHING: Oil residue may be a problem. This can be eliminated by wiping with the appropriate 100 percent pure (not recycled) solvent before the sealer is applied. **(See finishing comments on page 6.)**
COMMENTS: Some respiratory/allergic reaction potential.

Origin

South America.

Availability

Moderately available.

MAPLE, BRAZILIAN

Pau marfim, Guatambu

Balfourodendron riedelianum

Appearance

COLOR: Pale cream to yellow cream; no contrast between sapwood and heartwood.
GRAIN: Straight, fine, uniform.
VARIATIONS WITHIN SPECIES AND GRADES: Lower grades may have darker tan/brown colors.

Properties

HARDNESS (JANKA): 1500.
DIMENSIONAL STABILITY: Average. Very sensitive to moisture fluctuations.

Workability

NAILING: No known problems.
SANDING: Sands satisfactorily if correct sanding sequence is followed.

Suggested Sequence

First Cut: 50 at a 7-15 degree angle with the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 100
Hard Plate: 100
First Screen: 100
Second Screen: 120 or 150
FINISHING: Takes finish well. May be difficult to stain.

Origin

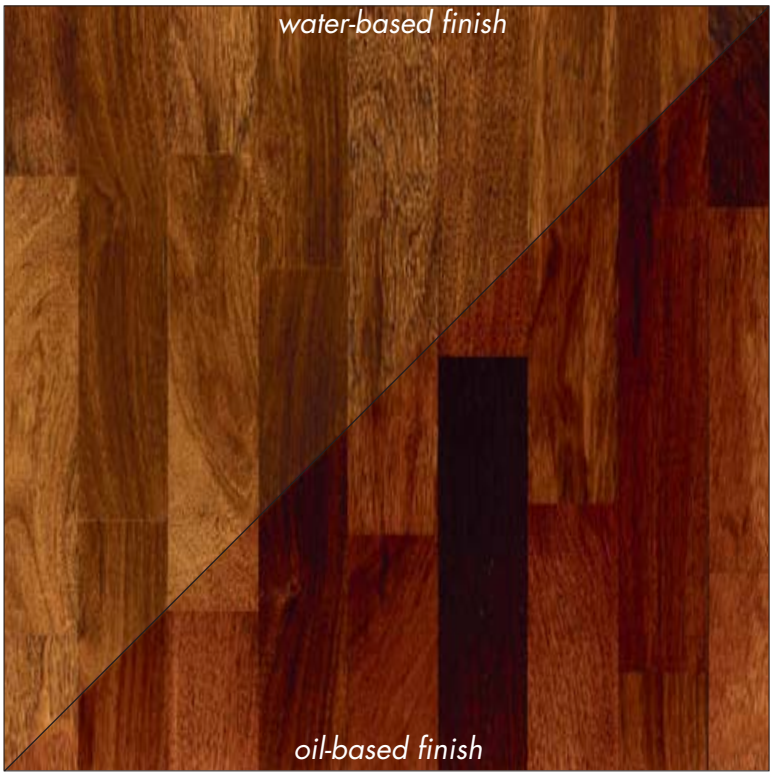
South America.

Availability

Moderately available.

MERBAU

Ipil, Kwila
Intsia spp.



Appearance

COLOR: Heartwood is yellowish to orange-brown when freshly cut, turning brown or dark red-brown upon exposure.
GRAIN: Straight to interlocked or wavy; coarse texture.
VARIATIONS WITHIN SPECIES AND GRADES: Moderate to high variation in color.

Properties

HARDNESS (JANKA): 1925.
DIMENSIONAL STABILITY: Excellent. However, actual installations have shown significant movement in use.

Workability

NAILING: No known problems.
SANDING: Sands satisfactorily if correct sanding sequence is followed.

Suggested Sequence
First Cut: 60 at a 7-15 degree angle with the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 100
Hard Plate: 120
First Screen: 100
Second Screen: 120

FINISHING: Takes neutral finish well. May be difficult to stain.
COMMENTS: High resistance to termites.

Origin

Southeast Asia.

Availability

Limited availability.

OAK, TASMANIAN

Victorian ash

Eucalyptus regnans/obliqua/delegatensis

Appearance

COLOR: Pale straw with occasional pinkish highlights, tan colors, some medium gray/brown colors; over time overall color variation is muted with an ambering of the straw colors to darker tan.
GRAIN: All riftsawn.
VARIATIONS WITHIN SPECIES AND GRADES: Even range of color shadings.

Properties

HARDNESS (JANKA): 1350.
DIMENSIONAL STABILITY: Data not available.

Workability

NAILING: No known problems.
SANDING: Sands satisfactorily if correct sanding sequence is followed.

Suggested Sequence

First Cut: 50 or 60 at a 7-15 degree angle with the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 80 or 100
Hard Plate: 80 or 100
First Screen: 80
Second Screen: 100 or 120

FINISHING: No known finishing problems.
COMMENTS: Has been known to cause contact dermatitis.

Origin

Australia.

Availability

Moderately available.

PADAUK

Pterocarpus soyauxii

Appearance

COLOR: Heartwood is vivid reddish orange when freshly cut, darkening to reddish- or purple-brown
or black over time. Sapwood is cream-colored. Very uniform in color.
GRAIN: Straight to interlocked; coarse texture.
VARIATIONS WITHIN SPECIES AND GRADES: Slight variation in color.

Properties

HARDNESS (JANKA): 1725.
DIMENSIONAL STABILITY: Excellent.

Workability

NAILING: No known problems.
SANDING: Sands satisfactorily. Job site furniture, walls, etc., should be protected from the fine red powder produced when sanding.

Suggested Sequence

First Cut: 40 at a 7-15 degree angle with the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 80 or 100
Hard Plate: 100
First Screen: 80
Second Screen: 100 or 120

FINISHING: Because of the oil in the wood, oil-modified finishes may require long dry times. Waterborne finishes are often recommended. Has a tendency to bleed. Conversion varnishes also have been known to work well. **(See finishing comments on page 6.)**
COMMENTS: Dermatological and respiratory allergic potential.

Origin

Africa.

Availability

Moderately available.

PURPLEHEART

Amaranth

Peltogyne spp.

Appearance

COLOR: Heartwood is brown when freshly cut, turning deep purple to purplish-brown over time. Sapwood is a lighter cream color.
GRAIN: Usually straight; medium to fine texture. Presence of minerals in some boards may cause uneven coloration.
VARIATIONS WITHIN SPECIES AND GRADES: Moderate to high color variation.

Properties

HARDNESS (JANKA): 2890.
DIMENSIONAL STABILITY: Above average.

Workability

NAILING: Good holding ability.
SANDING: Moderately difficult.

Suggested Sequence
First Cut: 50 at a 7-15 degree angle with the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 80 or 100
Hard Plate: 100
First Screen: 80
Second Screen: 100 or 120

FINISHING: Takes finishes well; some have found that water-based finishes hold color better. Tendency to bleed with some finishes. **(See finishing comments on page 6.)**
COMMENTS: Often used as a feature strip or as part of an inlay.

Origin

Mexico, Central and South America.

Availability

Limited availability.

SAPELE

Entandrophragma cynlindricum

Appearance

COLOR: Medium to dark red-brown; darkens over time.
GRAIN: Fine, interlocked.
VARIATIONS WITHIN SPECIES AND GRADES: Quartersawn material has a ribbon-striped effect.

Properties

HARDNESS (JANKA): 1500.
DIMENSIONAL STABILITY: Above average.

Workability

NAILING: No known problems.
SANDING: Sands satisfactorily if correct sanding sequence is followed.

Suggested Sequence

First Cut: 50 at a 7-15 degree angle with the grain
Second Cut: 80 straight with the grain
Third Cut: 100
Hard Plate: 100 or 120
First Screen: 100 or 120
Second Screen: 150

FINISHING: Staining may over-darken the wood. No known finishing problems.

Origin

Africa.

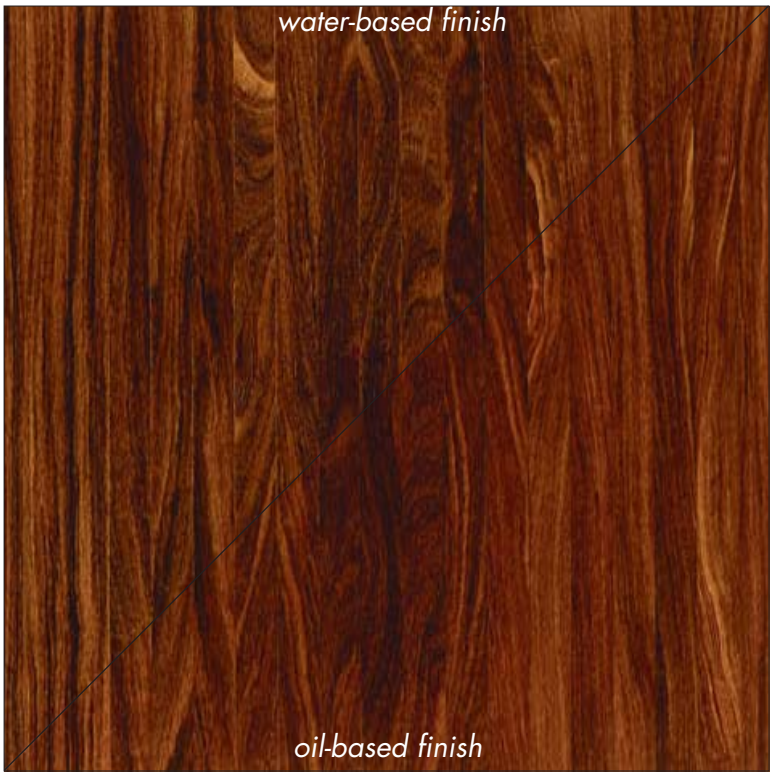
Availability

Moderately available.

TEAK, BRAZILIAN

Cumaru, Tonka, Southern Chestnut, Brazilian Chestnut

Dipteryx odorata



Appearance

COLOR: At first, red-brown or purple-brown with light yellow-brown or purple streaks; after exposure, uniform light brown or yellow-brown.
GRAIN: Fine texture, interlocked, waxy or oily feel.
VARIATIONS WITHIN SPECIES AND GRADES: Dramatic shading that mellows as the floor matures.

Properties

HARDNESS (JANKA): 3540.
DIMENSIONAL STABILITY: Average.

Workability

NAILING: Pre-drilling and hand-nailing are preferred.
SANDING: Difficult. Scratches are easily seen—each sanding must carefully remove the scratches from the previous cut, or sanding marks will be visible in the finish.

Suggested Sequence

First Cut: 50 at a 7-15 degree angle with the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 100
Hard Plate: 100
First Screen: 80
Second Screen: 100 or 120

FINISHING: Test all products before using them on the actual job site. Oil-modified finishes may not dry when applied over this wood if standard procedures are followed. Moisture-cure urethane, conversion varnish and waterborne finishes are generally more successful with this species. **(See finish comments on page 6.)** 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. These are spots of calcium carbonate and are a naturally occurring part of the species.
COMMENTS: Has been known to cause contact dermatitis.

Origin

South America.

Availability

Moderately available.

TEAK, THAI/BURMESE

Tectona grandis

Appearance

COLOR: Heartwood varies from yellow-brown to dark golden brown; turns rich brown under exposure to sunlight. Sapwood is a lighter cream color.
GRAIN: Straight; coarse, uneven texture.
VARIATIONS WITHIN SPECIES AND GRADES: Moderate to high color variation.

Properties

HARDNESS (JANKA): Average of 1000.
DIMENSIONAL STABILITY: Excellent.

Workability

NAILING: No known problems.
SANDING: Clogs abrasives; frequent sandpaper changes are required. Generally difficult to sand—it may dish out if screened too much with a dull screen, and the edger digs easily.

Suggested Sequence

First Cut: 50 or 60 at a 7-15 degree angle with the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 100
Hard Plate: 100 or 120
First Screen: 100
Second Screen: 120 or 150

FINISHING: Natural oils may interfere with adhesion and drying of some finishes. To reduce the wood's tendency to repel finish coats, surface resins may be removed with a 100-percent pure (not recycled) solvent that is compatible with the finish to be used. **(See finish comments on page 6.)**
COMMENTS: Has an oily feel. Respiratory and dermatological allergic potential.

Origin

Asia.

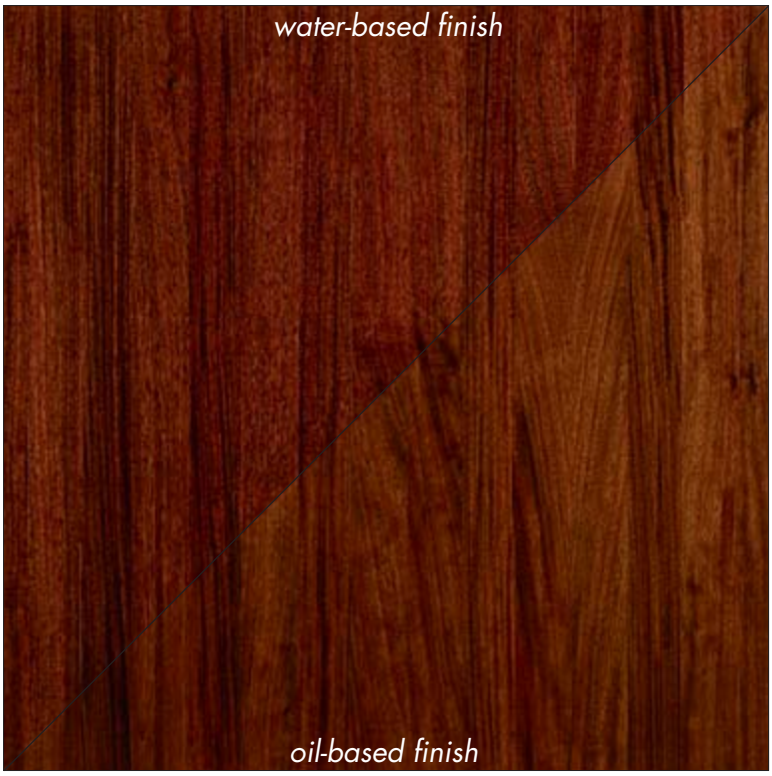
Availability

Moderately available.

WALNUT, BRAZILIAN

Ipé

Tabebuia spp



Appearance

COLOR: Can vary from light yellowish tan with green overtones to almost blackish brown; exhibits a large range of coloration when freshly milled; darkens over time to medium to dark brown.
GRAIN: Fine to medium, straight to very irregular.

Properties

HARDNESS (JANKA): 3680.
DIMENSIONAL STABILITY: Average.

Workability

NAILING: Predrilling and hand-nailing may be preferred.
SANDING: Difficult. The wood is dense and oily. Scratches are easily seen—each sanding must carefully remove the scratches from the previous cut, or sanding marks will be visible in the finish.

Suggested Sequence
First Cut: 40 or 50 at a 7-15 degree angle with the grain
Second Cut: 60 or 80 straight with the grain
Third Cut: 80 or 100
Hard Plate: 100 or 120
First Screen: 100
Second Screen: 120 or 150

FINISHING: Test all products before using them on the actual floor. Oil-modified finish will require a lengthy dry time. Successful techniques include using a moisture-cure urethane sealer and a waterborne topcoat, or burnishing and sealing with a shellac-based sealer, then applying wax or oil and wax. **(See finish comments on page 6.)**
COMMENTS: Often used as a decking material. Has been known to cause contact dermatitis.

Origin

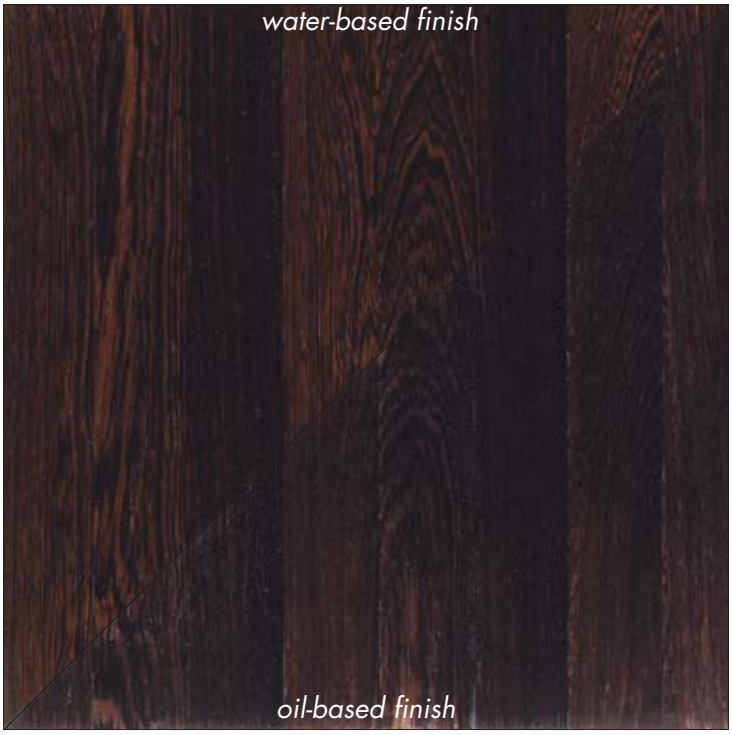
South America.

Availability

Readily available.

WENGE

Panga-panga
Millettia spp.



Appearance

COLOR: Heartwood is yellow-brown when freshly cut, turning dark brown to almost black with alternate layers of light and dark. Sapwood is yellowish-white and clearly demarcated from heartwood.
GRAIN: Straight when quartersawn; coarse texture.
VARIATIONS WITHIN SPECIES AND GRADES: Moderate variations in color.

Properties

HARDNESS (JANKA): 1630.
DIMENSIONAL STABILITY: Excellent. However, actual installations have shown significant movement in use.

Workability

NAILING: No known problems.
SANDING: Moderately difficult. Particular attention should be paid to removing the scratches from the previous sanding.

Suggested Sequence

First Cut: 50 at a 7-15 degree angle with the grain
Second Cut: 60 straight with the grain
Third Cut: 80 or 100
Hard Plate: 100
Screen: 100 or 120

FINISHING: Staining may be difficult.
COMMENTS: Dermatological and respiratory allergic potential.

Origin

Africa.

Availability

Limited availability.

SOURCES AND CREDITS

2010 TECHNICAL MANUAL COMMITTEE:
Janet Sullivan, Lenmar Inc.; Chairperson
Johannes Boonstra, Synteko Floor Finishes
Craig Dupra, Installers Warehouse Inc
John Freeto, WoodCraft Wood Floors Inc
Robert Humphreys, Majestic Wood Floors Inc
Mike Johns, Bostik Inc.
Mike Kearns, Primatech Inc.
Sprigg Lynn, Universal Floors Inc
Neil Moss, Armstrong Floor Products N.A.
Kevin Mullany, Benchmark Wood Floors Inc
Jim Schumacher, 3M
Steve Sharko, Les Bois G.B. Wood Inc.

THE FOLLOWING CONTRIBUTED INFORMATION FOR THIS PUBLICATION AND/OR SERVED AS REVIEWERS:
- Aged Woods, Jeff Horn
- Boone Flooring, Joe Sr., Joe Jr. and Daniel Boone
- Brickman Wood Floors, Howard Brickman
- Cornerstone Flooring, Tim McCool
- Derr Flooring, Chet Derr III
- Diamond "W" Floor Covering, Dennis Parks
- Firebird Industries, Greg McGavran
- Forest Products Laboratory, U.S. Forest Service, Regis Miller and William Simpson
- Galleher Hardwood, Jeff Hamar
- Golden State Flooring, Chris Coates
- Kelly-Goodwin Co., Mike Bennett
- Glitsa American, Bill Price
- Goodwin Heart Pine, Carol and George Goodwin
- Indiana Hardwood Specialists, Tom Derleth
- International Hardwood Flooring, Bill Jopling
- Kentucky Wood Floors, John Stern
- Lockwood Flooring, Lynne Schwan
- Lon Musolf Distributing, Lynn Musolf
- Maple Flooring Manufacturers Association, Rob Paterkiewicz
- Mastercraft Floors, Nick Kulhawy
- Mesquite Products of Texas, Doug Florence
- Mountain Lumber, Willie Drake and John Williams
- Mullican Flooring, Don Conner
- NOFMA: The Wood Floor Manufacturers Association, Mickey Moore
- Precision Flooring Services, Hu Smithers
- Primatech, Richard Poirier
- Quality Woods, Bob Steber
- Renaissance Floor In-Lays, Eugene Klotz
- Shelman USA, Dick Garwood
- Southern Forest Products Association, Richard Kleiner
- Wood Floor Products Inc., Don Bollinger

THE FOLLOWING COMPANIES CONTRIBUTED PRODUCTS FOR THIS PUBLICATION:
- Action Floor Systems
- Allwoods Hardwood Flooring
- Blake-Stevens Wood Flooring
- Boen Hardwood Flooring
- Dean Hardwoods
- Dimension Hardwood/Plaza Hardwood
- Firebird Industries
- Golden State Flooring
- Goodwin Heart Pine
- Grafco Hardwood Floors
- Hardwood Flooring Center
- Indiana Hardwood Specialists
- International Hardwood Flooring
- Kentucky Wood Floors
- Memphis Hardwood Flooring
- Mesquite Products of Texas
- Oregon Lumber
- Oshkosh Floor Designs
- Quality Woods
- Ray White Lumber
- WE Cork Inc.

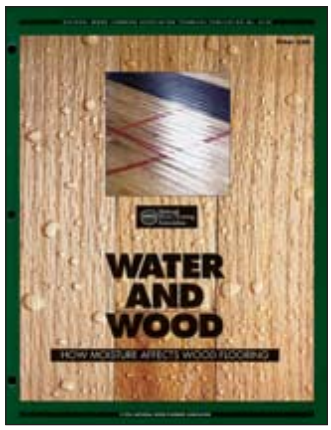
THE FOLLOWING SOURCES WERE CONSULTED:
- U.S. Dept. of Agriculture, Forest Service, Forest Products Laboratory, Center for Wood Anatomy Research Web site: www2.fpl.fs.fed.us/TechSheets/techmenu.html
- *Guide to Wood Species*, Architectural Woodwork Institute, Arlington, Virginia; 1977.
- *Fine Hardwoods Selectorama*, Fine Hardwood Veneer Association and American Walnut Manufacturers Association, Indianapolis; revised 1987.
- *Wood Handbook: Wood as an Engineering Material* (Agriculture Handbook 72), Forest Products Laboratory, Forest Service, U.S. Department of Agriculture; publications revised in 1987 and in 1999.
- Various handbooks and leaflets, Forest Service, U.S. Department of Agriculture.
- *Hardwoods of the U.S.A.*, Hardwood Export Trade Council and U.S. Department of Agriculture Foreign Agricultural Service; revised 1988.
- *Hardwood Flooring Manual*, National Wood Flooring Association, Manchester, Missouri; 1988.
- *The Wood User's Guide*, Pamela Wellner and Eugene Dickey, Rainforest Action Network, San Francisco; 1991.

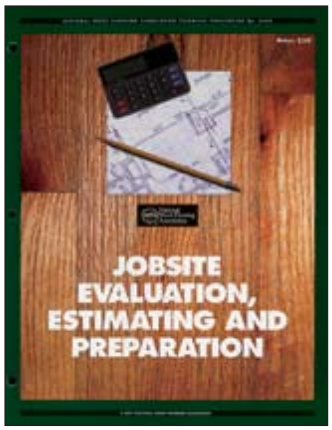
PUBLICATION EDITORS
- Kim Wahlgren, *Hardwood Floors* magazine
- Doug Dalsing, *Hardwood Floors* magazine

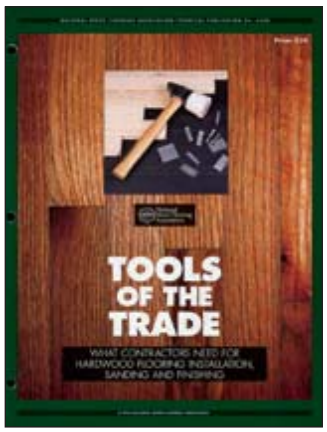
**** Note: Participation by the above organizations, companies and individuals does not imply their endorsement of all information appearing in this publication.***

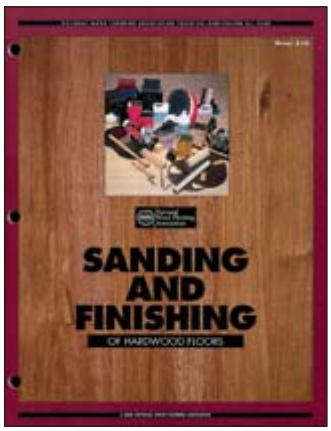
RESOURCES

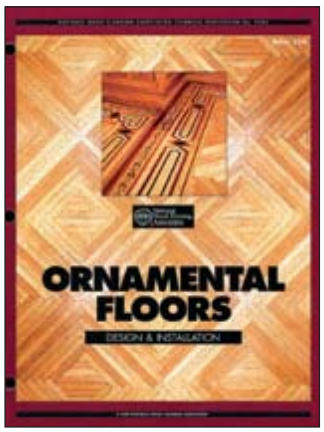
For more technical information, consult the other chapters in the NWFA's Technical Manual Series:

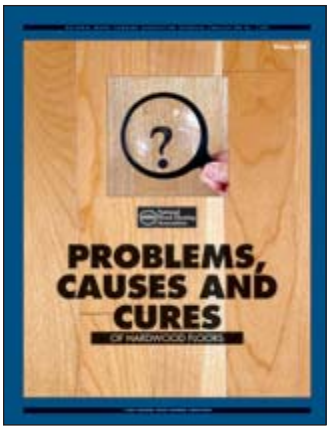












National Wood Flooring Association (NWFA)
111 Chesterfield Industrial Blvd. • Chesterfield, MO 63005
800/422-4556 (United States) • 636/519-9663 (local and international)
Fax: 636/519-9664
info@nwfa.org • Web site: www.nwfa.org

National
Wood Flooring
Association

For more information, contact:

National Wood Flooring Association
111 Chesterfield Industrial Blvd.
Chesterfield, MO 63005
Phone: 800/422-4556 (U.S.)
636/519-9663 (Local and International)
Fax: 636/519-9664
E-mail: info@nwfa.org
Website: www.nwfa.org