



QUANEX CUSTOM COMPONENTS WOOD CHARACTERISTICS A WOOD MATERIAL GUIDE

QUANEX.COM

The Quanex logo, featuring the word "Quanex" in a bold, sans-serif font. The letter "Q" is stylized with a circular arrow around it, suggesting a global or cyclical theme.

INTRODUCTION TO THE WORLD OF WOOD CHARACTERISTICS



Wood materials used in cabinets and the building industry are products of nature. They include numerous color hues, grain patterns, and other natural characteristics. As a manufacturer of wood components, Quanex Custom Components believes there is a crucial need to educate our company, customers, and consumers regarding naturally occurring wood characteristics.

As a renewable natural resource, harvesting mature trees provide wood products for our homes and offices while providing space to establish new forests. Our nation's inventory of growing hardwood is increasing; and has been for the past forty years. The total growth of hardwood trees exceeds the harvest.

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**WE'RE SOLVING
FOR TODAY AND
TOMORROW**

ENVIRONMENTAL STEWARDSHIP

Quanex Custom Components is committed to maintaining and strengthening our position as a sustainable corporation, attaining ambitious sustainability goals, and helping to deliver the solutions that the world needs. Forest conservation has always been at the heart of our business.

EQUIPMENT

Cutting-edge, safety-focused equipment, in combination with our decades of engineering and manufacturing experience, ensures that each component is built to your desired specification. Our equipment and processing methods continue to maintain species characteristics from manufacturing to installation.





This growth above harvest does not release us from the responsibility of wise and effective utilization of our hardwood resources. Approximately fifty percent of the surface area of the lumber introduced into our manufacturing plants is not currently used for millwork or cabinets because it contains characteristics such as burls, knots, stains, and grain distortions that customers and consumers find objectionable.

Responsible marketing and manufacturing of natural hardwood products can extend the hardwood supply while generating economic and environmental benefits for current and future generations.

We hope to develop an industry-wide appreciation and understanding of wood's color, grain, and natural characteristics by working together.

**WE ARE NOT JUST ANOTHER
MANUFACTURING COMPANY.
WE ARE A PART OF SOMETHING BIGGER.**





COLOR & GRAIN CHARACTERISTICS

INFLUENCES

Color and grain patterns are the primary factors influencing the appearance of wood. Other characteristics such as stains, burls, and insect damage also affect the appearance. All are variable, not only in different commercial wood groups but also within a given species, log, or board. This infinite natural variety is one of wood's most significant selling points ... no piece is the same. Many factors influence the natural causes of color variation within a species. Soil types, minerals, water levels, available sunlight, temperature, and genetic composition all contribute to color variation.

Hardwood trees regenerate from seeds, root sprouts, and stump sprouts. Trees originating from seeds contain genetic variables from two-parent trees. At the same time, sprouts from roots and stumps will be genetically identical to the parent tree. Because of these variables, trees of the same species from one area may differ from trees of the same species in other regions. The actual color variations are caused by natural chemical extractives found in the cell walls of wood. The hues produced through these deposits cover a wide range and are traceable to four spectral colors: red, orange, yellow, and violet. Other natural influences, such as fungi, may also contribute to color variations.

WOOD SPECIES

RANGE OF COLOR VARIANTS

The range of color variation in a commercial lumber group is increased by mixing species, such as northern red oak and pin oak, within the red oak commercial group. Logs of these species usually are not separated by sawmills. This mixed lumber will increase the color variation in products manufactured from this material. Grain variation, like color variation, is influenced by many factors. They include, but are not limited to, tree size, growth rate, climate conditions, site conditions, genetics, and bird, insect, and fire damage.



ALDER

SPECIES

- Common (*Alnus glutinosa*)
- Red alder (*Alnus rubra*)

COLOR VARIATION

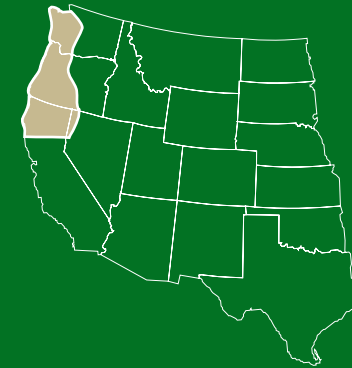
- Pale yellow to reddish brown

WOOD PROPERTIES

- Straight-grained, fine textured
- Moderately heavy and soft
- Low bending strength
- Low shock resistance
- Low decay resistance
- Susceptible to color shift
- End grain porosity may require additional finishing steps



GROWTH RANGE



BIRCH

SPECIES

- Paper birch (*Betula papyrifera*)
- Yellow birch (*Betula alleghaniensis*)

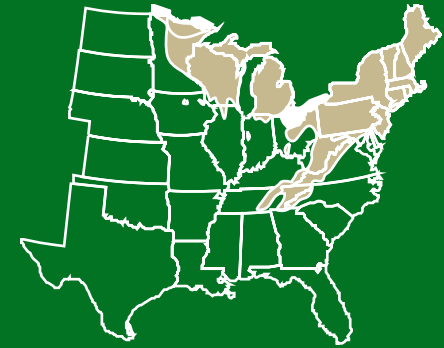
COLOR VARIATION

- Creamy white to medium brown

WOOD PROPERTIES

- Light, hard, strong
- Very high shock resistance
- Very fine, uniform grain
- Moderately large shrinkage during drying

GROWTH RANGE



CHERRY

SPECIES

- Black cherry (*Prunus serotina*)

COLOR VARIATION

- Nearly white to light red to dark reddish brown

WOOD PROPERTIES

- Moderately hard and heavy, strong, stiff
- High shock resistance
- Fine to medium, uniform grain
- Moderately large shrinkage during drying
- Susceptible to color shift
- End grain porosity may require additional finishing steps



GROWTH RANGE



HARD MAPLE

SPECIES

- Sugar maple (*Acer saccharum*)
- Black maple (*Acer nigrum*)

COLOR VARIATION

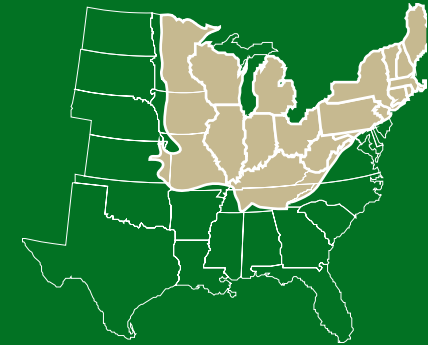
- Nearly white to slightly reddish brown

WOOD PROPERTIES

- Heavy, strong, stiff
- High shock resistance
- Fine, uniform grain
- Large shrinkage during drying
- Density and fiber direction adversely affects stain absorption



GROWTH RANGE



HICKORY

SPECIES

- Bitternut hickory (*Carya cordiformis*)
- Pecan (*Carya illinoensis*)
- Shagbark hickory (*Carya ovata*)
- Shellbark hickory (*Carya laciniosa*)
- Pignut hickory (*Carya glabra*)

COLOR VARIATION

- Nearly white to dark brown

WOOD PROPERTIES

- Very heavy, very hard, very strong, very stiff
- Extremely high shock resistance
- Fine, uniform grain
- Very large shrinkage during drying
- Requires special tools to process

GROWTH RANGE



RED OAK

SPECIES

- Northern red oak (*Quercus rubra*)
- Pin oak (*Quercus palustris*)
- Black oak (*Quercus velutina*)
- Scarlet oak (*Quercus coccinea*)
- Cherrybark oak (*Quercus pagoda*)
- Southern red oak (*Quercus falcata*, var.)

COLOR VARIATION

- Light tan to pink, to red, to dark brown

WOOD PROPERTIES

- Heavy, hard, stiff
- High shock resistance
- Medium fine, uniform grain
- Large shrinkage during drying

GROWTH RANGE



SOFT MAPLE

SPECIES

- Silver maple (*Acer saccharinum*)
- Red maple (*Acer rubrum*)

COLOR VARIATION

- Nearly white to light gray

WOOD PROPERTIES

- Moderately heavy, strong, stiff
- Medium shock resistance
- Fine, uniform grain
- Moderate shrinkage during drying

GROWTH RANGE



WHITE OAK

SPECIES

- White oak (*Quercus alba*)
- Burr oak (*Quercus macrocarpa*)
- Swamp white oak (*Quercus bicolor*)

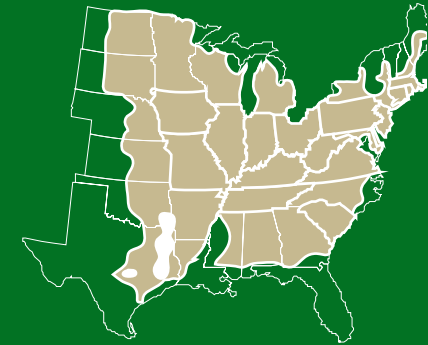
COLOR VARIATION

- Creamy white to medium brown

WOOD PROPERTIES

- Heavy, very hard, strong
- High shock resistance
- Medium fine, uniform grain
- Large shrinkage during drying

GROWTH RANGE



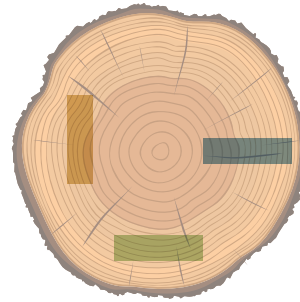
THE EFFECTS OF GROWTH RINGS

GROWTH RING ORIENTATION

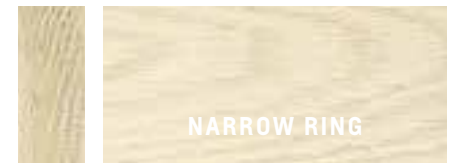
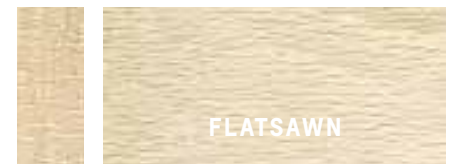
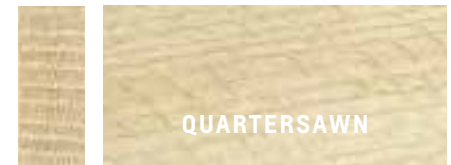
Lumber grain is categorized in one of three ways, as seen below. Growth ring orientation is determined by how the lumber is cut from the log. In commercial practice, quarter-sawn lumber has growth rings at angles of 45 to 90 degrees to the wide surface. Flat-sawn lumber has growth rings at 0 to 45 degrees, and rift-sawn lumber has growth rings at 30 to 60 degrees to the wide surface. All three orientations can occur in one board because of curves or bends in the log from which the board is sawn.

GROWTH RING SIZE

The amount of annual growth influences the “look” of sawn lumber. The growth rings of a tree are distinctive because of the light and dark colors. The lighter portion is usually grown in the spring and is called “springwood” & the darker, denser portion is “summerwood”. The size of growth rings varies from species to species and even tree to tree, depending on many factors, including genetics and growing conditions. These two examples have approximately the same growth ring orientation yet look very different.



-  **RIFTSAWN**
-  **FLATSAWN**
-  **QUARTERSAWN**







NATURAL CHARACTERISTICS

BURL GRAIN

Burl grain is common in most species and is also known as curly grain, burly grain, fiddle back, or figured wood. Various causes of burl grain include knot location, damage to the bark cambium layer, and tree genetics. Burl grain is often a desired characteristic for specialty products but can be difficult to machine.



RED OAK



HARD MAPLE



WHITE OAK



SOFT MAPLE



TIGER STRIPE

The unique tiger stripe grain pattern (also called zebrawood) is typical in red and white oak and both hard and soft maple and other species. Wood with this grain characteristic is usually quite dense compared to the average density of the species. Tiger stripe is most often found along with burl grain, which can be difficult to machine or sand.

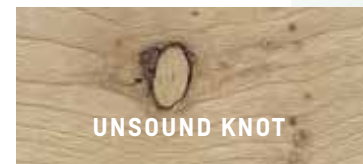
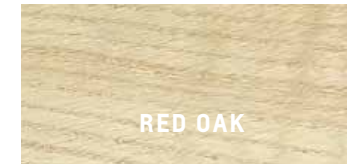
BIRD'S EYE

Bird's eye characteristic, as seen in this hard maple example, is a small area in the wood where fibers contort to form circular figures resembling bird's eyes on the board's surface. It is common in hard maple and rare in other species.

KNOTS

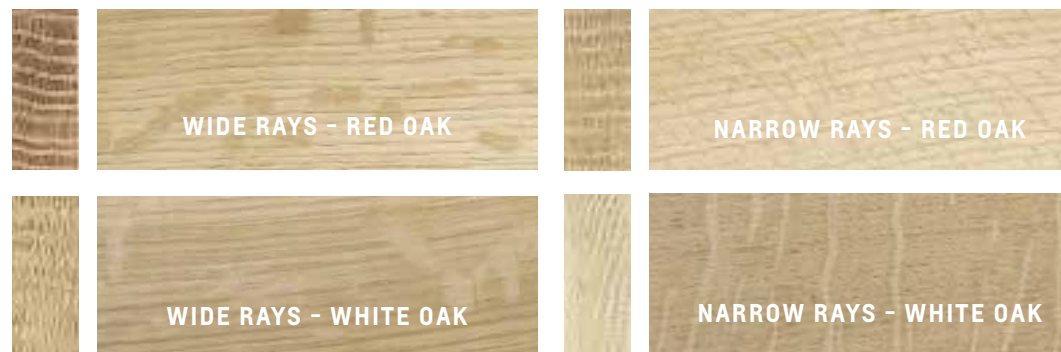
Knots vary in size, shape, structure, and color. Because of this, it may be the most difficult characteristic of wood to classify.

- **Closed Knot** - A closed knot has a flat face with no openings in the lumber surface.
- **Open Knot** - An open knot may occur in the form of a tiny pin-sized hole to a large gaping hole in the lumber surface.
- **Sound Knot** - A sound knot, also known as a tight knot, is completely solid with no portion of the knot movable. It is as hard as the surrounding wood and shows no sign of decay.
- **Unsound Knot** - An unsound knot, also known as a loose knot, has a portion that will move readily.
- **Pin Knot** - A pin knot is a small, sound, and tight knot.
- **Knot Cluster** - A knot cluster is a grouping of usually small knots.



RAY FLECKING

Ray flecking is visible in hardwood species that are quarter-sawn and have rays. Rays are strips of cells that extend radially within a tree. These rays primarily store food and transport it horizontally. Red oak and white oak are most noted for this characteristic. The examples show ray flecking with variations in ray widths.



OTHER NATURAL CHARACTERISTICS

Bark - This example shows a piece of lumber with bark on its outer edge. The outer portion of the bark is the nonliving portion, which protects the inner living portion from external damage.

Bark Pocket - This hard maple example shows a typical bark pocket with a bark-filled hole on the board surface.

Vining - This hickory example shows a maroon color stain with a uniform cross-hatch appearance. This characteristic appears to be seasonal and may develop in the log after harvesting.

Incipient Rot - Rot (also known as decay) is the decomposition of a substance by fungi. This photo of white oak shows incipient rot, which is rotting in the early stages and is identified by a slight discoloration or bleaching of the wood. Rot-causing fungi grow only in wood with a moisture content above approximately 30 percent and cease growing when the wood is dried below 30 percent.

Advanced Rot - Advanced rot causes the wood to become soft and punky. As the rot progresses to this stage, the wood loses much of its strength. Note the black zone lines in this birch example, which occasionally appear in and around the bleached areas.

Bird Peck - Bird peck is shown here in hickory but is also common in maple. Woodpeckers produce a small hole, which is the starting point for brown to blackish mineral streak.

Worm Track - Worm track (also referred to as pith fleck) is shown here in maple. Worm track appears as small, narrow, yellowish to brownish streaks 1/32" to 1/16" wide and 1/8" to 2" long. Worm track is caused by cambium miners feeding beneath the bark from the branches to the roots. Their tiny burrows are filled in by new cell growth and become embedded in the wood as the tree continues to grow.

Pitch Pocket - Pitch pocket (sometimes referred to as gum spot) is common in cherry. It is caused mainly by peach bark beetles and cambium miners. The feeding insects cause injury to the living portion of the bark, leading to the formation of gum spots in the wood as the tree continues to grow.

Carpenter Ant Damage - Carpenter ants can infest both hardwoods and softwoods. The heartwood lumber shown here has typical damage caused by carpenter ant infestation. Often the damaged wood is darkened by decay and staining.

Worm Hole - The damage in this red oak example was caused by oak timber worms. These worms cause most worm hole damage seen in red and white oak. The worm tunnel size ranges from 1/64" to 3/16". Wood moisture content must be above 30 percent for timber worms to continue activity.

Grub Hole - Red oak borers cause damage, as seen in this example. Red oak borer tunnels are flattened ovals 1/2" to 3/4" in diameter.

BEAUTY IN VARIATION & UNIQUENESS IN CHARACTER

BARK

WORM TRACK

BARK POCKET

PITCH POCKET

VINING

CARPENTER ANT DAMAGE

INCIPIENT ROT

WORM HOLE

ADVANCED ROT

GRUB HOLE

BIRD PECK

THE EFFECTS OF MINERALS

MINERAL STREAK

A darkened or discolored wood area, caused by minerals the tree extracts from the soil, can be either a mineral streak or mineral stain. Mineral streak appears as a blackish-blue, well-defined streak running parallel with the grain. It is commonly found in maple, birch, and occasionally in oak and cherry. The streak can be measured easily by its length and width.

MINERAL STAIN

Commonly found in oak, mineral stain appears as a dark, blotchy area with undefined boundaries. It can turn an entire board darker in color.



TYPES OF STAINS

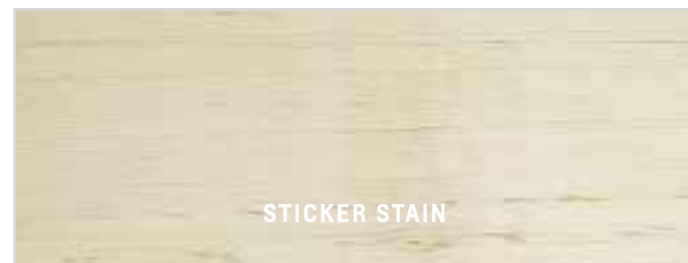
- **Water Spot Stain** - Water spot or water stain is a common condition in hickory. The exact origin of these spots is unknown; however, this example is either fungal growth or enzymatic stain developed in the sawn log or green lumber.
- **Heartwood Stain** - This hard maple sample shows what is commonly referred to as a heartwood stain. This characteristic can be caused by typical staining fungi or a buildup of natural extractives, such as sugars, in many species.
- **Bacterial Infection** - Typical bacterial infection (sometimes referred to as wet-wood stain), shown here in red oak, can have colors ranging from gray to brown. It can occasionally be identified in the pre-dryer or kiln by a sweet, fermented, sometimes foul-smelling odor (similar to corn silage). Due to the unusually high moisture content, wet-wood stain may cause lumber to shrink excessively in the kiln, causing surface checks, end checks, honeycomb, and shake.
- **Shake** - Shake (sometimes called ring shake or wind shake) is pictured here in red oak. Shake can be caused by bacteria that infect the living trees. The bacteria, which has a vinegar or rancid smell before drying, weakens the area between the growth rings and may cause a shake in apparently sound lumber. The flatsawn portion shows a typical shake, and the end grain portion shows the ring failure.
- **Sap Stain** - Sap stain usually appears in a pie-shaped area within sapwood. Depending on which fungus and wood species are involved, these stains have a wide color range, including blue, gray, brown, orange, purple, and red. These two examples show bluish and grayish sap stains in red oak.
- **Iron Stain** - This red oak board shows a typical iron stain or watermark left from a steel band used to band lumber for shipment. This discoloration affects areas that have come in direct contact with iron (such as bands, forks of a lift, or chains). This stain type usually affects only the surface and is easily removed during planing.
- **Water Stain** - Water stains can commonly look like this dirty gray-red oak example. Depending on which fungus and wood species are involved, these stains range in color from gray to brown to black. This stain can occur in green lumber before drying or in high-moisture dried lumber.



VARIOUS DRYING EFFECTS

STICKER STAIN

Sticker stains or sticker shadows can occur in most whitewoods. It is shown here in soft maple. This stain is bacteriological and is caused by lumber coming in contact with stickers used in the drying process. It can be challenging to control during the drying process in certain weather conditions. The stain is often quite deep and impossible to remove by surfacing the lumber.



AIR CHECK

This example shows a piece of red oak with an air check or surface check. This type of checking occurs in the early drying stages if too much moisture is removed from the outer portion of the lumber before the inner portion has had a chance to lose moisture and shrink.



HONEYCOMB

Although not a natural characteristic, honeycomb is common in the industry. This example shows lumber ripped in half to expose the severe interior honeycomb. This occurs when kiln temperatures are raised before the lumber core moisture has been lowered sufficiently.

SPLITTING OR CRACKING

Splitting or cracking can occur in any species. Here shown in red oak, it can be minimized by proper end coating of the logs or lumber before they have an opportunity to dry.

CARMELIZED MAPLE

Occurring in dry kilns for hardwood and hot log ponds used in manufacturing veneer; maple dried at temperatures too high results in a caramelized appearance.



TECHNICAL DATA & BIBLIOGRAPHY

TECHNICAL DATA

SPECIES	DENSITY (LBS/FT ³)	DIMENSION CHANGE (RADIAL)	COEFFICIENT (TANGENTIAL)
Alder	26.0	0.00151	0.00256
Birch	35.7	0.00219	0.00304
Cherry	35.0	0.00126	0.00248
Hard Maple	42.5	0.00165	0.00353
Hickory	50.5	0.00259	0.00411
Red Oak	42.5	0.00158	0.00369
Soft Maple	36.4	0.00137	0.00289
White Oak	45.8	0.00180	0.00365

Dimension change coefficient is the percent change per inch for every 1% change in moisture content.

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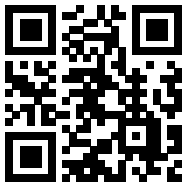
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