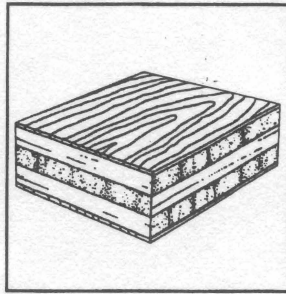


Core Types

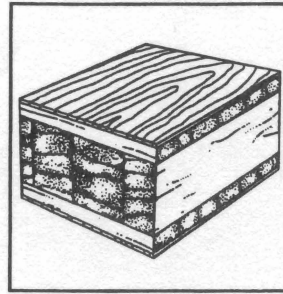
The Hardwood Plywood Family of Products

People have cherished the warmth and beauty of wood throughout the ages. Today, a variety of hardwood products are available to meet the customers' requirements. Although most people first think of a veneer core product when hardwood plywood is mentioned, hardwood plywood actually refers to a family of panel products which are so named because the face of the panel is made of hardwood veneer.

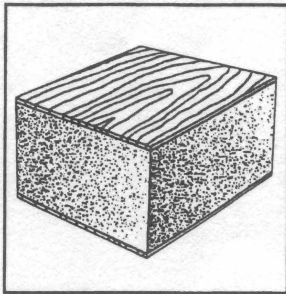
Hardwood plywood includes panel products constructed with core material made from: veneer (softwood or hardwood, which may be of a different species than the panel face), lumber, medium density fiberboard (MDF), or particleboard. Panels made with the various core types may differ from one another with respect to certain properties. The table on the following page provides a comparison of properties for the different core types. The relative importance of specific properties in a particular application of the product help determine the appropriate core type to be used.



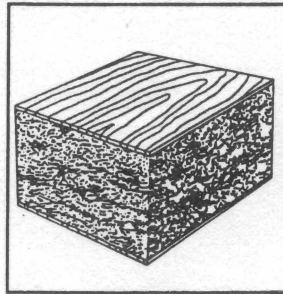
Veneer Core



Lumber Core



MDF Core



Particleboard Core

Note: The most common core types are shown in this publication, but other types may be available from the manufacturer. For example, combination type cores are a recent development in the plywood industry. They contain a combination of veneer plies and particleboard, MDF, or other engineered wood product as the substrate for the panel.

The Manufacturing Process

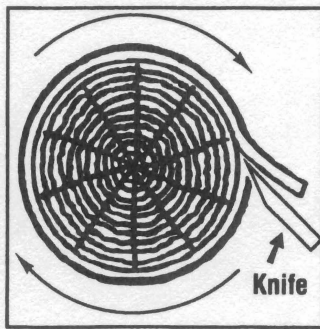
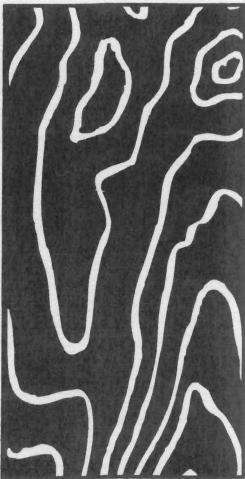
The manufacturing of veneer and plywood starts with the selection of the log. Only a certain percentage of logs are suitable for veneer. A log must meet specific grade requirements, be of certain diameter, and, depending upon its intended use, may have other desirable characteristics. After transport to the mill, logs are cut to the correct length and stripped of their bark. They are then placed in steam baths for softening before being cut into veneer. The next stage, opening the log, is the most exciting. The pattern of the grain and the natural beauty or "character" marks that are inside the log will be uncovered during this step.

How the patterns unfold depends on the method of cutting. Veneer may be cut in one of five basic ways. The most commonly produced veneers are rotary and plain sliced.

The method used to cut veneer determines the appearance of the grain.

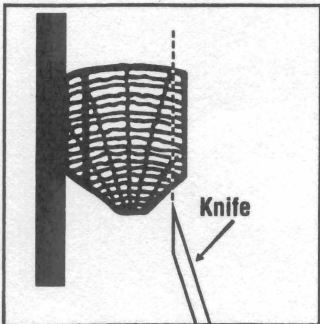
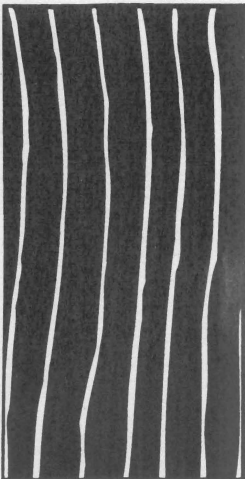
Types of Cutting Veneer

Rotary Cut Produces Variegated Grain



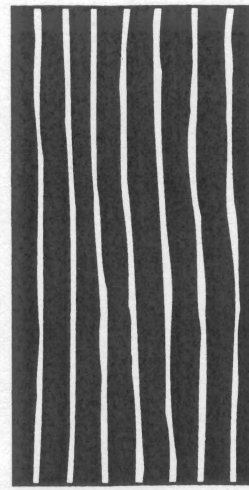
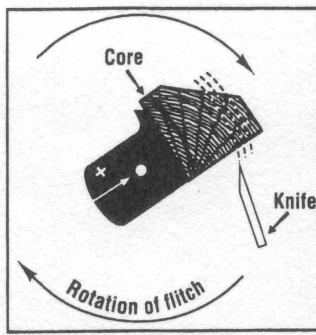
- **"Rotary"** - veneer produced by centering the log in a lathe and turning it against a broad cutting knife which is set into the log at a slight angle. Rotary cut veneer can be sufficiently wide to provide full sheet (one piece) faces.

Quarter or Variation of Quarter Cut Produces Straight Grain Veneer



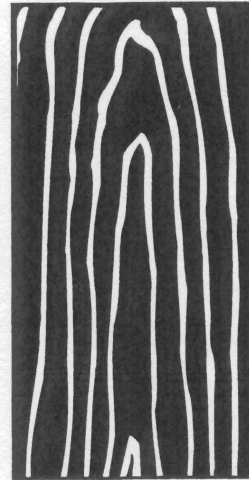
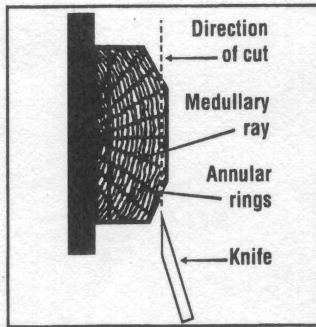
- **"Quarter Slicing"** - achieves a straight grain appearance by slicing perpendicular to the annual growth rings.

- **“Rift-Cut”** - rift-cut veneer is produced from the various species of oak. Oak has medullary ray cells which radiate from the center of the log like the curved spokes of a wheel. This straight grain cut is at a slight angle to the medullary rays in oak to minimize ray fleck (flake).

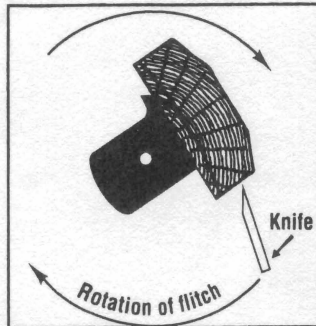


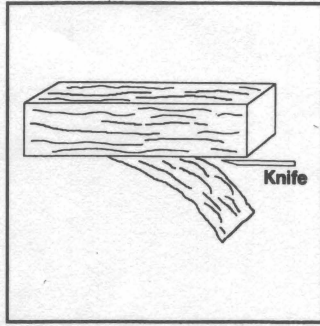
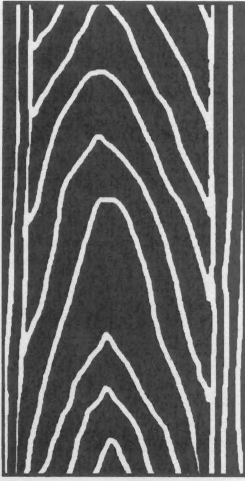
Flat Cutting Produces a Cathedral Grain Effect

- **“Plain Slicing”** - veneer sliced parallel to the center of the log to achieve flat-cut veneer. The cathedrals are formed by the innermost annual growth rings as the veneer is cut through the flitch.



- **“Half-Round Slicing”** - is cutting on an arc roughly parallel to the center of the log to achieve flat-cut veneer. The cathedrals can have more rounded tops since the grain is formed by the innermost growth rings as the veneer is cut through the flitch.





- “*Lengthwise Slicing*” - a board of flat sawn lumber is passed flat over a stationary knife. As it passes, a sheet of veneer is sliced from the bottom of the board. This produces a variegated figure.

It should be noted that face veneer thicknesses can vary. The current standards are defined in the current version of the Voluntary Standard for Sliced Veneer. Imported panels may have face veneer 1/64" thick or thinner.

After veneers are cut, they may go directly to a clipper which trims the veneer to various widths and removes defects.

From the clipper, the veneer goes to the dryer. The dryer's large chambers are equipped with heating elements and fans for air circulation. An automatic conveying system transports the veneer through the dryer. Veneers are generally dried to a **moisture content** below 12 percent - a level compatible with gluing and consistent with the moisture content to which hardwood plywood products will be exposed in use.

After drying, less than full-size sheets are dry-clipped and joined together to form full-size sheets. These full-size sheets of veneer are called “faces” (and/or “backs”) in North America and “lay-ons” in other parts of the world. **Taping** machines and tapeless splicers are used in this joining process.

The veneers are now ready to be glued to make hardwood plywood. Alternate ply veneers for the core are fed through a glue spreader which coats both sides of the sheets with liquid adhesive (face and back veneers have glue applied to one side only). The spreader roller controls the amount of adhesive transferred to the veneer.

Now comes the final step in the process - the pressing together of the veneers to make individual panels. Heat (about 250 °F) and pressure (150 to 300 pounds per square inch) are applied by means of a hot press. Presses may have as many as 35 or more openings (one opening per panel). A less frequently used method is cold pressing which uses pressure only.

Face Grade Applications

| | |
|--------------------|---|
| AA | The best quality face grade for high end uses such as architectural paneling, doors and cabinets, case goods, and quality furniture. |
| A | Where AA is not required but excellent appearance is very important as in cabinets and furniture. |
| B | Where the natural characteristics and appearance of the species are desirable. |
| C, D, and E | Provide sound surfaces but allow unlimited color variation; grades C, D, and E, respectively, allow repairs in increasing size ranges. Applications: where surface will be hidden or a more natural appearance is desired. |
| Specialty | Appearance characteristics are not standardized and are subject to agreement between the individual buyer and seller, as in factory finished wall paneling. Usually, effects such as those created by wormy chestnut, bird's-eye maple, and English brown oak are considered specialty grade. |

Back Grade Descriptions

| | |
|-----------------------|--|
| 1, 2, 3, and 4 | Back grades are designated by numbers: 1, 2, 3, and 4. Requirements of grade 1 are most restrictive, with grades 2, 3, and 4 being progressively less restrictive. Grades 1 and 2 provide sound surfaces with all openings in the veneer repaired except for vertical worm holes not larger than 1.6 mm (1/16"). Grades 3 and 4 permit some open defects; however, grade 3 can be obtained with repaired splits, joints, bark pockets, laps, and knotholes to achieve a sound surface if specified by the buyer. Grade 4 permits knotholes up to 102 mm (4") in diameter and open splits and joints limited by width and length. |
|-----------------------|--|

Veneer Inner Ply Grade Descriptions

| | |
|-----------------------|--|
| J, K, L, and M | Four inner ply grades are described with the following letter designations: J, K, L, and M. Grade J is the most restrictive, allowing minimal size openings. Grades K, L, and M are progressively less restrictive. The least restrictive grade (M) is usually reserved for plies not adjacent to faces and allows round and similar shaped openings not to exceed 63.5 mm (2 1/2") and elongated openings up to 25.4 mm (1") as visible on the edges or ends of panels. |
|-----------------------|--|

NOTE: The above grade descriptions are taken from the current version of the Standard and may change with future editions. Please make sure and use the most recent version of the Voluntary Standard.

Matching

There are a variety of veneer matching techniques available to the purchaser. Each method produces a very specific pattern, visual effect, and finished appearance ranging from the casual to the formal. In some cases a symmetrical pattern is created, in others the pattern is random and creates the illusion that boards have been used.

Except where whole piece faces are used, one basic step is completed in all matching processes: the desired appearance is obtained by edge gluing two or more pieces of veneer. In some cases, the Standard indicates the type of matching usually specified for a particular species and grade. *If another type of matching is required, it must be specified at the time the order is placed.*

Not only can veneer be matched within a single panel, it can also be matched from one panel to another so that, when installed, a visual symmetry is created around a room. Installations such as these use "blueprint" or "sequence" matched architectural panels. Even within these styles there is a variety from which to choose.

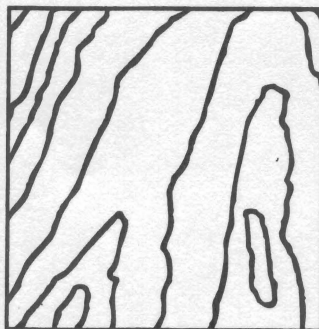
Veneer matching is not just a craft, it can be an art form. It allows people to express what they imagine. The possibilities of patterns which can be created are almost endless.

Matching may be broken down into several categories, each containing several specific subgroups. The categories are:

- matching between adjacent veneer leaves or pieces
- matching of panel faces including architectural matching
- special matching effects

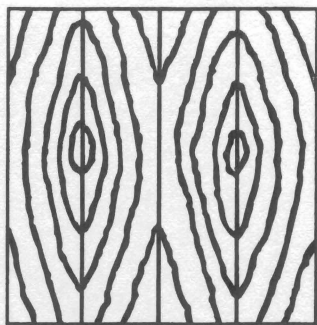
Whole Piece Rotary Cut

Not a veneer matching method; one single piece of veneer is used with continuous grain characteristics running across the sheet.



Matching Between Adjacent Veneer Leaves (Pieces)

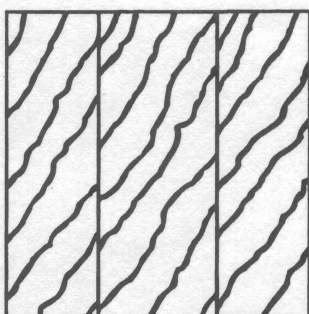
Four matching techniques are commonly used:



Book Matching

Alternating pieces of veneer from a flitch are turned over, so that adjacent leaves are “opened” as two pages in a book.

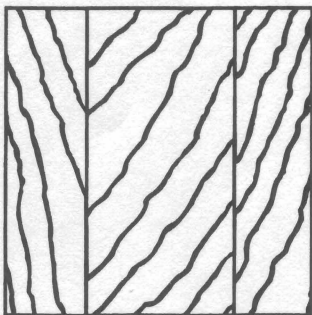
Visual Effect: Veneer joints match, creating a symmetrical pattern. Yields maximum continuity of grain. Prominent characteristics will ascend or descend across the match. Because tight side and loose side faces alternate in adjacent leaves, they reflect light and accept stain differently and may yield a noticeable color variation. This effect may be minimized through the use of proper finishing techniques.



Slip Matching

Adjoining leaves are fed out in sequence, with all the same-face sides being exposed. The joint may not be noticeable if grain is straight. (If grain is not exactly vertical, vertical slant may occur).

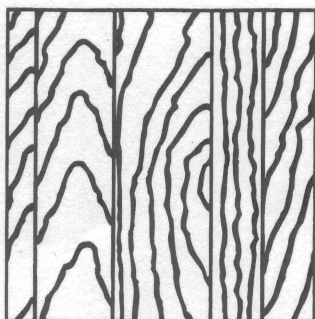
Visual Effect: Figure repeats but grain does not match at joints. Enhances color uniformity because all faces have a similar light reflection.



Pleasing Match

Veneers are matched by color similarity, not necessarily grain characteristics.

Visual Effect: Since no sharp color contrasts can appear at the joints, an effect between book and slip matched and random matched is achieved.



Random (or Mismatch)

Random selection of the arrangement of the leaves from one or more flitches. Usually done with lower grade veneers or for a specific effect (such as “rustic walnut”). The components may be of different widths within the panel face.

Visual Effect: Casual, “board-like” to achieve mismatched or plank effect.

Matching of Panel Faces

Individual leaves in a sliced flitch may increase or decrease in width as the slicing progresses. If a number of panels are manufactured from a specific flitch, the number of veneer leaves per panel face may change as individual leaves are taken from the flitch. There are several different methods of arranging *book* and *slip* matched leaves within a face:

Running Match - Each panel face is assembled from as many leaves as necessary. (Any portion left over from the last leaf may be used as the start of the next panel).

Balance Match - Each panel face is assembled from leaves of uniform width. This is usually more aesthetically pleasing than running match but comes at a higher cost.

Center Match - Each panel has an even number of veneer leaves of uniform width. There is a veneer joint in the center of the panel which provides horizontal symmetry. This method increases the amount of waste from a flitch so, consequently, the cost is increased.

The matching arrangement (running, balance, or center) will be selected by the manufacturer if not otherwise specified.

Architectural panel matching may be provided for specific installations. The Architectural Woodwork Quality Standards Guide Specifications and Quality Certification Program, published by the Architectural Woodwork Institute (see Appendix I for complete address) should be consulted for further details and illustrations.

For architectural installations, veneer flitches may be used to manufacture panel sets (a quantity of plywood sheets with faces manufactured from the same flitch). Application and use largely determines the amount and size of veneer that will be required. The following describes the three major types of panel sets.

Pre-Manufactured Sets - Also referred to as running match or lot match, these are pre-manufactured panel sets and are numbered in sequence. They may be the product of a single flitch or part thereof. If more than one set is required, matching between sets cannot be expected. Doors within the panel set cannot be matched to the panel.

Sequence Matched Uniform Size Panel Sets - These sets are usually manufactured for a specific installation to a uniform panel width and height. If more than one flitch is needed to produce the required number of panels, similar flitches may be specified. This type of matching is best used when panel layout is uninterrupted and the design permits the use of near equal width panels.

Matching Architectural Panels