PANEL PRODUCTS

SECTION 200

General Criteria

200-G-1

Scope

Includes:

The purpose of this section is to define, describe, illustrate, and establish quality grades of all the panel products used throughout this standard.

There are a great variety of panels manufactured with differences in core materials, adhesives or binders, forming techniques, surface treatments, etc., which affect characteristics of the panels.

In addition, constant research gives rise to the production of new panel products. These new products are usually accompanied by data on test results of important characteristics for end-use purposes. In selecting new panel products for architectural woodworking, such data should be considered with reference to the Standards contained in this section.

Many prefinished wood panels and decorative overlays have æsthetic and performance characteristics that meet or exceed these standards, and should be evaluated, approved, and specified by the design professional when desired.

Excludes:

Solid lumber edge glued into a panel which is defined in Section 100. Adjoining cabinet doors and drawer faces which are described in Section 400. The matching of adjoining panels when used as wall paneling which is defined and illustrated in Section 500.

200-G-2

Types of Panel Cores

There are a wide range of core materials available for the fabrication of architectural woodwork. The primary core materials are covered in this standard as follows.

Industrial Grade Particleboard Core — wood particles of various sizes that are bonded together with a synthetic resin or binder under heat and pressure.

Medium Density Industrial Particleboard is used in the broadest applications of architectural woodwork. It is especially well suited as a substrate for high quality veneers and decorative laminates.

When used as panels without any surface plies, the product is referred to as particleboard. *When used as an inner core with outer wood veneers, the panel is referred to as particle core plywood.* Industrial particleboard is commercially classified by "density," which is measured by the weight per cubic foot of the panel product.

• Low Density [LD series] = generally less than 640 kg per m^3 (40 pounds per ft^3)

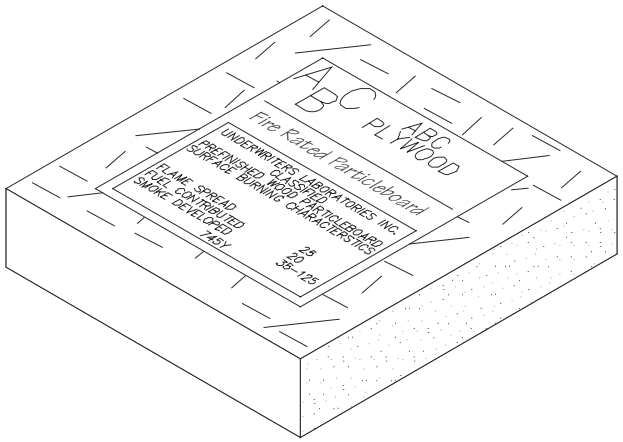
• Medium Density [M series] = generally between 640-800 kg per m^3 (40-50 pounds per ft^3)

• High Density [H series] = generally above 800 kg per m^3 (50 pounds per ft^3)

Moisture Resistant Particleboard Core

Some Medium Density Industrial Particleboard is bonded with resins more resistant to swelling when exposed to moisture. The most common grades are ANSI 208.1-1999 Type M-2-Exterior Glue and M-3-Exterior Glue. Availability to the architectural woodworker is limited in some markets.

Fire-Retardant Particleboard Core



Fire-Retardant Core - Figure 200-01

Some Medium Density Industrial Particleboard has been treated during manufacture to carry a UL stamp for Class I fire rating (Flame spread 20, Smoke developed 450). This material is often used as a substrate for paneling requiring a Class I rating. Fire-retardant Medium Density Fiberboard is also available in some markets.

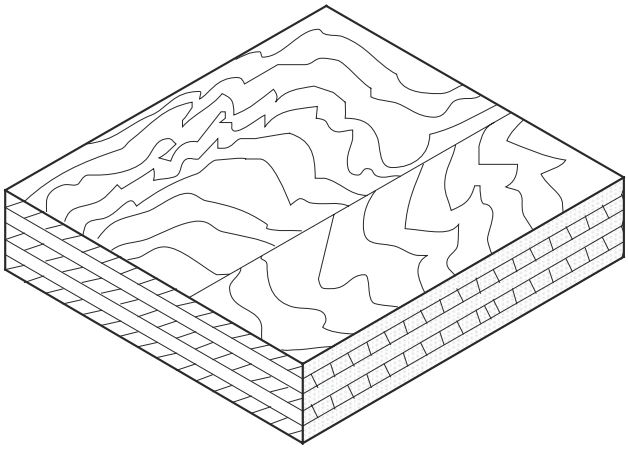
Medium Density Fiberboard (MDF) Core — wood particles reduced to fibers in a moderate pressure steam vessel, combined with a resin, and bonded together under heat and pressure.

Due to the finer texture of the fibers used in manufacturing Medium Density Fiberboard (MDF) it is smoother than Medium Density Particleboard. The uniform texture and density of the fibers create a homogenous panel that is very useful as a substrate for paint, thin overlay materials, veneers and decorative laminates. MDF is among the most stable of the mat-formed panel products. *When used as an inner core with outer wood veneers, the panel is referred to as MDF core plywood.*

Moisture Resistant MDF Core

Some MDF is made to meet the ANSI 208.2-2002 reduced thickness swell criteria. Availability to the architectural woodworker is limited in some markets.

VENEER CORE — THREE OR MORE LAYERS (PLIES) OF WOOD VENEERS PRESSED AND GLUED INTO A SINGLE SHEET.



Veneer Core - Figure 200-02

What many think of as traditional "plywood," a panel made up of alternating layers of thin veneers, is called veneer core. Adhesive is placed between the veneer layers, and the panels are assembled under heat and pressure until the adhesive is set. The two outside layers of veneer are often selected for species, grain, and appearance; and are called the "face veneers."

COMBINATION CORE - A BALANCED BLEND OF PARTICLEBOARD OR FIBERBOARD WITH VENEER LAYERS.

A combination of veneer core and particleboard/fiberboard core technologies, utilizing some of the advantages of each. This material should be evaluated and approved by the customer. Many products will meet these standards.

HARDBOARD CORE - HARDBOARD IS DEFINED AS INTER FELTED FIBERS CONSOLIDATED UNDER HEAT AND PRESSURE TO A DENSITY OF 500 KG PER M^3 (31 POUNDS PER CUBIC FOOT) OR GREATER.

Often used for casework backs, drawer bottoms, and divider panels, hardboard is available with either one side (S1S) or two sides (S2S) smooth. There are typically two types of hardboard core used by architectural woodworkers: Standard (untempered) and Tempered, which is standard hardboard subjected to a curing treatment increasing its stiffness, hardness, and weight.

AGRIFIBER CORE - PANEL PRODUCTS MADE FROM STRAW AND SIMILAR FIBER ARE APPEARING IN THE MARKETPLACE. BOARDS WHICH MEET THE ANSI 208.1 STANDARDS FOR MEDIUM DENSITY ARE ACCEPTABLE FOR USE UNDER THIS STANDARD.

200-G-3

Characteristics of Core Material Performance

NOTE: It is important for the reader to understand the difference between "flatness" and "dimensional stability" characteristics. Particleboard and MDF are the recommended substrates for high pressure decorative laminate and wood veneer work because of their excellent flatness. Fair dimensional stability (expansion/contraction in panel size) is acceptable unless the product is exposed to wide swings in relative humidity, generally below 20% or above 80% with swings of more than 30 points.

Panel Core Type	Flatness	Visual Edge Quality	Surface Uniformity	Dimensional Stability	Screw-holding	Bending Strength	Availability
Industrial Particleboard (Medium)	Excellent	Good	Excellent	Fair	Fair	Good	Readily
Medium Density Fiberboard (MDF)	Excellent	Excellent	Excellent	Fair	Good	Good	Readily
Veneer	Fair	Good	Fair	Excellent	Excellent	Excellent	Readily
Lumber	Good	Good	Good	Good	Excellent	Excellent	Limited
Combination Core with composite crossbands	Excellent	Good	Excellent	Good	Excellent	Excellent	Limited
Combination Core with composite inner ply	Good	Fair	Good	Good	Good	Good	Limited
Moisture Resistant Particleboard	Excellent	Good	Good	Fair	Fair	Good	Limited
Moisture Resistant MDF	Excellent	Excellent	Excellent	Fair	Good	Good	Limited
Fire Rated Particleboard	Excellent	Fair	Good	Fair	Fair	Good	Limited

Notes: Various characteristics above are influenced by the grade and thickness of the core and specific gravity of the core species. Visual Edge Quality is rated before treatment with edge bands or fillers and Visual Edge Quality of lumber core assumes the use of "clear edge" grade. Surface Uniformity has a direct relationship to the performance of fine veneers placed over the surface. Dimensional Stability is usually related to exposure to wide swings in relative humidity. Screwholding and Bending Strength are influenced by proper design and engineering.

200-G-4

Plywood

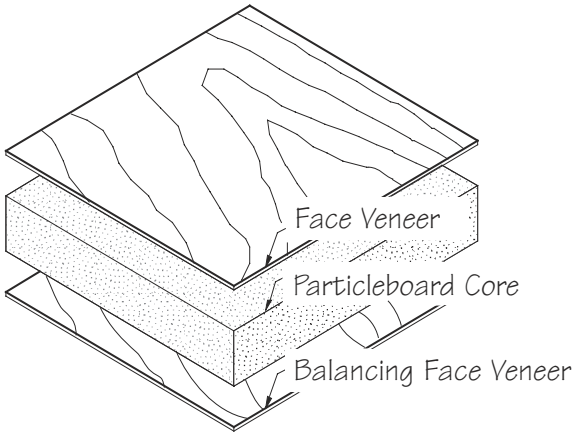
The term "plywood" is defined as a panel manufactured of three or more layers (plies) of wood or wood products (veneers or overlays and/or core materials), generally laminated into a single sheet (panel). Plywood is separated into two groups according to materials and manufacturing:

Hardwood plywood - manufactured of hardwood or decorative softwood veneers over a core material, such as medium density particleboard, medium density fiberboard, low density lumber, and/or other veneers.

Softwood plywood - Panels manufactured with softwood face veneers are described in standards published by the APA–The Engineered Wood Association. Softwood plywood is seldom incorporated into finished architectural woodworking project, except to achieve specific design æsthetics. Softwood (construction) plywood is not recommended for use as a core material due to poor stability and core voids.

Panel Construction Balance

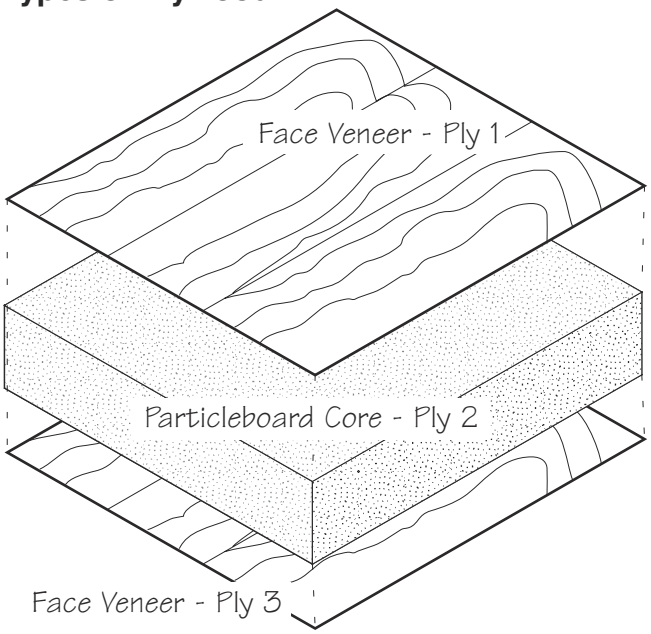
To achieve balanced construction, panels must be an odd number of layers (plies) symmetrical from the center line, i.e., all inner plies, except the innermost ply, should occur in pairs, using materials and adhesives on both sides that contract and expand, or are moisture permeable, at the same rate. A ply may consist of a single veneer, particleboard, medium density fiberboard, or hardboard. Each pair of inner plies should be of the same thickness and direction of grain. Each ply of each pair is placed on opposite sides of the innermost ply or layer, alternating grain directions from the center out. (Particleboard and MDF do not have a specific grain orientation.)



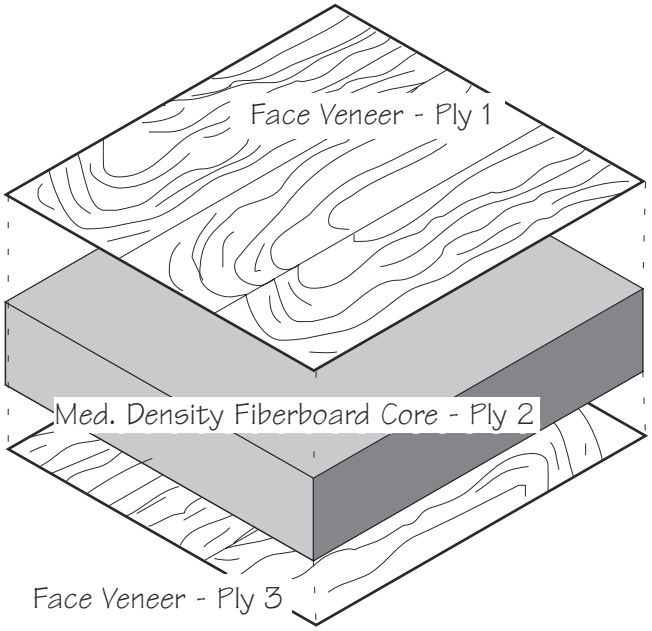
Balanced Construction - Figure 200-03

General Rules: The thinner the facing material, the less force it can generate to cause warping. The thicker the substrate, the more it can resist a warping movement or force.

Types of Plywood

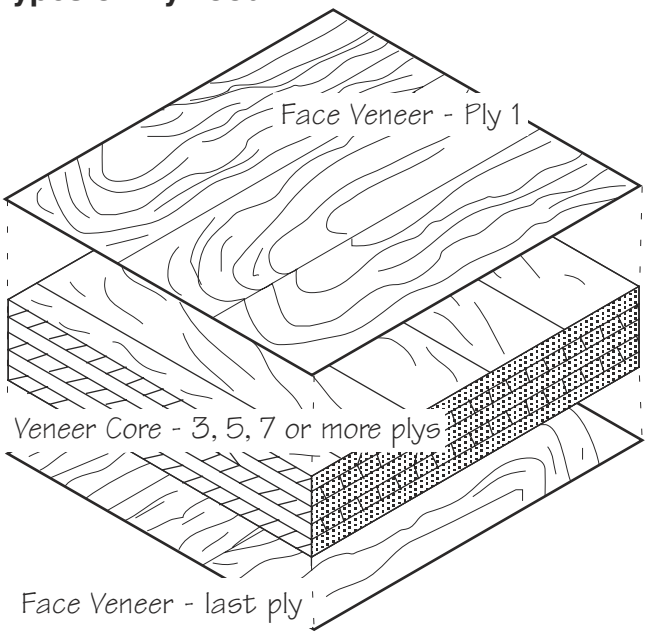


Particleboard Core Plywood - Figure 200-04



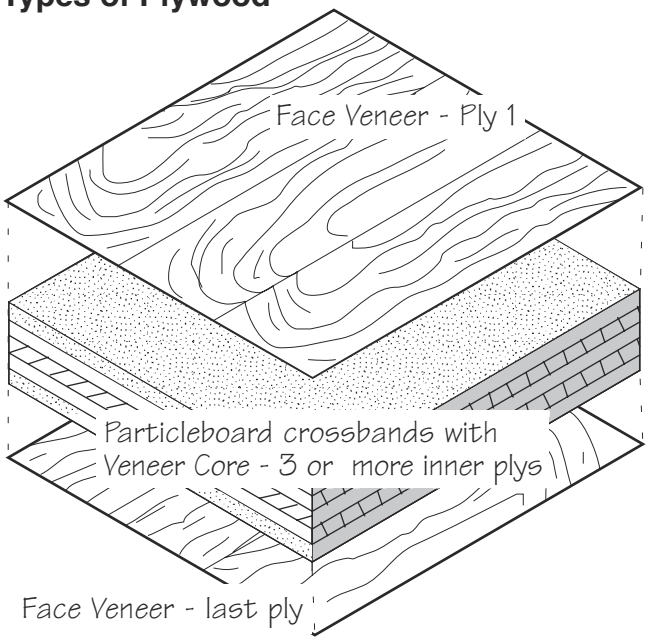
Medium Density Fiberboard Core Plywood - Figure 200-05

Types of Plywood

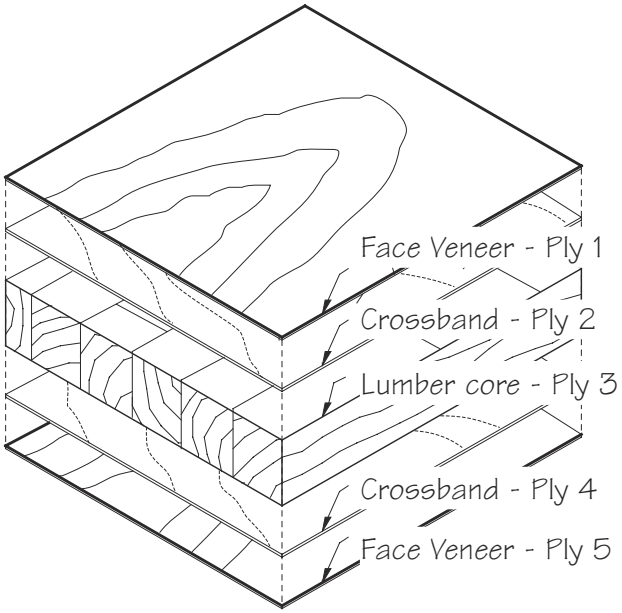


Veneer Core Plywood - Figure 200-06

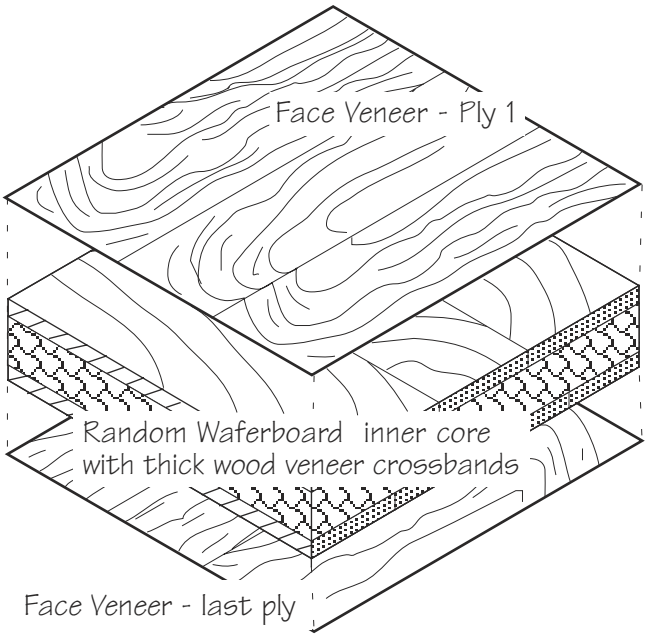
Types of Plywood



Combination Core Plywood - Figure 200-08



Lumber Core Plywood - Figure 200-07



Combination Core Plywood - Figure 200-09

200-G-5

Types of Facing Materials

Wood Veneers

Wood veneer is produced by veneer manufacturers in a variety of "industry standard" thicknesses. The slicing process is controlled by a number of variables. The thickness of the raw veneer has little bearing on the ultimate quality of the end product so long as show-through and sand-through is avoided.

HARDWOOD VENEER

Species: Available in many domestic and imported wood species.

Cut: Normally cut as plain sliced. Rift sliced and quarter sliced available in certain species at additional cost. Some species available as rotary cut.

SOFTWOOD VENEER

Species: Most common is Douglas-fir; pines are available; other softwoods in limited supply.

Cut: Most softwood veneer is Rotary cut. Plain sliced softwood veneer and "vertical grain" (quarter sliced) softwood veneer are limited in availability with the long lead times and higher prices associated with special orders.

Decorative Laminates, Overlays, and Prefinished Panel Products

Decorative surfacing materials are often applied to wood product substrates such as industrial particleboard, fiberboard, hardboard, etc.. Terminology and definitions of these overlay products follow, broadly grouped as:

Thermoset Decorative Overlay

Decorative thermally fused panels flat pressed from a thermoset polyester or melamine resin-impregnated web. Most products are pre-laminated to Industrial Particleboard or Medium Density Fiberboard substrates when they arrive at the woodwork fabricator. Performance characteristics are similar to High Pressure Decorative Laminate.

Medium Density Overlays

Pressed resin-impregnated paper overlays, highly resistant to moisture, applied to suitable cores for both interior and exterior uses. The seamless panel face and uniform density furnishes a sound base for opaque finishes and paint.

Thermoplastic Sheet

Semirigid sheet or roll stock extruded from a nonporous acrylic/polyvinyl chloride (PVC) alloy solid color throughout. Withstands high impact. Minor scratches and gouges are less conspicuous due to the solid color. Thickness ranges from 0.7 mm [.028"] to 6.4 mm [.250"]. Not recommended for horizontal surfaces where hot items may be placed and in areas near heat sources.

High Pressure Decorative Laminates

Resin-impregnated kraft paper substrates with decorative plastic face materials and a clear protective top sheet, formed under heat and pressure. The assembly offers resistance to wear and many common stains and chemicals. Common uses include casework exteriors, countertops, and wall paneling.

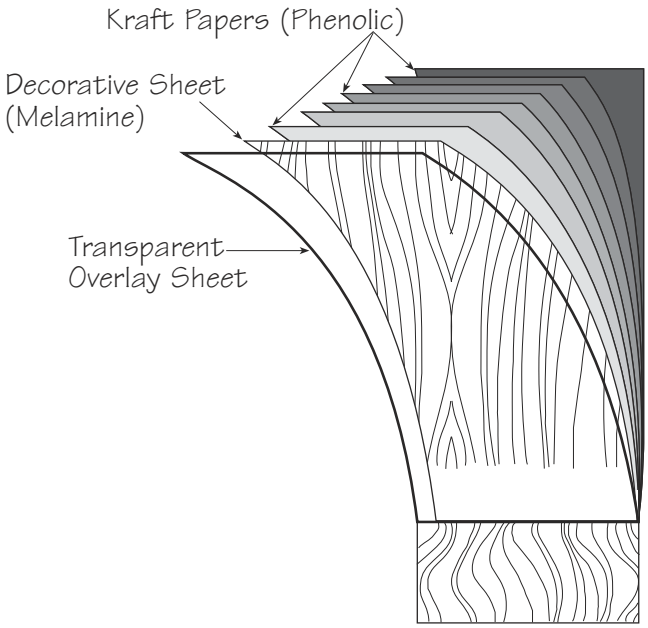


Figure 200-10 - HPDL Elements

Vinyl Films

Polyvinyl chloride (PVC) film, either clear or solid color, used extensively for decorative vertical surfaces in mobile homes, recreational vehicles, commercial panels and movable walls. Product thicknesses range from 0.5 mm to 8 mm. Some films are available with scuff-resistant top coatings. (Of limited use in custom architectural woodworking.)

Low Basis Weight Papers

Sometimes referred to as "micro-papers" or "rice papers," these overlays are printed paper coated with polyurethane, urea, polyester, acrylic, or melamine resins. They offer an economical alternative for low-wear surfaces. (Of limited use in custom architectural woodworking.)

Foils

These papers are generally referred to as "finished foils" in Europe. In the United States they have been called melamine papers, intermediate weight foils and impregnated foils. Not all foils are finished, nor are they all impregnated. Therefore foils vary in bond strength, porosity, cutting qualities and machinability. (Of limited use in custom architectural woodworking.)

VOLUNTARY STANDARDS

Voluntary standards for the production of these overlay products are available from:

National Electrical Manufacturers Association (NEMA), Rosslyn, VA.

Laminating Materials Association (LMA), Oradell, NJ.

Special Products

Included in this classification are special panel products such as lead-lined panels for X-ray areas; bullet-resistant panels for armor protected areas; honeycomb-core panels when light weight is a consideration, etc..

Lead-lined Panels

Usually a sheet of lead of a specified thickness, to meet X-ray shield requirements, is laminated between 2 layers of core material. A decorative overlay and balancing sheet can then be applied as required.

Projectile resistant armor (bullet proofing)

Available as steel plate-, glass-, polycarbonate-, acrylic- or fiberglass-reinforced material which can offer protection against most available small-arms fire, depending upon the thickness specified. These panels are usually built into the interior of the structure of the counter, teller's lines, judge's benches, etc.. Standards and tests for bullet resistance are set by both Underwriters Laboratories (UL. 752) and the National Institute of Justice (N.I.J.-0108.01).

Solid surfacing materials

Solid surfacing materials are available and can be fabricated and/or supplied by many woodworkers. The products (and manufacturer's warranties) vary and must be fabricated according to manufacturer's recommendations, including the use of unique fasteners and adhesives. Many decorative inlays are available. Consult your woodworker about performance issues, materials, colors, and patterns.

Composite veneers

Composite veneers are slices of blocks or "flitches" made from pre-dyed veneer which has been laminated, and in some cases deformed, to produce a special grain and color characteristic.

Composite veneer has both advantages and limitations. The woodworker and the design professional may choose to use composite veneers for economical and/or æsthetic reasons.

Composite veneers are not meant as a substitute for real wood veneer. Each has its own place and proper application. The design professional, in consultation with a woodwork manufacturer, will determine which product to use on a specific project.

Acrylic and Methacrylate Sheets

Overlay materials typically 3.2 mm [1/8"] thick with a high-gloss finish. Individual products should be evaluated and specified or approved by the design professional when desired. Manufacturer's performance test data is available for review.

Solid Phenolic Core (SPC)

A composite of solid phenolic resins moulded with a homogeneous core of organic fiber reinforced phenolic and one or more integrally cured surfaces of compatible thermoset nonabsorbent resins.

SPC has seen some use in recent years as wall surfacing, casework parts, and countertops.

200-G-6

Wood Veneer Species

General characteristics of selected species:

Species	Cut and Details	Width to	Length	Flitch Size	Cost (1)	Availability
Mahogany	Plain Sliced Honduras Mahogany	457 mm [18"]	3658 mm [12']	Large	Moderate	Good
	Quartered Honduras Mahogany	305 mm [12"]	3658 mm [12']	Large	High	Moderate
	Plain Sliced African Mahogany	457 mm [18"]	3658 mm [12']	Large	Moderate	Moderate
	Quartered African Mahogany	305 mm [12"]	3658 mm [12']	Large	High	Good
Ash	Plain Sliced American White Ash	305 mm [12"]	3048 mm [10']	Medium	Moderate	Good
	Quartered American White Ash	203 mm [8"]	3658 mm [12']	Small	High	Good
	Quartered or Plain Sliced European Ash	254 mm [10"]	3048 mm [10']	Medium	High	Limited
Anegre	Quartered or Plain Sliced Anegre	305 mm [12"]	3658 mm [12']	Large	High	Good
Avodire	Quartered Avodire	254 mm [10"]	3048 mm [10']	Large	High	Limited
Cherry	Plain Sliced American Cherry	305 mm [12"]	3353 mm [11']	Medium	Moderate	Good
	Quartered American Cherry	102 mm [4"]	3048 mm [10']	V. Small	High	Moderate
Birch	Rotary Cut Birch (Natural)	1220 mm [48"]	3048 mm [10']	Large	Low	Good
	Rotary Cut Birch (Select Red or White)	914 mm [36"]	3048 mm [10']	Medium	Moderate	Moderate
	Plain Sliced Birch (Natural)	254 mm [10"]	3048 mm [10']	Small	Moderate	Limited
	Plain Sliced Birch (Select Red or White)	127 mm [5"]	3048 mm [10']	Small	High	Limited
Butternut	Plain Sliced Butternut	305 mm [12"]	3048 mm [10']	Medium	High	Limited
Makore	Quartered or Plain Sliced Makore	305 mm [12"]	3658 mm [12']	Large	High	Good
Maple	Pl. Sl. (Half Round) American Maple	305 mm [12"]	3048 mm [10']	Medium	Moderate	Good (2)
	Rotary Birdseye Maple	6096 mm [20"]	3048 mm [10']	Medium	V. High	Good
Oak	Plain Sliced English Brown Oak	305 mm [12"]	3048 mm [10']	Medium	V. High	Limited
	Quartered English Brown Oak	254 mm [10"]	3048 mm [10']	Medium	V. High	Limited
	Plain Sliced American Red Oak	4877 mm [16"]	3658 mm [12']	Large	Moderate	Good
	Quartered American Red Oak	203 mm [8"]	3048 mm [10']	Small	Moderate	Good
	Rift Sliced American Red Oak	254 mm [10"]	3048 mm [10']	Medium	Moderate	Good
	Comb Grain Rift American Red Oak	203 mm [8"]	3048 mm [10']	Small	V. High	Limited
	Plain Sliced American White Oak	305 mm [12"]	3658 mm [12']	Medium	Moderate	Good
	Quartered American White Oak	203 mm [8"]	3048 mm [10']	Small	Moderate	Good
	Rift Sliced American White Oak	203 mm [8"]	3048 mm [10']	Medium	High	Good
	Comb Grain Rift American White Oak	203 mm [8"]	3048 mm [10']	Small	V. High	Limited
Hickory or Pecan	Plain Sliced American Hickory or Pecan	305 mm [12"]	3048 mm [10']	Small	Moderate	Good
Sapele	Quartered or Plain Sliced Sapele	305 mm [12"]	3658 mm [12']	Large	High	Good
Sycamore	Plain Sliced English Sycamore	254 mm [10"]	3048 mm [10']	Medium	V. High	Limited
	Quartered English Sycamore	152 mm [6"]	3048 mm [10']	Medium	V. High	Limited
Teak	Plain Sliced Teak	305 mm [12"]	3658 mm [12']	Large	V. High	Limited (3)
	Quartered Teak	305 mm [12"]	3658 mm [12']	Medium	V. High	Limited (3)
Walnut	Plain Sliced American Walnut	305 mm [12"]	3658 mm [12']	Medium	Moderate	Good
	Quarter Sliced American Walnut	152 mm [6"]	3048 mm [10']	V. Small	High	Rare

(1) Cost reflects raw veneer costs weighted for waste or yield characteristics and degree of labor difficulty.
(2) Seasonal factors may affect availability.
(3) Availability of blond Teak is very rare.
When Quartered or Plain Sliced (Pl. Sl.) are listed on the same line, the width dimensions are Plain Sliced; Quartered is narrower

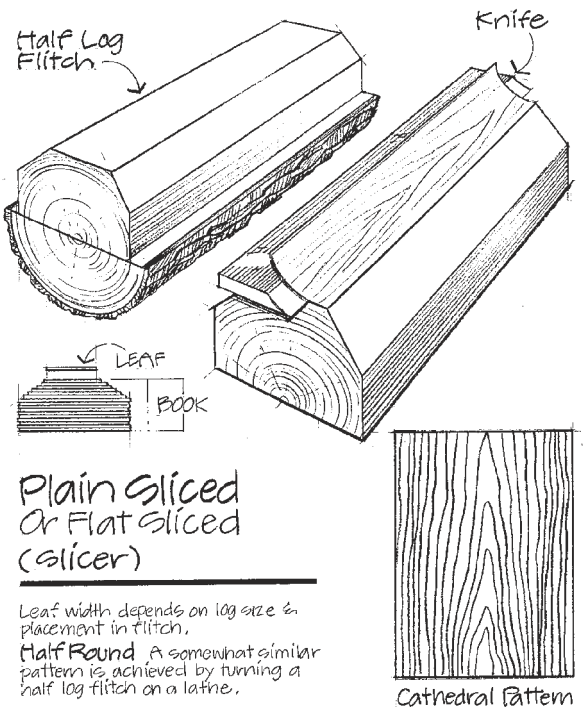
200-G-7

Types of Veneer Cuts

The manner in which a log segment is cut with relation to the annual rings will determine the appearance of the veneer. When sliced, the individual pieces of veneer, referred to as *leaves,* are kept in the order in which they are sliced, thus permitting a natural grain progression when assembled as veneer faces. The group of leaves from one slicing is called a *flitch* and is usually identified by a flitch number and the number of gross square feet of veneer it contains. The faces of the leaves with relation to their position in the log are identified as the *tight face (*toward the outside of the log) and the *loose face (*toward the inside or heart of the log). During slicing the leaf is stressed on the loose face and compressed on the tight face. When this stress is combined with the natural variation in light refraction caused by the pores of the wood, the result is a difference in the human perception of color and tone between tight and loose faces.

The principal methods of slicing veneers and the general visual characteristics of the grain are:

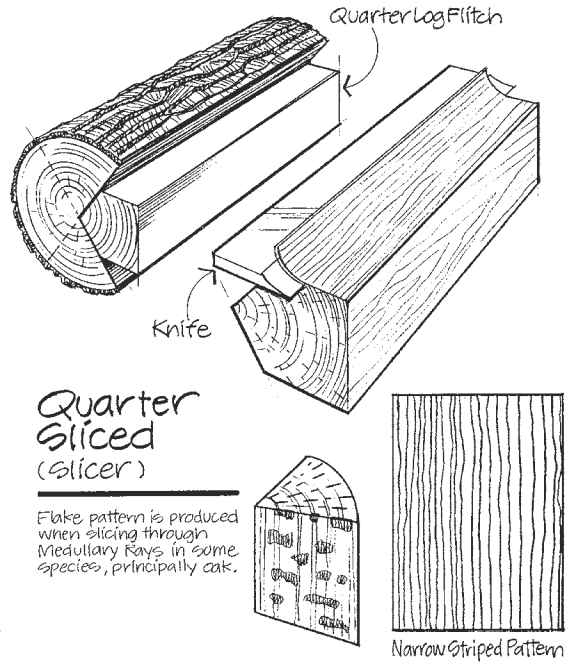
Plain Slicing (or Flat Slicing)



Plain Sliced - Figure 200-11

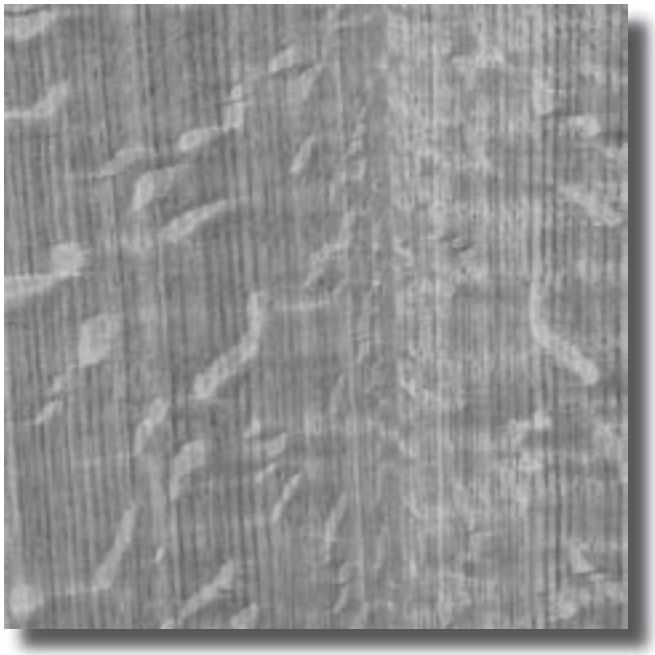
This is the slicing method most often used to produce veneers for high quality architectural woodworking. Slicing is done parallel to a line through the center of the log. A combination of cathedral and straight grain patterns results, with a natural progression of pattern from leaf to leaf.

Quarter Slicing (or Quarter Cut)

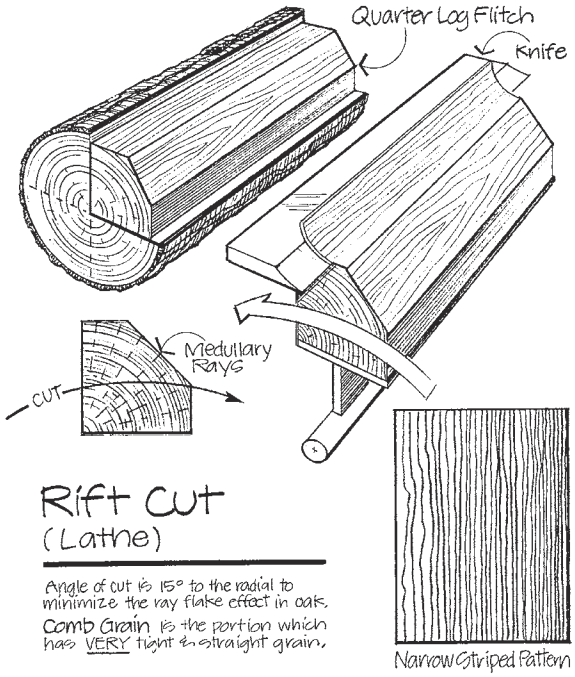


Quarter Sliced - Figure 200-12

Quarter slicing simulates the quarter sawing process of solid lumber, roughly parallel to a radius line through the log segment. In many species the individual leaves are narrow as a result. A series of stripes is produced, varying in density and thickness from species to species. "Fleck" (sometimes called flake) is a characteristic of this slicing method in Red and White Oak.



Rift Slicing (or Rift Cut)



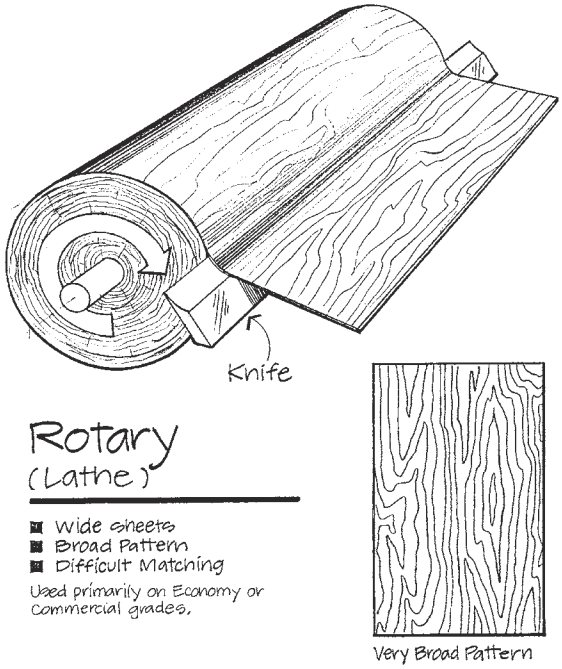
Rift Sliced - Figure 200-13

Rift veneers are produced most often in Red and White Oak, rarely in other species. Note that rift veneers and rift sawn solid lumber are produced so differently that a "match" between rift veneers and rift sawn solid lumber is highly unlikely. In both cases the cutting is done slightly off the radius lines minimizing the "fleck" (sometimes called flake) associated with quarter slicing.

Comb Grain

Limited in availability, comb grain is a select product of the Rift process distinguished by tight, straight grain along the entire length of the veneer. Slight angle in the grain is allowed. Comb grain is restricted to Red and White Oak veneers.

Rotary



Rotary Sliced - Figure 200-14

The log is center mounted on a lathe and "peeled" along the general path of the growth rings like unwinding a roll of paper, providing a generally bold random appearance. Rotary cut veneers may vary in width and matching at veneer joints is extremely difficult. Almost all softwood veneers are cut this way. Except for a specific design effect, rotary veneers are the least useful in fine architectural woodwork.

Note: Rotary sliced fine hardwood veneers are used in a limited way, and usually for special figure and cut, in the manufacture of Premium Grade woodwork. Careful consideration, specification, and communication are recommended when rotary cut is contemplated.

Composite Veneers

Sliced from fast-growing trees, these veneers are dyed and then reglued in molds to create "grain" patterns. The color is established during manufacture because the high percentage of glue lines resist staining by the woodworker. Must be specified by brand name and manufacturer's designation. "Matching" between components may not be possible.

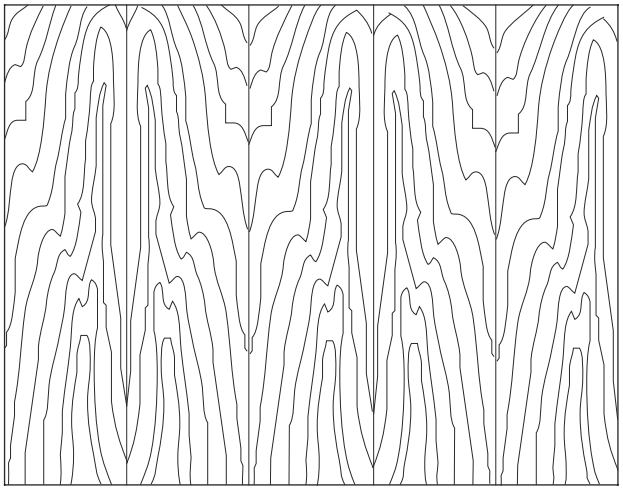
200-G-8

Matching Between Adjacent Veneer Leaves

It is possible to achieve certain visual effects by the manner in which the leaves are arranged. As noted, rotary cut veneers are difficult to match; therefore most matching is done with sliced veneers. The matching of adjacent veneer leaves must be specified. Special arrangements of leaves such as "diamond" and "box" matching are available. Consult your woodworker for choices. The more common types are:

Book Matching

The most commonly used match in the industry. Every other piece of veneer is turned over so adjacent pieces (leaves) are opened like the pages of a book.

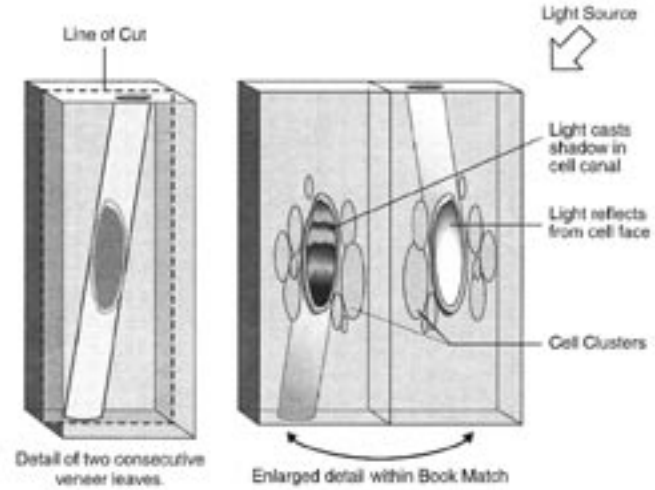


Book Matching - Figure 200-15

Visual Effect - Veneer joints match, creating a symmetrical pattern. Yields maximum continuity of grain. When sequenced panels are specified, prominent characteristics will ascend or descend across the match as the leaves progress from panel to panel.

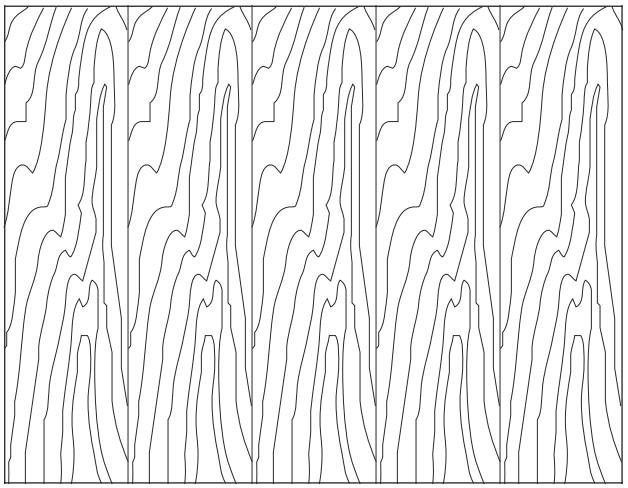
Barber Pole Effect in Book Match

Because the *tight* and *loose* faces alternate in adjacent pieces of veneer, they may accept stain differently, and this may result



Slip Matching

Often used with quarter sliced and rift sliced veneers. Adjoining leaves are placed (slipped out) in sequence without turning, resulting in all the same face sides being exposed.



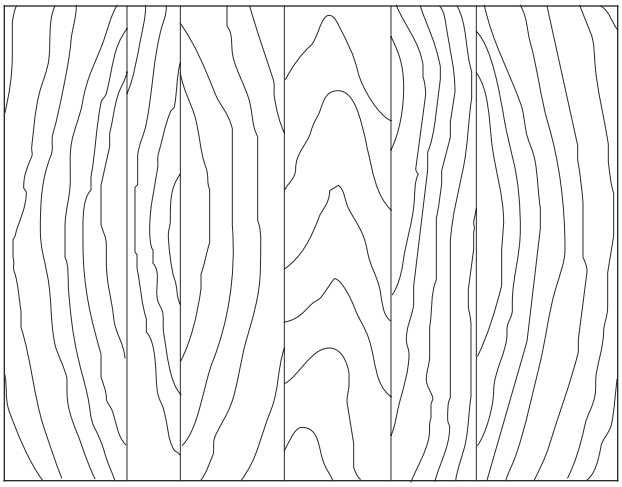
Slip Matching - Figure 200-16

Visual Effect - Grain figure repeats; but joints do not show visual grain match.

Note: The lack of grain match at the joints can be desirable. The relatively straight grain patterns of quartered and rift veneers generally produce pleasing results and a uniformity of color because all faces have the same light refraction.

Random Matching

Veneer leaves are placed next to each other in a random order and orientation, producing a "board-by-board" effect in many species.



Random Matching - Figure 200-17

Visual Effect - Casual or rustic appearance, as though individual boards from a random pile were applied to the product. Conscious effort is made to mismatch grain at joints.

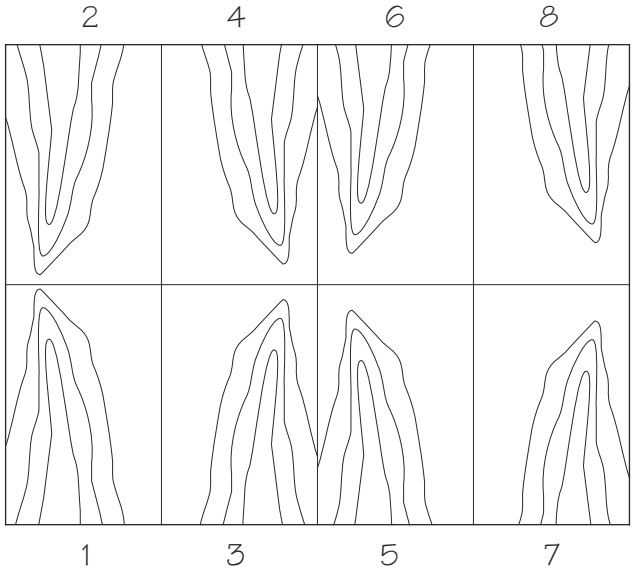
Degrees of contrast and variation may change from panel to panel. This match is more difficult to obtain than book or slip match, and must be clearly specified and detailed.

End Matching

Often used to extend the apparent length of available veneers for high wall panels and long conference tables. End matching occurs in two types:

A. Architectural End Match

Leaves are individually book (or slip) matched, first end-to-end and then side-to-side, alternating end and side.

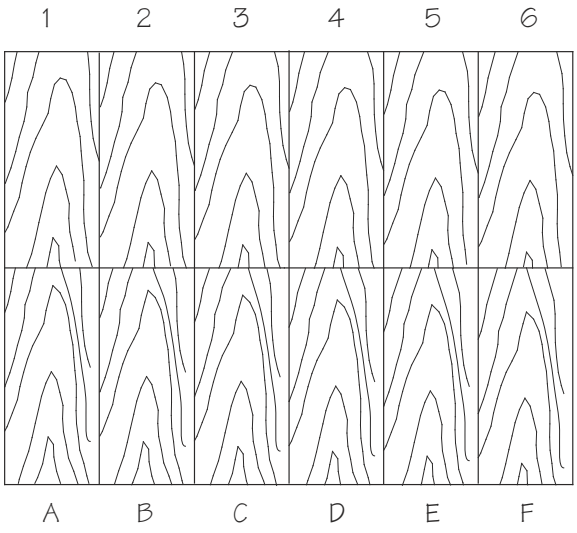


Architectural End Match - Figure 200-18a

Visual Effect - Yields best continuous grain patterns for length as well as width.

B. Continuous End Match

Leaves are individually book (or slip) matched, separate panels are stacked in sequenced order, either horizontally or vertically in the elevation. (Horizontal sequence illustrated.)

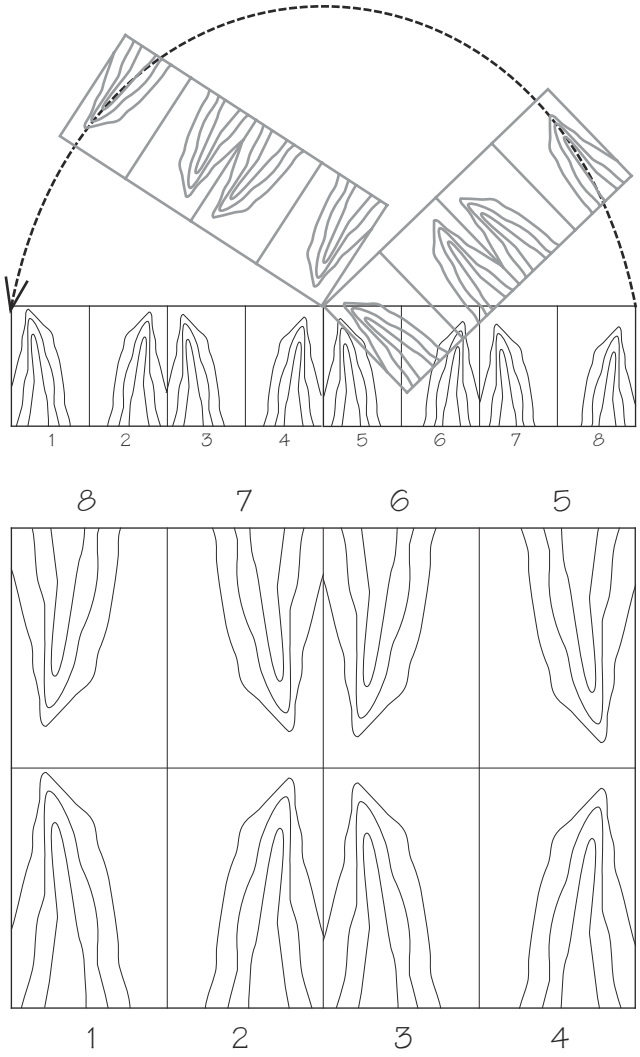


Continuous End Match - Figure 200-18b

Visual Effect - Yields sequenced grain patterns for elevations, with pleasing blend of figure horizontally or vertically.

C. Panel End Match

Leaves are book (or slip) matched on panel subassemblies, with sequenced subassemblies end matched, resulting in some modest cost savings on projects where applicable.



Panel End Match - Figure 200-19

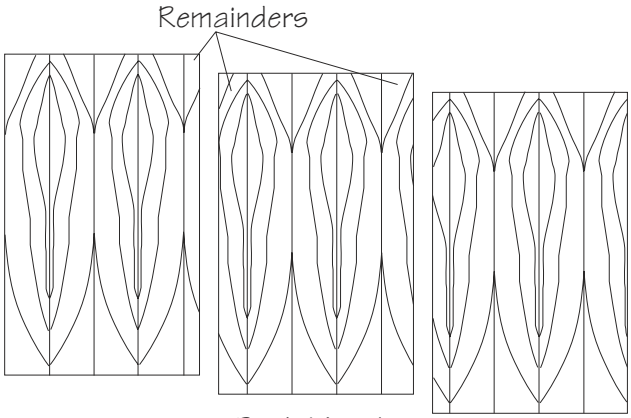
Visual Effect - For most species, yields pleasing, blended appearance and grain continuity.

200-G-9

Matching Within Individual Panel Faces

The individual leaves of veneer in a sliced flitch increase or decrease in width as the slicing progresses. Thus, if a number of panels are manufactured from a particular flitch, the number of veneer leaves per panel face will change as the flitch is utilized. The manner in which these leaves are "laid up" within the panel requires specification, and is classified as follows:

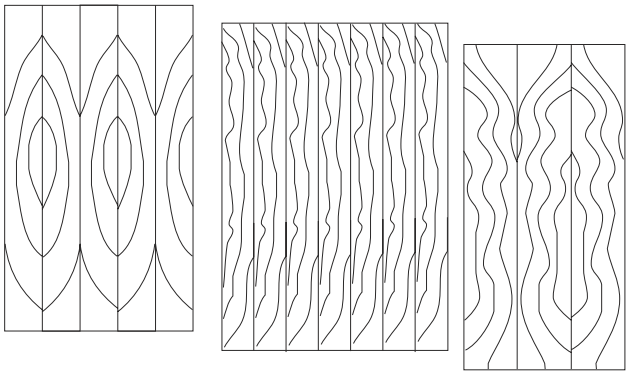
Running Match



Running Match - Figure 200-20

Each panel face is assembled from as many veneer leaves as necessary. This often results in a non-symmetrical appearance, with some veneer leaves of unequal width. Often the most economical method at the expense of æsthetics, it is the standard for Custom Grade and must be specified for other Grades. Running matches are seldom "sequenced and numbered" for use as adjacent panels. Horizontal grain "match" or sequence cannot be expected.

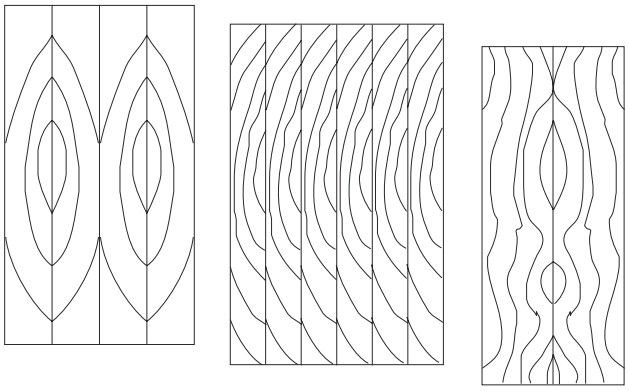
Balance Match



Balance Match - Figure 200-21

Each panel face is assembled from veneer leaves of uniform width before edge trimming. Panels may contain an even or odd number of leaves, and distribution may change from panel to panel within a sequenced set. While this method is the standard for Premium Grade, it must be specified for other Grades, and it is the most common assembly method at moderate cost.

Balance and Center Match



Balance and Center - Figure 200-22

Each panel face is assembled of an even number from veneer leaves of uniform width before edge trimming. Thus, there is a veneer joint in the center of the panel, producing horizontal symmetry. A small amount of figure is lost in the process. Considered by some to be the most pleasing assembly at a modest increase in cost over Balance Match.

200-G-10
Fire-Retardant Panels
Flame Spread Classification

The various codes utilize flame spread classifications for wood and other materials. It is the responsibility of the specifier to determine which elements, if any, of the woodwork require special treatment to meet local codes. In most codes, the panel products used to fabricate casework and furniture are not regulated. For more detailed information, please refer to the *Fire Code Summary* in the Appendix and your local Code Book.

Flame Spread Factors

A. Core - The fire rating of the core material determines the rating of the assembled panel. Fire-retardant veneered panels must have a fire-retardant core. Particleboard core is available with a Class I (Class A) rating and can be used successfully with veneer or rated high pressure decorative laminate faces. MDF (Medium Density Fiberboard) is available with a fire rating in some markets.

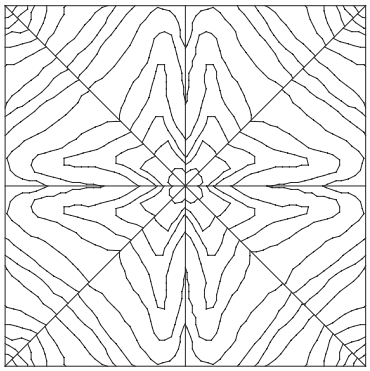
B. Face - Some existing building codes, except where locally amended, provide that facing materials $^{1}/_{28}$" or thinner are not considered in determining the flame spread rating of the panel. If state and local codes move toward adoption of the International Building Code provisions, it is possible that the $^{1}/_{28}$" exemption may not be available.

Note: In localities where basic panel building codes have been amended it is the responsibility of the specifier to determine whether the application of the facing material specified will meet the code.

Traditionally, face veneers are not required to be fire-retardant treated, and such treatment will adversely affect the finishing process.

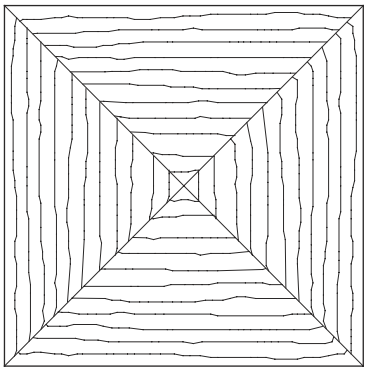
Special Matches

There are regional variations in the "names" of the following veneer leaf matching techniques. It is strongly recommended the design professional use *both* names and drawings to define the effect desired.



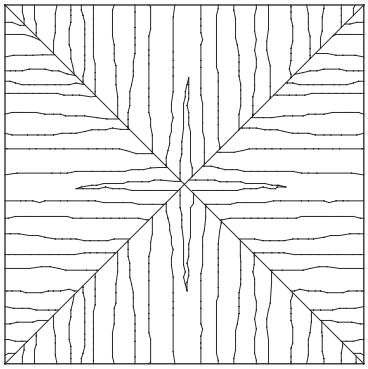
8-piece Sunburst

Sunburst - Figure 500-09a



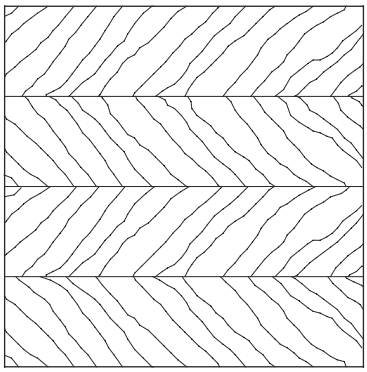
Box Match

Box - Figure 500-09b



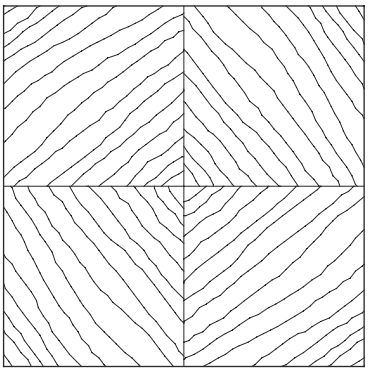
Reverse or End Grain Box

Reverse Box - Figure 500-09c



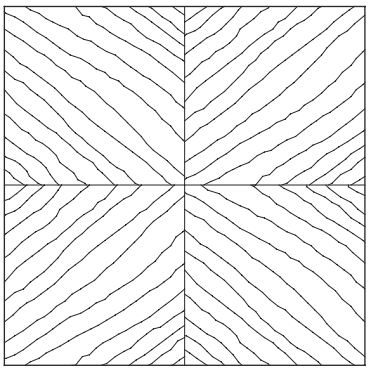
Herringbone or
V-Book Match

Herringbone - Figure 500-09d



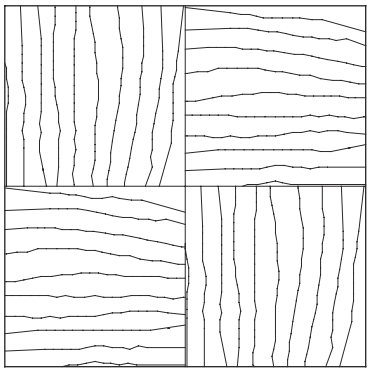
Diamond Match

Diamond - Figure 500-09e



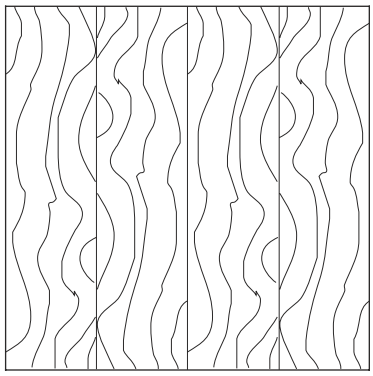
Reverse Diamond

Reverse Diamond - Figure 500-09f



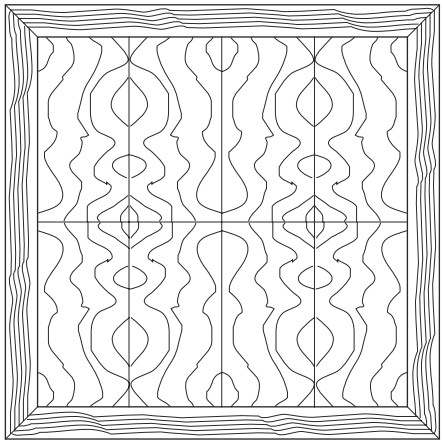
Parquet Match

Parquet - Figure 500-09g



Swing Match

Swing - Figure 500-09h



Book & Butt Match w/ border

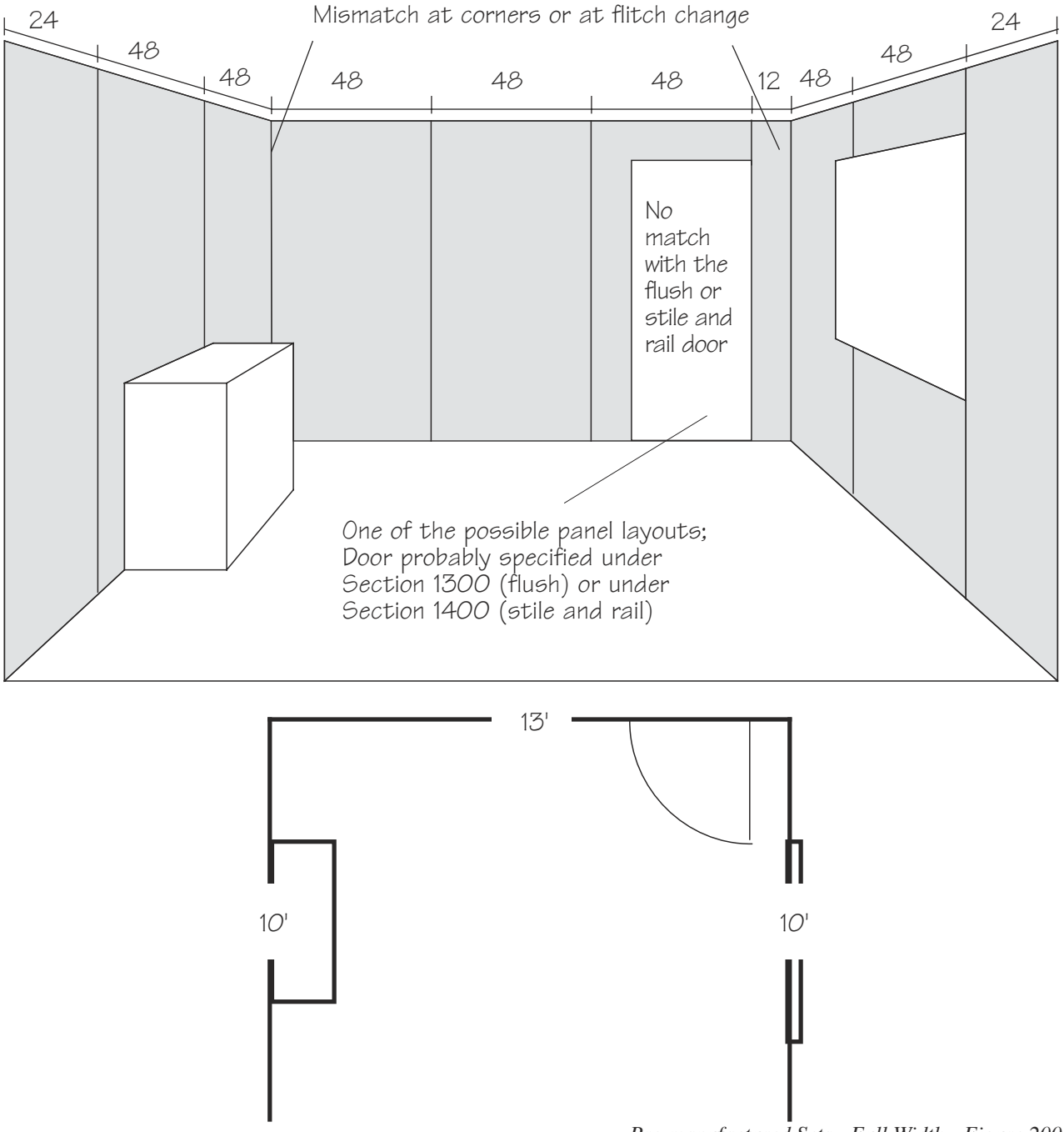
Combination Face - Figure 500-09i

200-G-11

Methods of Matching Panels

Veneered panels used in casework or paneling in the same area may be matched to each other. This important component of the project must be carefully detailed and specified. The natural growth patterns of the tree will cause the figure on the sequential panels to ascend, descend, or show a "grain progression" as the eye moves from panel to panel. These illustrations were developed in Imperial measure and have not been converted for this edition. The four common methods are:

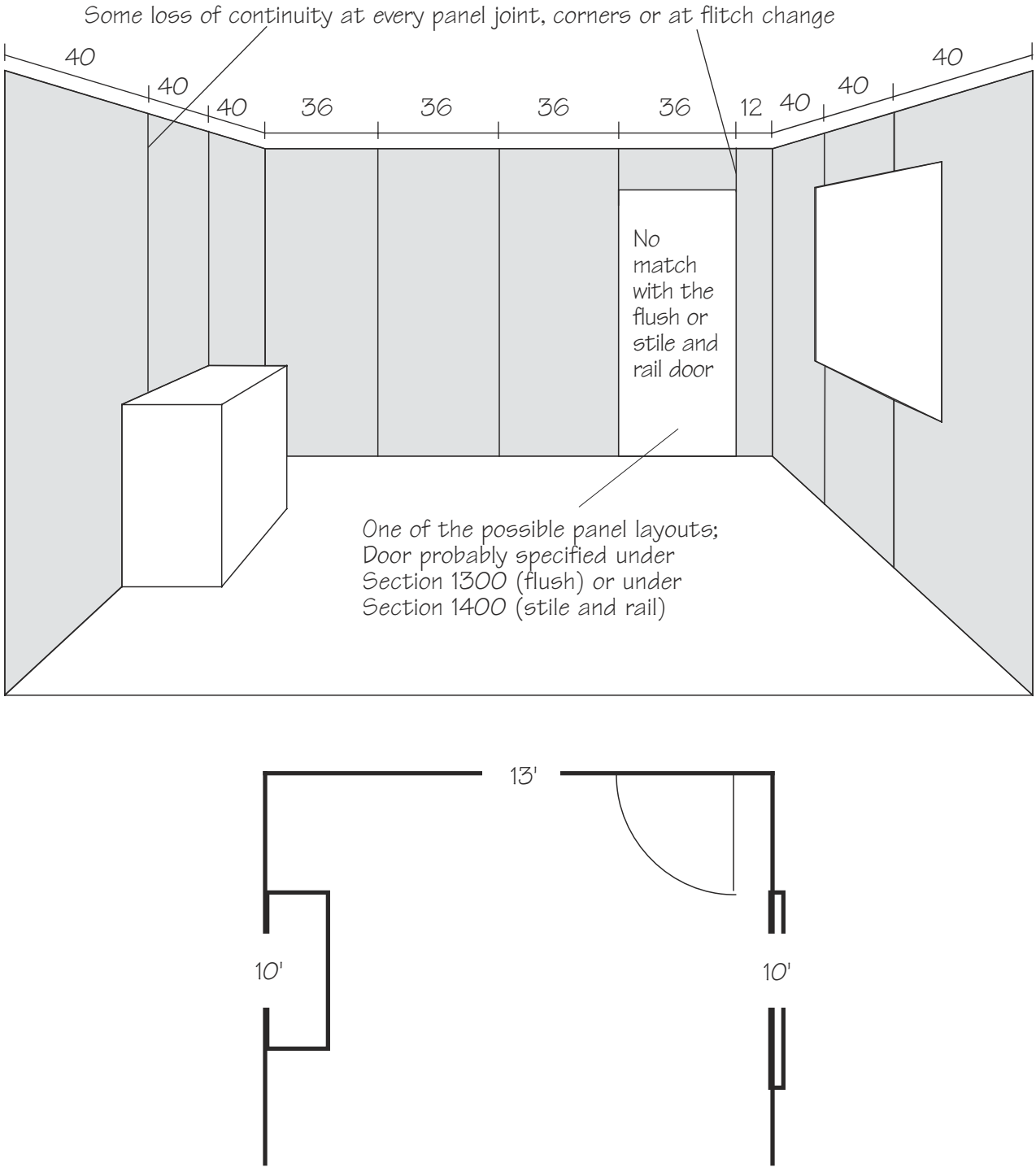
1 - Pre-manufactured Sets - Full Width



Pre-manufactured Sets - Full Width - Figure 200-23

These are one step above stock plywood panels, usually made and warehoused in 4' x 8' or 4' x 10' sheets in sequenced sets. They may be produced from a single flitch or a part of a flitch, usually varying in number from 6 to 12 panels. If more than one set is required, matching between the sets cannot be expected. Similarly, doors or components often cannot be fabricated from the same flitch materials, resulting in noticeable mismatch. This is often the most economical type of special panel products.

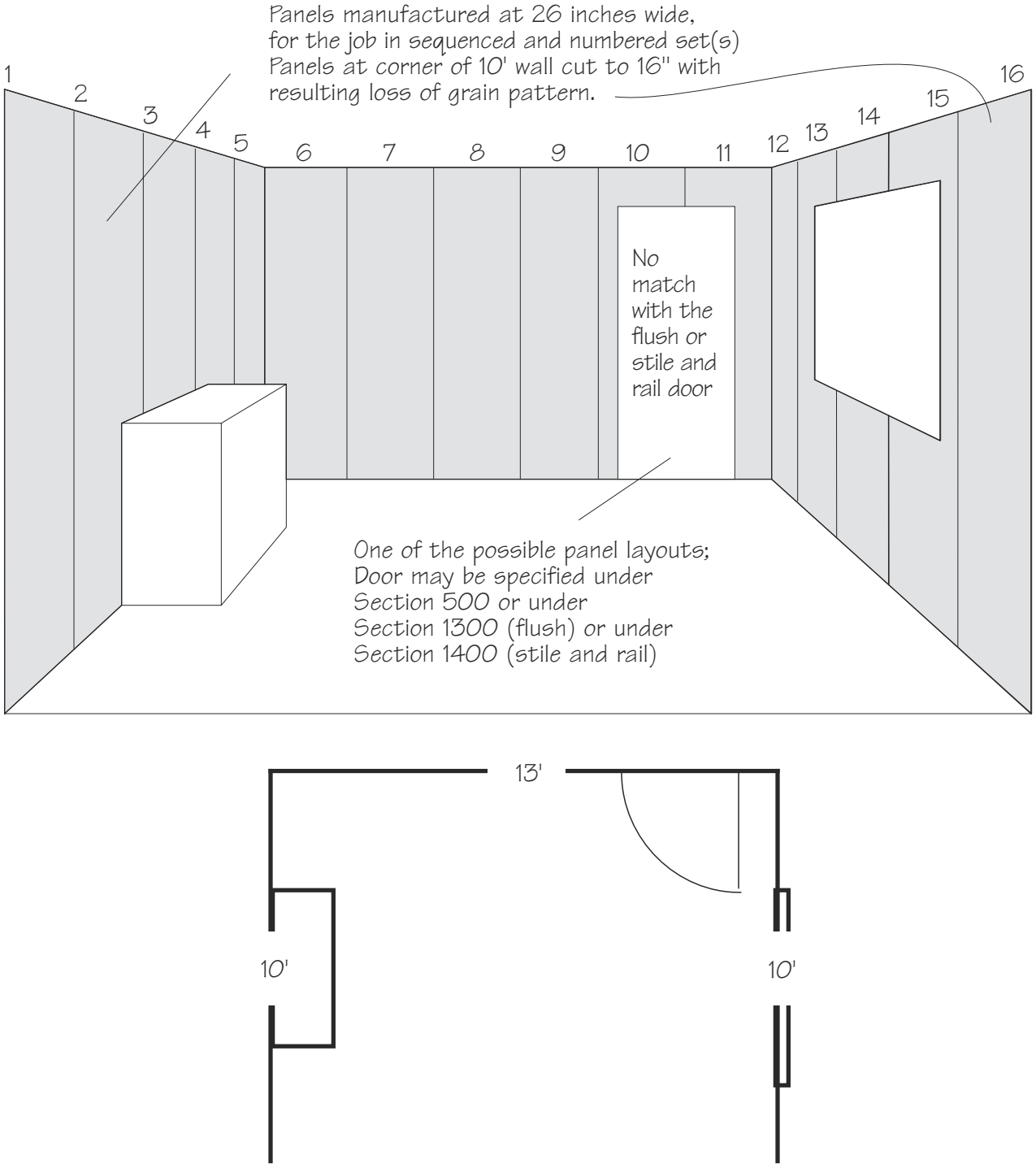
2 - Pre-manufactured Sets - Selectively Reduced in Width



Pre-manufactured Sets Reduced - Figure 200-24

These are panels just like those in the previous illustration, usually made and warehoused in 4' x 8' or 4' x 10' sheets in sequenced sets. They are often selected for continuity, recut into modular widths, and numbered to achieve the appearance of greater symmetry. If more than one set is required, matching between the sets cannot be expected. Similarly, doors or components often cannot be fabricated from the same flitch materials, resulting in noticeable mismatch.

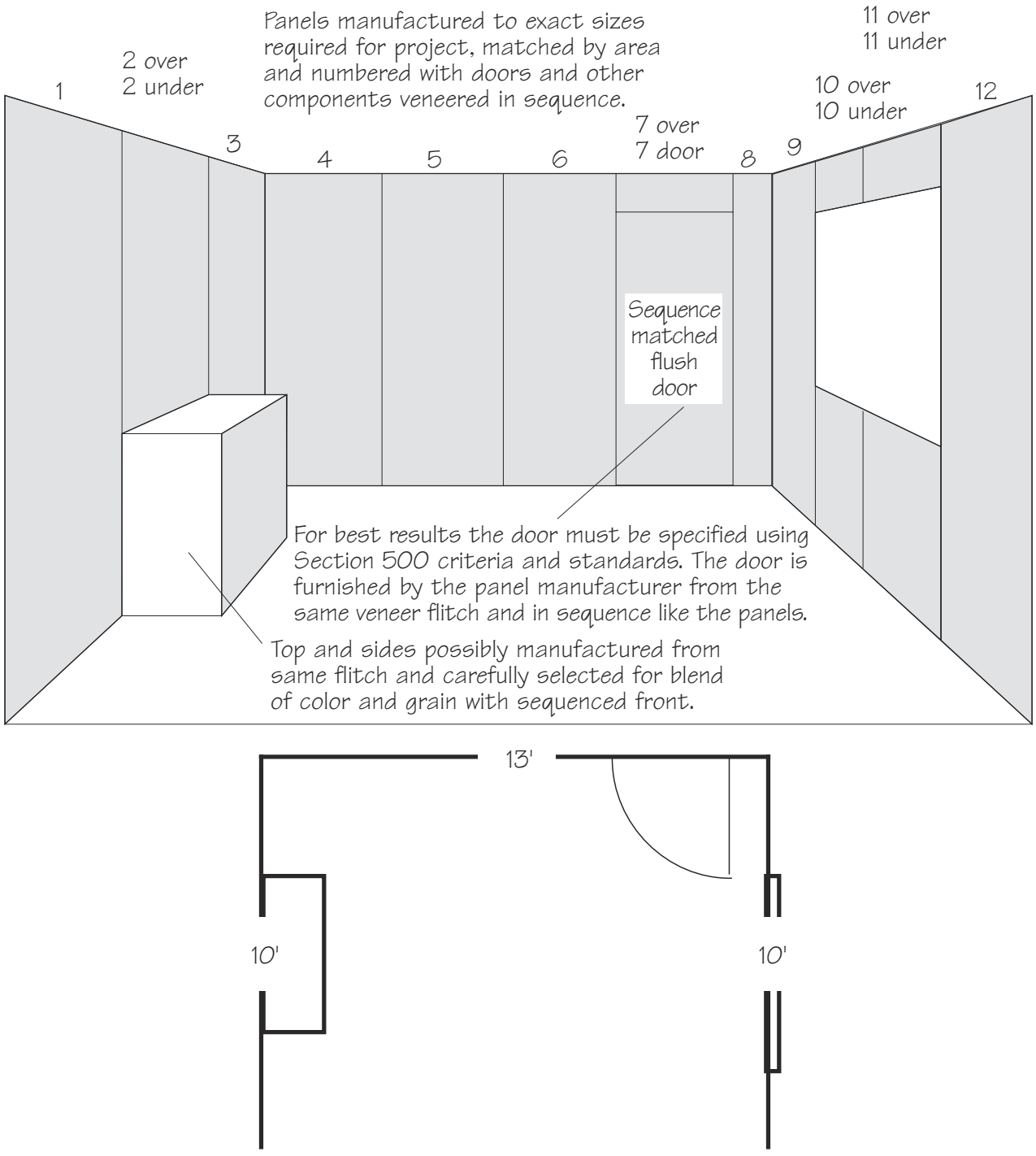
3 - Sequence-Matched Uniform Size Set



Sequence-Matched Uniform Set(s) - Figure 200-25

These sets are manufactured for a specific installation to a uniform panel width and height. If more than one flitch is required to produce the required number of panels, similar flitches will be used. This type of panel matching is best used when panel layout is uninterrupted, and when the design permits the use of equal-width panels. Some sequence will be lost if trimming is required to meet field conditions. Doors and components within the wall cannot usually be matched to the panels. Moderate in cost, sequenced uniform panels offer a good compromise between price and æsthetics.

4 - Blueprint-Matched Panels and Components



Blueprint-Matched Panels - Figure 200-26

This method of panel matching achieves maximum grain continuity since all panels, doors, and other veneered components are made to the exact sizes required and in the exact veneer sequence. If possible, flitches should be selected that will yield sufficient veneer to complete a prescribed area or room. If more than one flitch is needed, flitch transition should be accomplished at the least noticeable, predetermined location. This method requires careful site coordination and relatively long lead times. Panels cannot be manufactured until site conditions can be accurately measured and detailed. This panel matching method is more expensive and expresses veneering in its most impressive manner.

Technical Criteria

Other sections of these standards control the use of panel products for casework, paneling, shelving, and other purposes. *NOTE: In the absence of any provisions in these later sections, or in the project specifications or drawings, the following standards shall apply for panel products.*

200-T-1
Cores

A. **Core Selection** — Shall be at the option of the woodworker.

B. **Quality of Core** — Shall comply with published industry standards for cores as manufactured for use in architectural woodwork.

C. **Particleboard and/or Fiberboard** — Shall be Industrial Grade Medium Density, complying with current ANSI A208.1 (particleboard) or ANSI A208.2 (fiberboard). Core materials for typical flush passage doors, gates, etc. are usually a lower density LD-1 or -2.

200-T-2
Wood Veneers

Note: Only Grades of workmanship and finished product are defined by the QSI Grade designations: Premium, Custom or Economy. Hardwoods, softwoods and wood veneers are raw materials. Raw material Grades, or properties, are defined by independently formulated grading rules. The grades of material defined and utilized in the QSI are Grade I, II and III, for hardwood and softwood lumber and Grades A-A, A and B, for veneer face products. For the most part, the QSI requires that the grade of material correspond to the Grade of workmanship/product specified; i.e. Premium Grade must utilize Grade I and Grade AA. However, a higher, or lower, grade of material may be defined for aesthetic, or structural reasons. Opaque finishes usually use a lower material grade.

A. **Hardwood Veneers** - shall be of species, cut, match and grain direction at the option of the woodworker. In the absence of specifications for "select white" ash or maple or birch, natural-colored veneers will be supplied.

B. **Softwood Veneers** - shall be of species, cut, match and grain direction at the option of the woodworker.

C. **Rotary Sliced Veneers** - In the absence of specifications to the contrary, rotary sliced veneers shall NOT be used in Premium Grade work for any section of this standard.

D. **Delamination** of any element of a panel shall not be permitted in any grade.

E. **Surface cracking, crazing, or ridges** in the exposed face veneer shall not be permitted in any grade.

200-T-3
Panel Assembly Adhesives

A. Interior Use — Either interior (Type II, moisture resistant) or exterior (Type I, waterproof) panel assemblies may be supplied at the option of the woodworker. The use of contact cement to bond veneer leaves or 2-ply faces to a substrate is not permitted unless there is no alternative. If used, contact adhesive shall be spray applied and veneer shall be backed with a solvent-impermeable membrane or phenolic barrier material.

B. **Exterior Use** — Exterior (Type I, waterproof) panel assemblies shall be supplied.

200-S-4
Fire-Retardant Panels

Note: The specifier shall indicate what fire-retardant classification is required for a particular panel. In the absence of such a specified rating, the woodworker may supply unrated panel products.

200-T-5
Field Treatment of Panel Products

Dissimilar treatment or finishing in the field to the two faces of a panel product, by other than the woodworker, shall relieve the woodworker of any responsibility for tests for flatness promulgated in this publication.

200-T-6
Wood Veneer Panel Standards

In order to ensure quality consistent with veneer availability, the Standard has generally adapted the established face veneer characteristics of the Hardwood Plywood and Veneer Association (HPVA). These face grades apply to architectural woodwork. Veneer shall be firmly adhered to core with no evidence of bubbling, blistering, or delamination on the finished product. "Stock" or "commodity" products (other than sequenced and numbered warehouse sets of architectural grade panels) incorporated into project specifications are not addressed in this section. Hardwood plywood panel thickness tolerances are established by the HPVA, and adopted here as +0/-0.8 mm ($^1/_{32}$") for panels up to a nominal stated thickness of 6 mm ($^1/_4$"), and +0/-1.2 mm ($^3/_{64}$") for panels with a nominal thickness of 6 mm ($^1/_4$") or more.

Softwood plywood characteristics are generally set by the APA–The Engineered Wood Association and have limited application in the finished surfaces of architectural woodwork.

Doors and panels can be manufactured in other species and to other specifications, provided veneer of the proper quality and length is available, by mutual agreement between the buyer and seller.

Note: If pre-selection of a particular flitch is approved by the owner's representative, the face veneer characteristics in the Sections which follow do not apply. In this case, careful consideration and approval by the owner's representative must be given as to which characteristics or defects shall be accepted or eliminated and the resultant effect upon the widths of the veneer leaves, the yield from the flitch, and the total face appearance.

200-T-7

Veneer Face Grades

The upper three veneer face grades established by the Hardwood Plywood and Veneer Association (HPVA) are utilized in high quality architectural woodwork. (These are not the same standards used for softwood plywood. HPVA Grade "B" hardwood plywood may be superior to APA Grade "A" fir plywood, for example.) The grading requirements for the purposes of *this* Quality Standard are described in the following paragraphs, and detailed in Section 200.

When faces consist of more than one piece, the edges shall appear parallel. Face grade characteristics appear in the tables which follow the text. The requirements for veneer and manufacturing characteristics relate to the minimum requirements for that grade.

Other hardwood species not specifically listed in the tables are also covered by this Standard. For unlisted species, the buyer and seller shall select from species groupings most similar to the product required as a basis for the grade of the unlisted species. For other applications, and as agreed to by buyer and seller, requirements for veneer and manufacturing characteristics are not prohibited from being more restrictive than those outlined.

Panels shall be identified by veneer species and grade of face. A tolerance of 5 percent of the shipment or order is allowed.

Note: It is improper to refer to veneers (or any raw material) using the terms Premium, Custom, or Economy Grades. These grade designations *only* apply to finished products, as outlined in other sections of this Quality Standards Illustrated.

Wood is a natural material. Thus, its appearance is influenced by a number of factors uncontrolled by man. Natural processes are, in part, responsible for the inherent natural characteristics in wood.

No species and no tree can be totally free of these characteristics. Because of the inherent individuality of trees, consideration should be given to the overall appearance of the veneer face to determine the appropriate grade for that veneer.

GRADE AA — The veneer shall be smooth, tight cut and full length. When the face consists of more than one veneer component or piece, the edges shall appear parallel and be edge matched as described for the various species in 200-T-9. All components of a book or slip matched face shall be from the same flitch. Rotary cut faces shall be whole piece or multi-piece with edge joints tight and no sharp color contrasts at the joints. Species specified for natural color will allow color contrasts, but must be book matched or conform to the type of matching specified. The components of plain sliced (flat cut) and multi-piece rotary faces shall be book matched, unless otherwise specified, with a running, balanced, or center match arrangement. Unless otherwise specified, components in plain sliced faces shall have a matching arrangement selected by the manufacturer. Plain sliced faces shall consist of two or more components. Rotary faces shall consist of one or more components. Neither plain sliced nor rotary faces shall have any components, except outside components, that are less than 152 mm [6"] in width. Outside components shall be sized to allow for certain types matching or panel edge trim loss. No plain sliced components shall have a split heart. No full quarter cut is allowed in plain sliced faces. The width of any single component in quarter cut, rift cut or comb grain faces, except for outside components, shall not be less than 76 mm [3"]. Outside components shall be sized to allow for certain types of matching or panel edge trim loss. Sapwood and heartwood requirements shall be in accordance with table(s) in this standard.

GRADE A — The veneer shall be smooth, tight cut and full length. When the face consists of more than one veneer component or piece, the edges shall appear parallel and be edge matched as described for the various species in 200-T-9. All components of a book or slip matched face shall be from the same flitch. Rotary cut faces shall be whole piece or multi-piece with tight edge joints; however, no sharp color contrasts are permitted at the joints and the face shall provide a good general appearance. Species specified for natural color will allow color contrasts, but must be book matched or conform to the type of matching specified. The components of plain sliced (flat cut) and multi-piece rotary faces shall be book matched, unless otherwise specified, with a running, balanced, or center matched arrangement. Unless otherwise specified, components in plain sliced faces shall have a matching arrangement selected by the manufacturer. Plain sliced faces shall consist of two or more components. Rotary faces shall consist of one or more components. Neither plain sliced nor rotary faces shall have any components, except outside components, that are less than 127 mm [5"] in width. Outside components shall be sized to allow for matching or panel edge trim loss. There shall not be any split heart in plain sliced faces unless a manufactured cathedral is achieved. No full quarter cut is allowed in plain sliced faces. The width of any single component in quarter cut, rift cut or comb grain faces, except outside components, shall not be less than 76 mm [3"]. Outside components shall be sized to allow for matching or panel edge trim loss. Sapwood and heartwood requirements shall be in accordance with table(s) in this standard.

GRADE B — The veneer shall be smooth, tight cut and full length as described for the various species in 200-T-9. Slip or book matched veneers are available if specified by the buyer. In sliced veneer, all components of a book or slip matched face shall be from the same flitch. If not specified, multi-piece faces shall be pleasingly matched. Sharp color contrasts at the joints are not permitted. Species specified for natural color will allow color contrasts, but must be pleasingly matched or conform to the type of matching specified. Plain sliced, quarter sliced, rift sliced and comb grain faces shall consist of two or more components with no component, except outside components, being less than 76 mm [3"] wide. Rotary faces shall consist of one or more components with no component, except outside components, being less than 102 mm [4"] wide. Outside components shall be sized to allow for certain types of matching or panel edge trim loss. Sapwood and heartwood requirements shall be in accordance with table(s) in this standard.

Figure is NOT part of the Grade

Many beautiful veneers have names like mottled cherry, figured maple, olive ash burl, etc.. These descriptive terms for the figure of the veneer help us remember what a sample of them looked like. The design professionals and the woodworkers are obligated to consult with the vendor(s) regarding the degree of figure expected. There is some danger in using “archival samples” from previous projects to select veneers. They will rarely match or even be similar to a similarly-named figure sliced from a different tree. For the purposes of these standards, figure shall not be part of the grade.

Unusual Matching Specifications

When variances from the HPVA Standards are made part of the contract documents, certain criteria and tests will be invalidated. For example, the specification of rotary natural veneers to be slip matched (when the standards call for book matching) will result in sharp color contrasts at joints as an outgrowth of the unusual specification.

Strong color contrasts will occur when rotary natural birch leaves, for example, are slip matched. The Grade language specifically addresses this issue by stating "...species specified for natural color must be book matched or conform to the matching specified."

When the matching *specified* can only result in sharp color contrasts at joints, then the tests established by the standards can no longer be applied, as the contract documents override the standard. When variance from the standard is made part of the contract documents, then performance to the contract documents must be judged compliant.

In essence, the design team gets exactly what they specified. An error on the part of the design team shall not be held against the fabricator.

200-T-8

Face Veneer Options

Face Veneer Options				
Primary Commercial Hardwood Species	**Plain Sliced (Flat Cut)**	**Quartered**	**Rift and Comb Grain**	**Rotary**
Ash	Yes	Yes	No	Yes
Birch	Yes	No	No	Yes
Cherry	Yes	Yes	No	Yes
Hickory	Yes	No	No	Yes
Lauan	No	Yes	No	Yes
Mahogany, African	Yes	Yes	No	Yes
Mahogany, American (Honduras)	Yes	Yes	No	Yes
Maple	Yes	Yes	No	Yes
Oak, Red	Yes	Yes	Yes	Yes
Oak, White	Yes	Yes	Yes	Yes
Pecan	Yes	No	No	Yes
Poplar, Yellow	Yes	No	No	Yes
Walnut	Yes	Yes	No	Yes
Typical Methods of Cutting	Plain Slicing or Half-Round on Rotary Lathe	Quarter Slicing	Off-set Quarter on Rotary Lathe	Rotary Lathe
Table developed in cooperation with the Hardwood Plywood and Veneer Association, and used with permission.				

Notes: The headings above refer more to the face veneer pattern than to the method of cutting. Cherry, for example, is rarely quarter sliced but rather the quarters are clipped of from larger plain sliced flitches.

The method of cutting a given face veneer pattern shall be at mill option (*EXCEPTION: Rotary not allowed in Premium Grade work*) unless otherwise specified in an explicit manner to avoid the possibility of misunderstanding. For example, specifying plain sliced veneer on a vertical slicer vs. specifying plain sliced veneer cut on a half-round lathe.

Many wood species and face veneer patterns other than those listed above are available from your woodworker. Consultation early, during the design phase of a project, can result in the combination of value and functional beauty.

200-T-9

Face Grade Descriptions

Other hardwood species not specifically listed in the following tables can also be covered by this standard. For unlisted species, the buyer and seller shall select from species groupings in tables most similar to the product required as a basis for the grade of the unlisted species. It is obviously not workable to try to develop and include individual grade requirements for every known species. For other applications, and as agreed to by buyer and seller, requirements for veneer and manufacturing characteristics are not prohibited from being more restrictive than those outlined in the tables.

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Hardwood Veneer Face Grade Summary Tables [Tables reprinted with permission from HPVA]

Species	**Ash, Birch, Maple, Poplar**								
Cut	**Plain sliced (Flat cut), Quarter, Rotary**								
Grade Description	**AA**			**A**			**B**		
Color and Matching	Sap (White)	Heart (Red or Brown)	Natural	Sap (White)	Heart (Red or Brown)	Natural	Sap (White)	Heart (Red or Brown)	Natural
Sapwood	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
Heartwood	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Color Streaks or Spots	Slight			Slight	Yes		Yes		
Color Variation	Slight		Yes	Slight	Yes		Yes		
Sharp Color Contrasts at Joints	No			No			No		
Type of Matching									
Book Matched	Yes			Yes			Specify		
Slip Matched	Specify			Specify			Specify		
Pleasing Matched	not applicable			not applicable			Yes		
Random Matched	Specify			Specify			Specify		
End Matched	Specify			Specify			Specify		
Nominal Minimum Width of Face Components [a]	Plain-Sliced — 152 mm [6"]			Plain-Sliced — 127 mm [5"]			Plain-Sliced — 76 mm [3"]		
	Quarter — 76 mm [3"]			Quarter — 76 mm [3"]			Quarter — 76 mm [3"]		
	Rotary — 152 mm [6"]			Rotary — 127 mm [5"]			Rotary — 102 mm [4"]		
Natural Characteristics									
Small Conspicuous Burls & Pin Knots - Combined Avg. Number	2 per 1 square meter (10 square feet)			4 per 1 square meter (10 square feet)			6 per 1 square meter (10 square feet)		
Conspicuous Burls - Max. Size	6.4 mm [1/4"]			9.5 mm [3/8"]			12.7 mm [1/2"]		
Conspicuous Pin Knots - Avg. Number	No			4 per 3 square meters (32 square feet)			3 per 1 square meter (10 square feet)		
Max. Pin Knot Size - Dark Part				3.2 mm [1/8"]			3.2 mm [1/8"]		
Max. Pin Knot Size - Total				6.4 mm [1/4"]			6.4 mm [1/4"]		
Scattered Sound and Repaired Knots - Combined Avg. Number	No			No			4 per 3 square meters (32 square feet)		
Maximum Size - Sound							9.5 mm [3/8"]		
Maximum Size - Repaired							3.2 mm [1/8"]		
Average Number - Repaired							4 per 3 square meters		
Mineral Streaks	No; Maple slight			Slight			Slight		
Bark Pockets	No			No			Few to 3.2 mm [1/8"] x 25.4 mm [1"]		
Worm Tracks	Slight			Slight			Slight; Ash yes		
Vine Marks	Slight			Slight			Slight		
Cross Bars	Slight			Slight			Yes		
Manufacturing Characteristics									
Rough Cut/Ruptured Grain	No			No			Slight		
Blended Repaired Tapering Hairline Splits	Two 0.8 mm [1/32"] x 76 mm [3"] on panel ends only			Two 1.6 mm [1/16"] x 152 mm [6"]			Four 3.2 mm [1/8"] x 203 mm [8"]		
Repairs	Very small blending			Small blending			Blending		
Special Characteristics									
Unfilled worm holes, open splits, open joints, open bark pockets, or doze not permitted in above grades.									
[a] Outside components will be a different size to allow for edge trim loss and certain types of matching.									
Under Color and Matching: Red available in Birch and some Maple only, Brown available in Ash only.									

200-T-9 Hardwood Veneer Face Grade Summary Tables (cont.)

Species	**African and Honduras Mahogany, Lauan, Meranti**		
Cut	**Plain sliced, Quarter, Rotary**		
Grade Description	**AA** [a]	**A** [a]	**B**
Color and Matching			
Sapwood	No	No	No
Heartwood	Yes	Yes	Yes
Color Streaks or Spots	Slight	Slight	Occasional
Color Variation	Slight	Slight	Moderate
Sharp Color Contrasts at Joints	No	No	No
Type of Matching			
Book Matched	Yes	Yes	Specify
Slip Matched	Specify	Specify	Specify
Pleasing Matched	not applicable	not applicable	Yes
Random Matched	Specify	Specify	Specify
End Matched	Specify	Specify	Specify
Nominal Minimum Width of Face Components [b]	Plain-Sliced — 152 mm [6"]	Plain-Sliced — 127 mm [5"]	Plain-Sliced — 76 mm [3"]
	Quarter — 76 mm [3"]	Quarter — 76 mm [3"]	Quarter — 76 mm [3"]
	Rotary — 152 mm [6"]	Rotary — 127 mm [5"]	Rotary — 102 mm [4"]
Natural Characteristics			
Small Conspicuous Burls & Pin Knots - Combined Avg. Number	2 per 1 square meter (10 square feet)	4 per 1 square meter (10 square feet)	6 per 1 square meter (10 square feet)
Conspicuous Burls - Max. Size	6.4 mm [1/4"]	9.5 mm [3/8"]	12.7 mm [1/2"]
Conspicuous Pin Knots - Avg. Number	No	4 per 3 square meters (32 square feet)	3 per 1 square meter (10 square feet)
Max. Pin Knot Size - Dark Part		3.2 mm [1/8"]	3.2 mm [1/8"]
Max. Pin Knot Size - Total		6.4 mm [1/4"]	6.4 mm [1/4"]
Scattered Sound and Repaired Knots - Combined Avg. Number	No	No	4 per 3 square meters (32 square feet)
Maximum Size - Sound			9.5 mm [3/8"]
Maximum Size - Repaired			3.2 mm [1/8"]
Average Number - Repaired			4 per 3 square meters
Mineral Streaks	No	Slight	Occasional
Bark Pockets	No	No	Few to 3.2 mm [1/8"] x 25.4 mm [1"]
Worm Tracks [a]	No	No	Slight
Vine Marks	Slight	Slight	Yes
Cross Bars	Occasional	Occasional	Yes
Manufacturing Characteristics			
Rough Cut/Ruptured Grain	No	No	Slight
Blended Repaired Tapering Hairline Splits	Two 0.8 mm [1/32"] x 76 mm [3"] on panel ends only	Two 1.6 mm [1/16"] x 152 mm [6"]	Two 3.2 mm [1/8"] x 203 mm [8"]
Repairs	Very small blending	Small blending	Blending
Special Characteristics			
Unfilled worm holes, open splits, open joints, open bark pockets, or doze not permitted in above grades.			

[a] In Lauan and Meranti, Grade AA will permit occasional slight worm tracks, and Grade A will permit occasional worm tracks.
[b] Outside components will be a different size to allow for edge trim loss and certain types of matching.

200-T-9 Hardwood Veneer Face Grade Summary Tables (cont.)

Species	**Red and White Oak**								
Cut	**Plain sliced, Quarter, Rift and Comb Grain, Rotary**								
Grade Description	**AA**			**A**			**B**		
Color and Matching	Red	<-Oak->	White	Red	<-Oak->	White	Red	<-Oak->	White
Sapwood	No		No	5% [a]		Yes [a]	10-20% [b]		Yes
Heartwood	Yes		Yes	Yes		Yes	Yes		Yes
Color Streaks or Spots	Yes			Yes			Yes		
Color Variation	Slight			Slight			Yes		
Sharp Color Contrasts at Joints	No			No			No		
Type of Matching									
Book Matched	Yes			Yes			Specify		
Slip Matched	Specify			Specify			Specify		
Pleasing Matched	Not applicable			Not applicable			Yes		
Random Matched	Specify			Specify			Specify		
End Matched	Specify			Specify			Specify		
Nominal Minimum Width of Face Components [c]	Plain-Sliced — 152 mm [6"]			Plain-Sliced — 127 mm [5"]			Plain-Sliced — 76 mm [3"]		
	Quarter/Rift — 76 mm [3"]			Quarter/Rift — 76 mm [3"]			Quarter/Rift — 76 mm [3"]		
	Rotary — 152 mm [6"]			Rotary — 127 mm [5"]			Rotary — 102 mm [4"]		
Natural Characteristics									
Small Conspicuous Burls & Pin Knots - Combined Avg. Number	3 per 1 square meter (10 square feet)			4 per 1 square meter (10 square feet)			8 per 1 square meter (10 square feet)		
Conspicuous Burls - Max. Size	6.4 mm [1/4"]			9.5 mm [3/8"]			12.7 mm [1/2"]		
Conspicuous Pin Knots - Avg. Number	No			4 per 1 square meter (10 square feet)			6 per 1 square meter (10 square feet)		
Max. Pin Knot Size - Dark Part				3.2 mm [1/8"]			3.2 mm [1/8"]		
Max. Pin Knot Size - Total				6.4 mm [1/4"]			6.4 mm [1/4"]		
Scattered Sound and Repaired Knots - Combined Avg. Number	No			No			4 per 3 square meters (32 square feet)		
Maximum Size - Sound							9.5 mm [3/8"]		
Maximum Size - Repaired							3.2 mm [1/8"]		
Average Number - Repaired							4 per 3 square meters		
Mineral Streaks	No			Slight, Blending			Few to 305 mm [12"]		
Bark Pockets	No			No			Few to 3.2 mm [1/8"] x 25.4 mm [1"]		
Worm Tracks	No			No			Slight		
Vine Marks	No			Slight			Yes		
Cross Bars	Slight			Slight			Yes		
Manufacturing Characteristics									
Rough Cut/Ruptured Grain	No			No			Slight		
Blended Repaired Tapered Hairline Splits	Two 0.8 mm [1/32"] x 76 mm [3"] on panel ends only			Two 1.6 mm [1/16"] x 152 mm [6"]			Four 3.2 mm [1/8"] x 203 mm [8"]		
Repairs	Very small blending			Small blending			Blending		
Special Characteristics									
Ray Fleck [d]	Slight, blending			Slight, blending			Slight, blending		
Rift and Comb Grain	Rift permits 1 mm [1"] in 12 mm [12"] max. grain slope; 2.5 mm [2.5"] in 12 mm [12"] max. grain sweep; occasional flake not to exceed 9.5 mm [3/8"] in width. Comb grain permits 0.5 mm [0.5"] in 12 mm [12"] max. grain slope; 0.5 mm [0.5"] in 12 mm [12"] max. grain sweep; occasional flake not to exceed 2.4 mm [3/32"] in width.								
Unfilled worm holes, open splits, open joints, open bark pockets, shake or doze not permitted in above grades.									

[a] Sap allowed in Rotary only unless otherwise specified.
[b] 10% sap allowed in Rift, Comb and Plain-Sliced; 20% sap allowed in Rotary.
[c] Outside components will be a different size to allow for edge trim loss and certain types of matching.
[d] In the absence of specific flitch selection by owner representative, the natural distribution of ray fleck in quarter cut Red and White Oak is unlimited.

200-T-9 Hardwood Veneer Face Grade Summary Tables (cont.)

Species	**Pecan and Hickory**		
Cut	**Plain sliced, Rotary**		
Grade Description	**AA**	**A**	**B**
Color and Matching			
Sapwood	Yes	Yes	Yes
Heartwood	Yes	Yes	Yes
Color Streaks or Spots	Yes	Yes	Yes
Color Variation	Yes	Yes	Yes
Sharp Color Contrasts at Joints	No	No	No
Type of Matching			
Book Matched	Yes	Yes	Specify
Slip Matched	Specify	Specify	Specify
Pleasing Matched	not applicable	not applicable	Yes
Random Matched	Specify	Specify	Specify
End Matched	Specify	Specify	Specify
Nominal Minimum Width of Face Components [a]	Plain-Sliced — 152 mm [6"]	Plain-Sliced — 127 mm [5"]	Plain-Sliced — 76 mm [3"]
	Quarter — not applicable	Quarter — not applicable	Quarter — not applicable
	Rotary — 152 mm [6"]	Rotary — 127 mm [5"]	Rotary — 102 mm [4"]
Natural Characteristics			
Small Conspicuous Burls & Pin Knots - Combined Avg. Number	11 per 1 square meter (10 square feet]	22 per 1 square meter (10 square feet)	No limit
Conspicuous Burls - Max. Size	6 mm [1/4"]	9.5 mm [3/8"]	12.7 mm [1/2"]
Conspicuous Pin Knots [b] - Average Number	6 per 1 square meter (10 square feet)	22 per 1 square meter (10 square feet)	No limit
Max. Pin Knot Size - Dark Part	3.2 mm [1/8"]	3.2 mm [1/8"]	3.2 mm [1/8"]
Max. Pin Knot Size - Total	6.4 mm [1/4"]	6.4 mm [1/4"]	6.4 mm [1/4"]
Scattered Sound and Repaired Knots - Combined Avg. Number	No	No	4 per 3 square meters (32 square feet)
Maximum Size - Sound			9.5 mm [3/8"]
Maximum Size - Repaired			3.2 mm [1/8"]
Average Number - Repaired			4 per 3 square meters
Mineral Streaks	Slight	Slight	Yes
Bark Pockets	No	Small, occasional	Few to 6.4 mm [1/4"] x 50.8 mm [2"]
Worm Tracks	No	Slight	Few
Vine Marks	Slight	Occasional	Yes
Cross Bars	Slight	Occasional	Yes
Manufacturing Characteristics			
Rough Cut/Ruptured Grain	No	No	Slight
Blended Repaired Tapering Hairline Splits	Two 0.8 mm [1/32"] x 76 mm [3"] on panel ends only	Two 1.6 mm [1/16"] x 152 mm [6"]	Four 3.2 mm [1/8"] x 203 mm [8"]
Repairs	Very small blending	Small blending	Blending
Special Characteristics			
Bird Peck [c]	No	Slight	Yes
Knife Marks	Knife marks may occur in these high-density species.		
Unfilled worm holes, open splits, open joints, open bark pockets, or doze not permitted in above grades.			

[a] Outside components will be a different size to allow for edge trim loss and certain types of matching. [b] For Pecan and Hickory, conspicuous pin knots means sound knots 6.4 mm [1/4"] or less in diameter with dark centers larger than 1.6 mm [1/16"]. Blending pin knots are sound knots 6.4 mm [1/4"] or less in diameter with dark centers 1.6 mm [1/16"] or less and are permitted in all grades of Pecan and Hickory. [c] To achieve a more rustic appearance, bird peck shall be specified.

200-T-9 Hardwood Veneer Face Grade Summary Tables (cont.)

Species	**Walnut, Butternut, Cherry**		
Cut	**Plain sliced, Quarter, Rotary**		
Grade Description	**AA**	**A**	**B**
Color and Matching			
Sapwood	No	No [a]	No [a]
Heartwood	Yes	Yes	Yes
Color Streaks or Spots	Slight	Slight	Yes
Color Variation	Slight	Slight	Yes
Sharp Color Contrasts at Joints	No	No	No
Type of Matching			
Book Matched	Yes	Yes	Specify
Slip Matched	Specify	Specify	Specify
Pleasing Matched	Not applicable	Not applicable	Yes
Random Matched	Specify	Specify	Specify
End Matched	Specify	Specify	Specify
Nominal Minimum Width of Face Components [b]	Plain-Sliced — 152 mm [6"]	Plain-Sliced — 127 mm [5"]	Plain-Sliced — 76 mm [3"]
	Quarter — 76 mm [3"]	Quarter — 76 mm [3"]	Quarter — 76 mm [3"]
	Rotary — 152 mm [6"]	Rotary — 127 mm [5"]	Rotary — 102 mm [4"]
Natural Characteristics			
Small Conspicuous Burls & Pin Knots - Combined Avg. Number	3 per 1 square meter (10 square feet)	8 per 1 square meter (10 square feet)	22 per 1 square meter (10 square feet)
Conspicuous Burls - Max. Size	6.4 mm [1/4"]	9.5 mm [3/8"]	12.7 mm [1/2"]
Conspicuous Pin Knots [c] - Average Number	3 per 1 square meter (10 square feet)	6 per 1 square meter (10 square feet)	11 per 1 square meter (10 square feet)
Max. Pin Knot Size - Dark Part	3.2 mm [1/8"]	3.2 mm [1/8"]	3.2 mm [1/8"]
Max. Pin Knot Size - Total	6.4 mm [1/4"]	6.4 mm [1/4"]	6.4 mm [1/4"]
Scattered Sound and Repaired Knots - Combined Avg. Number	No	No	4 per 3 square meters (32 square feet)
Maximum Size - Sound			9.5 mm [3/8"]
Maximum Size - Repaired			3.2 mm [1/8"]
Average Number - Repaired			4 per 3 square meters
Mineral Streaks	Slight	Slight	Yes
Bark Pockets	No	No	Few to 3.2 mm [1/8"] x 25.4 mm [1"]
Worm Tracks	No	No	Slight
Vine Marks	Slight	Occasional	Yes
Cross Bars	Slight	Occasional	Yes
Manufacturing Characteristics			
Rough Cut/Ruptured Grain	No	No	Slight
Blended Repaired Tapering Hairline Splits	Two 0.8 mm [1/32"] x 76 mm [3"] on panel ends only	Two 1.6 mm [1/16"] x 152 mm [6"]	Four 3.2 mm [1/8"] x 203 mm [8"]
Repairs	Very small, blending	Small, blending	Blending
Special Characteristics			
Gum Spots	Occasional gum spots permitted in Cherry	Occasional gum spots permitted in Cherry	Gum spots and gum streaks permitted in Cherry
Unfilled worm holes, open splits, open joints, open bark pockets, or doze not permitted in above grades.			

[a] Sap is allowed in A and B grades; however the percentage to be agreed to by buyer and seller. [b] Outside components will be a different size to allow for edge trim loss and certain types of matching. [c] For Walnut and Cherry, conspicuous pin knots means sound knots 6.4 mm [1/4"] or less in diameter with dark centers larger than 1.6 mm [1/16"]. Blending pin knots are sound knots 6.4 mm [1/4"] or less in diameter with dark centers of 1.6 mm [1/16"] or less and are allowed in all grades of Walnut and Cherry.

200-T-9 (cont.)

Softwood Veneer Face Grade Summary Tables

Species	**Western Red Cedar**		**White Pine**		**Douglas Fir**	**Redwood**
Cut	**Rotary and Sliced Knotty Veneer**				**Sliced Vertical Grain**	
Grade Description	**A**	**B**	**A**	**B**	**A**	**A**
Color and Matching						
Sapwood	Yes		Yes		Limited - No Bright Sapwood	Yes
Heartwood	Yes		Yes		Yes [b]	
Color Streaks	Slight	Yes	Slight	Yes	No	No
Color Variation	No	Slight	No	Slight	Slight	Slight
Stain, Blue and Brown	No	Slight	No	Slight	No	No
Type of Matching						
Book Matched	Not applicable				Yes - matched for color and grain at the joints	
Random Matched	Yes, for pleasing appearance				Not applicable	
Slip Matched	Not applicable				Yes, for color	
End Matched	Specify - Not readily available		Specify - Not readily available		Specify - Not readily available	
Natural Characteristics						
Burls	Yes		Yes		Small	Small
Pin Knots	Yes		Yes		No	Yes
Sound Knots, max. size	50.8 mm [2"]		89 mm [3-1/2"]		No	No
Spike Knots, max. size	50.8 mm [2"]	89 mm [3-1/2"]	50.8 mm [2"]	89 mm [3-1/2"]	No	No
Repaired Knot Holes - Maximum Size	19 mm [3/4"]	38 mm [1-1/2"]	19 mm [3/4"]	38 mm [1-1/2"]	No	No
Pitch Streaks	Small		Small		Small	No
Pitch Pockets	Few to 3.2 mm x 25.4 mm [1/8" x 1"]	Few to 3.2 mm x 50.8 mm [1/8" x 2"]	Few to 3.2 mm x 25.4 mm [1/8" x 1"]	Few to 3.2 mm x 50.8 mm [1/8" x 2"]	No	No
Crows Foot	Slight	Occasional	Slight	Yes	No	No
Manufacturing Characteristics						
Rough Cut	No	Slight	No	Slight	No	No
Blending Repaired Tapering Hairline Splits	Yes		Yes		Yes	Yes
Repairs	Blending		Blending		Blending	Blending
Special Characteristics						
Cross Bars	Not applicable				No	No
Unfilled worm holes, open splits, open joints, or doze not permitted in grades above.						
[b] Heartwood must have 6 or more annual rings per 25.4 mm [1"].						

200-T-10

High Pressure Decorative Laminate Summary Table

High pressure decorative laminate (HPDL) is used as a surfacing material on counters, desktops, cabinets, as wall paneling, and on furniture. The physical characteristics of the materials should be considered in design, fabrication, and installation.

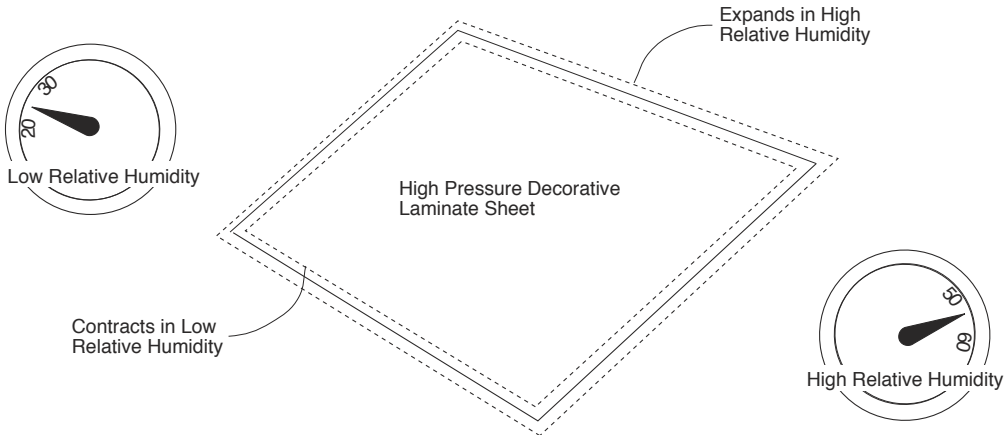
Like wood, HPDL has a grain direction, and its dimensional behavior is similar to that of wood. When humidity varies, the width of a laminate (cross direction) undergoes greater dimensional changes than the length by a ratio of nearly two to one.

The laminate types are abbreviated as "HGS/L" and "VGS/L" for Horizontal and Vertical General purpose; "HGP" and" VGP" for post forming; "HGF" for Fire rated, "CLS" for Cabinet liner; and "BKL" for Backer; in accordance with 2000 NEMA usage. The number under the abbreviation is the nominal thickness in millimeters and thousandths of an inch.

Chart of performance properties: a guide to laminate selection [1]

Tests for resistance to: [2]	HGS	HGL	VGS	VGL	HGP	VGP	HGF	CLS	BKL
Nominal thickness mm [inch]	1.2 [0.048]	1.0 [0.039]	0.7 [0.028]	0.5 [0.020]	1.0 [0.039]	0.7 [0.028]	1.2 [0.048]	0.5 [0.020]	0.5 [0.020]
Thickness tolerance mm [inch]	±0.12 [±0.005]	±0.12 [±0.005]	±0.10 [±0.004]	±0.10 [±0.004]	±0.12 (±0.005)	±0.10 (±0.004)	±0.12 (±0.005)	±0.10 (±0.004)	±0.10 (±0.004)
Wear (cycles, min.)	400	400	400	400	400	400	400	400	—
% Dim change (cross dir.)	0.9	1.0	1.2	1.3	1.4	1.4	0.9	2.0	—
Stain (variety of agents)	No effect 1-10 Moderate effect 11-15							Moderate effect 1-15	—
Cleanability (cycles, max.)	20								—
Light [3]	Slight effect							Moderate effect	—
High temperature	Slight effects							Moderate effect	—
Radiant heat (sec., min.)	125	100	80	60	100	80	75	—	—
Boiling water	No effect				Slight effect		No effect	Moderate effect	—
Impact (inches, min.)	50	35	20	15	30	20	45	10	—

[1] These test procedures are those used by the National Electrical Manufacturers Association (NEMA) for testing high-pressure decorative laminates. The minimum requirements are excerpted from and comply with NEMA Standard LD3-2000 for high-pressure decorative laminates.
[2] This standard applies to decorative panel faces only.
[3] Environmental regulations have caused certain colors to be subject to changes in appearance and the manufacturer should be consulted.



Movement in Relation to Humidity Changes - 200-27

200-T-11

Thermoset Decorative Overlay Summary Table

Tests for Resistance to:	Test Description [1]	Minimum Requirements		NEMA LD3-2000 VGL [2]
		Solid Colors	Wood Grains	
Wear	A measure of the ability of a decorative overlaid surface to maintain its design or color when subjected to abrasive wear.	400 cycles	125 cycles	400 cycles
Scuff	A measure of the ability of a decorative overlaid surface to maintain its original appearance when exposed to scuffing.	No effect		<---Same
Stain	A measure of the ability of a decorative overlaid surface to resist staining or discoloration from contact with 29 common household substances.	No effect 1-10 Moderate 11-15		<---Same
Cleanability	A measure of the ability of a decorative overlaid surface to be cleaned using a sponge.	No effect. Surface cleaned in 20 or fewer strokes		<---Same
Light [3]	A measure of the ability of a decorative overlaid surface to retain its color after exposure to a light source having a frequency range approximating sunlight.	Slight		<---Same
High temperature	A measure of the ability of a decorative overlaid surface to maintain its color and surface texture when subjected to a high temperature [180˚ C (356˚ F)].	Slight		<---Same
Radiant heat	A measure of the ability of a decorative overlaid surface to resist spot damage when subjected to a radiant heat source.	No effect up to 60 seconds		<---Same
Boiling water [4]	A measure of the ability of a decorative overlaid surface to maintain its color and surface texture when subjected to boiling water.	No effect		<---Same
Impact	A measure of the ability of a decorative overlaid surface to resist fracture due to spot impact by a steel ball dropped from a measured height.	380 mm [15”] without fracture		<---Same

[1] These test procedures are identical to those used by the National Electrical Manufacturers Association (NEMA) for testing high pressure decorative laminates. The minimum requirements to comply for SOLID COLORS meet or exceed NEMA Standard LD3-2000 for high pressure decorative laminates.
[2] This standard applies to decorative panel faces only.
[3] Environmental regulations have caused certain colors to be subject to changes in appearance and the manufacturer should be consulted.
[4] Melamine panels, when produced under conditions for optimum panel performance, may show slight effect.
A shipment meeting 95% of the minimum requirements of the performance standard is in conformance.

200-T-12

Formaldehyde in Panel Products

Formaldehyde update – 2003

"Formaldehyde is naturally produced in our bodies as a part of our normal, everyday metabolism and causes us no harm." *CIIT: Toxicological Profile for Formaldehyde, Syracuse Research Corporation; Research Triangle Institute; U.S. Department of Health and Human Services, July 1999.*

"Contrary to the erroneous belief that even a low dosage could have negative health effects, there is now information about the safety of formaldehyde. The Chemical Industry Institute of Toxicology (CIIT), a scientifically independent, not-for-profit research institute that began studying Formaldehyde in the 1970s, announced in a recent assessment that there is no increased health risk from low-level exposures to the chemical. In a report, developed with input from peer reviewers, CIIT stated that "formaldehyde is not likely to be carcinogenic to humans under low exposure conditions…" *CIIT: Formaldehyde: Hazard Characterization & Dose – Response Assessment for Carcinogenicity by the Route of Inhalation, CIIT, September 1999.*

"During the development of the CIIT report, U.S. EPA, and Health Canada representatives participated regularly in advising CIIT and reviewing the work. In addition to cancer, several other reviews have recently been published in the scientific literature regarding formaldehyde and specific health outcomes. The conclusions of these reviews indicate there is little reason to expect human health concerns from exposure to current formaldehyde-containing building products." *CIIT: Formaldehyde Risk: Implications of Recent Research, Georgia-Pacific Corporation, September 2001.*

Panel products fabricated to meet HPVA-HP-1-2000, CPA/ANSI A208.1, medium density, and CPA/ANSI A208.2, medium density meet the criteria for use in the Quality Standards Illustrated.

The quotes above are added to this edition of the QSI because of calls taken by the technical support people at a number of professional and trade associations in the construction industry from design professionals, woodworkers, and customers who want to be assured that wood and wood products made with products containing a small amount of formaldehyde will not hurt them.

No chemical has been studied more than formaldehyde. Opinions about its toxicity vary widely.

It is true there are people for whom the exposure to formaldehyde and other chemical agents is harmful. Health-compromised individuals and those with demonstrated sensitivity to certain chemicals must avoid them.

However, the above quoted information would indicate that the vast majority of workers in the plant and customers of the products from those plants will be unaffected by the tiny residual amounts of formaldehyde escaping from the woodwork.

Wood and wood products containing formaldehyde and produced in North America have very small amounts, even at the point of production. This is a result of compliance with U.S. Housing and Urban Development (HUD) guidelines for emissions.

By the time the product is machined, fabricated, assembled, sealed and finished, the emissions from the woodwork are virtually undetectable.

As a result, the customer is exposed to exceptionally low formaldehyde emissions from finished woodwork. So low, in fact, that the ambient formaldehyde in the environment is most often higher than that measured from the wood product.

Some furniture can emit trace amounts of formaldehyde. A few years ago the American Furniture Manufacturers Association undertook a study to determine how much. The association hired Phillip J. Wakelyn, Ph.D. and Noel T. Wakelyn, Ph.D. chemists with decades of experience in air pollution research and other environmental issues.

The Wakelyns developed exposure estimates and risk assessments for furniture and studied exposures to formaldehyde from household furniture. They found that risks for exposures from furniture are well below the *no significant risk level* of 1 in 100,000 for a cancer – causing substance.

In their study they estimated home occupant exposure to formaldehyde emissions from furniture in a typical room and for the whole house. The various gas amounts used are reasonable worst-case input assumptions; the estimates overstate actual average formaldehyde exposures.

The initial product emission levels and other assumptions the Wakelyn team used to estimate exposure to formaldehyde gas from furniture came from a mathematical model developed for the EPA. The Wakelyn team included a number of worst-case assumptions that clearly overstated the typical risk.

These assumptions included a 24-hour-per-day exposure, high loading, the purchase of an entire house of furniture on three separate occasions over a 70-year period. The furniture purchased on each occasion was purchased all at one time, and all furniture was made of MDF unfinished on all surfaces.

The typical house in the study considered the differing potential formaldehyde emission characteristics of hardwood plywood, particleboard, and MDF. It added a miscellaneous value, obtained from chamber studies using a finished solid cherry wood table, to account for all other emissions such as assembly glues, finishes, wood, hardboard, and fabric.

Formaldehyde exposures from furniture reported in this study are for the time-weighed average for the first 10 years and are stated as the increase above a 0.03 ppm background level.

All furniture in the analysis is assumed to decline in formaldehyde emissions to a 0.03 ppm home background level from the initial or highest formaldehyde level using a realistic decay profile. Using this decay profile in the mathematical model, furniture items from a typical house reach indoor background levels in less than one year.