VENEERING NOTES

This is a compilation of information gathered from a number of sources, including conversations, articles and books, videos, trial and error, and especially the veneering forum hosted by Darryl Keil at www.vacupress.com. It will always be a "work in progress". Every effort has been made to evaluate content but no guarantee is offered of accuracy. Use at your own risk.

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Resources

Forums:
www.vacupress.com

Books:
Recommended:
The Complete Manual of Wood Veneering W A Lincoln 674.833 84
Vacuum Pressing Made Simple Darryl Keil
The Veneering Book David Shath Square 749.5 qS773 1995
Veneering Handbook Ian Hosker 684.084 H826 2001

Others:
A Manual of Veneering Paul Villiard 674.833 75.1
Practical Veneering Charles Hayward 674.833 75.2
Veneering Simplified Harry Jason Hobbs 674.833 78

Articles:
"The Torsion Box" by Ian Kirby. Fine Woodworking #32 Jan/Feb 1982, pp 96-102
"Figured Veneers" by Jim Dumas. Fine Woodworking #89 Jul/Aug 1991 pp. 44-45 (reprinted at www.certainlywood.com/figuretypes.htm)
"Easy Veneering With A Household Iron" by Mario Rodriguez. Fine Woodworking #108 Sep/Oct 1994
"Veneer Matching - From Small Sheets, Great Patterns" by Frank Pollaro. Fine Woodworking Mar/Apr 1995, Cover Photo, pp. 40-44
"Satinwood Box - Create a Masterpiece Using Basic Veneer Techniques" by Frank Pollaro. American Woodworker February 1998, pp. 56-59
"Checkmate - Build a Chessboard in Less Time than it Takes to Play a Game" by Frank Pollaro. American Woodworker October 1998 pp. 82-85
"Coaxing Veneer over the Edge" by Darryl Keil. Fine Woodworking #149 May/Jun, 2001, pp. 100-104
"Tackling Large Tabletops" by Kim Carleton Graves. Fine Woodworking #151 Sep/Oct 2001, pp 76-81
"Veneer a Reverse-Diamond Pattern" by Kim Carleton Graves. Fine Woodworking #155 Mar/Apr, 2002 pp. 102-106
"Decorative Veneering" by Paul Schürch. Fine Woodworking #164 July/August, 2003, pp. 74-79
"Curved, Solid Edge for a Veneered Tabletop" by Mark Edmundson. Fine Woodworking #164 July/August, 2003 pp. 102-106
"Inner Fire" by Thomas Schrunk. Fine Woodworking #182 Jan/Feb, 2005 pp. 26-30
"Veneering Tight Curves" by Craig Thibodeau, Fine Woodworking #212 May/Jun 2010 pp.88-90
"How Veneer is Made" by Ben Barrett, Fine Woodworking #213 Jul/Aug 2010 pp84-87

Videos:
"Decorative Veneering" (with companion booklet), Paul Schürch, www.schurchwoodworking.com
"Marquetry" (with companion booklet), Paul Schurch, www.schurchwoodworking.com
"The Master Techniques of Marquetry", Silas Kopf, www.silaskopf.com
"Working in a Vacuum", Darryl Keil, www.vacupress.com
"Working with Veneer", Darryl Keil, www.vacupress.com

Veneer:
www.berkshireveneer.com/product1.htm
www.certainlywood.com
www.herzogveneers.com
www.schurchwoodwork.com
www.wood-veneers.com

Tools, Equipment and Supplies:
www.schurchwoodwork.com
www.vac-u-clamp.com
www.vacupress.com

The Vacuum Veneering "Sandwich", Platen, Bag, and Supporting Surface

Electric heating blanket (if needed)
Top side of the vacuum bag
Top caul (if pressing both sides at once)
Veneer, single layer or two ply (show or backer)
Glue
Substrate
Glue
Veneer, single layer or two ply (other of show or backer)
Bottom caul
Platen
Under side of the vacuum bag
Supporting table

Common Projects and Techniques (Descriptions, How To Instructions)

Book Match (2 piece), Double Book Match (4 piece)
Starburst
Diamond Match
Reverse Diamond Match
Drawer Fronts (solid wood, cock bead, MDF core, …)
Speaker boxes
Skateboards
Door Panels
Edge Banding
Raised panels (solid banding, veneer, then raise the panel)
Seaming sheet goods for larger panel, …(If making a panel larger than sheet size, such as a 6' x 8' panel using 4' x 8' sheets, glue the common edges of the sheets together as they are pressed to the core, usually honeycomb. Apply backer veneer to the surface of the sheets after the panel has been pressed, so that the seam won't telegraph through. Sand the surface of the backer veneer flat and smooth, then glue on the face veneer.)

Bending Plywood
Can make a curved 3/4" lamination using two layers of 3/8" bending plywood. Best to put a cross band veneer in the center between the two layers of bending plywood – it will hold the exact shape better with a center cross band. If need to join leaves of veneer for the center cross band between the two layers of plywood, use 3 hole tape as it will be buried in the sandwich. The lamination will also hold its shape better if a rigid adhesive is used rather than white or yellow glue. If the lamination is a fixed panel that will be held in a hardwood frame and the radius is not too tight the center cross band might be optional. If the lamination is a door or a door panel the center cross band is highly recommended.

The surface of bending plywood facets slightly when it's curved and this will show to some extent through a face veneer. A (cross band) backer veneer applied to the back of the face veneer will eliminate that. A possible approach is to veneer the face veneer to the (cross band) backer veneer in a first pressing. Once this is done, double stick tape this two ply to the bench and sand it. This way, when it's glued to the curved lamination, the sanding is all done except for a little touch up. Sanding veneer on a curve is time consuming and difficult.

Bent Laminations
Should be able to bend a single layer to the final shape with hand pressure – if not, use thinner material. With 6 or more laminations and a rigid glue, there should be almost no springback. If bandsawing the laminations from solid lumber, before sawing draw a triangle on the edge of the board so that the strips can be kept in the order in which they were cut.

If using thin layers of solid wood, the grain runs the same direction in all the layers. If using bending plywood, use the same thickness of plywood throughout, and ideally include a cross grain veneer between layers of bending plywood.

Some suppliers sell a limited selection of 1/16" thick veneer, which can be used for bent laminations. For the best grain match, the layers of the lamination must be cut from consecutive leaves of veneer.

1/8" Italian bending poplar plywood is a void free three ply that gives excellent results. Cross grain veneer is not necessary between layers of this plywood.

1/8" bending birch plywood is only a two ply and not recommended.

A rigid glue is recommended for the most stable panel.

If vacuum pressing a bent lamination, always easiest with a convex form so the bag will press on the center first and on the edges last. With a concave form, the laminations contact the edges of the form first. As a further vacuum is drawn, there may be a too much stretching of the bag as the center of the lamination continues to settle into the form.

Canvas
As an alternative to a rubber sheet when pressing different thickness of veneer in an assembly, cotton canvas can be used. 4 mil plastic sheeting should be used to protect the canvas from glue bleed through.

www.schurchwoodwork.com is a source for the canvas.

Caul
The cauls are pieces both under and over the work to be glued. The typical veneer press "sandwich" consists of the bottom caul, the backer veneer, the substrate, the face veneer, and the upper caul. Four pieces of masking tape or clear packing tape on the four corners can be used to hold this sandwich together and keep the contents from shifting as the sandwich is placed in the bag. The cauls press the veneer into close contact with the substrate and press out surplus glue. They also provide flat pressing surfaces so that the glue cannot puddle under the veneer.

If the surface area of the substrate is small (for example, a jewelry box lid, the top caul should extend one eighth inch beyond the edges of the substrate. If the surface of the substrate is larger, such as a coffee table top, the top caul should extend one eighth to one quarter inch beyond the edges of the substrate. Even for substrates with larger surface area, the top caul overhang should not exceed one quarter inch.

Dubbing over the top corners of the top caul is recommended to reduce stress on the vacuum bag.

If the bottom caul extends beyond an edge of the substrate more than one half inch in any direction, position one side and end of the bottom caul within one quarter inch of one side and end of the platen. The bag will drape down the sides of the sandwich, and if the bottom caul extends out more than one half inch from the edges of the substrate, the bag can form a tight seal against the bottom caul resulting in lower vacuum around the sandwich, and hence less clamping pressure on it.

If only one side of the substrate is being veneered, the veneer press "sandwich" is abbreviated to the bottom caul, veneer, and substrate. To protect the bag from the substrate's sharp corners, a piece of cardboard, rubber membrane, or canvas can be laid over the substrate.

Melamine coated sheet goods make excellent cauls, because most adhesives cannot bond to the coating. Instead of melamine coated sheet, can lay a piece of 4 mil plastic over veneer and then use MDF or other sheet goods for the caul. (6 mil plastic sometimes has thick spots which can dent the veneer.)

Resawn veneer is too thick to wrinkle and doesn't require cauls.

The main thing the top caul does is to make sure the vacuum pressure is "leveled". If the veneer is slightly buckled, as air is removed from the bag the first parts of the veneer to be pushed against the substrate are the low spots. The glue will respond to these initial higher pressure areas and puddle under the higher areas of the veneer where the initial pressure is lower. Without a top caul the flexible vacuum bag will apply uniform pressure everywhere and the puddles will remain. Using a top caul, greater pressure is applied to the veneer over the puddled glue, forcing it to level out again so that the veneer will be flat against the substrate.

Even on flat veneer a caul is beneficial because all veneer wants to wrinkle to some extent when it starts to absorb the glue.

A one quarter inch thick caul usually sufficient. A one-half inch thick caul only needed if large wrinkle in middle of wider leaf of veneer, and at that point probably better to flatten the veneer before gluing. No need for caul thicker than one half inch.

If different veneers are combined in an assembly, such as an inlay and/or cross band with a book matched burl, they may not all be the same thickness. In this instance the top caul would not apply as much pressure to the thinner veneer, and there might be lack of adhesion. Lay a piece 4 mil plastic sheet over the veneer assembly and then a piece of either 1/16" rubber or heavy canvas between the plastic sheet and the caul to even out the pressure. The plastic will keep any glue bleed through from sticking to the rubber or canvas. See also the "Canvas" section and "Rubber Sheet" section.)

For curved vacuum pressing, the top caul can be 3/8" bending ply, 1/8" bending ply, or even plastic laminate such a Formica or Wilsonart.

Cherry

Cherry veneer not infrequently is stained yellow by Unibond bleed through. Although a good idea on every veneering project, a test pressing with some of the same veneer to be used in the project is especially recommended when working with cherry veneer.

Cold Creep

White and yellow glues only cure semi-rigid. The cured glue can sometimes expand out of the glue line to make an almost imperceptible ridge. The cured glue can also allow the two sides of the joint to shift over time ever so slightly so that their surfaces are no longer perfectly flush. Cold creeping can cause joints in a substrate to telegraph through a face veneer, especially with a high gloss finish. This joint telegraphing can be prevented by using two ply veneer. (See the "Veneer, Two Ply" section.)

Contact Cement

Contact cement stays rather flexible, even when fully cured. It works well with plastic laminates such as Formica because the laminate cannot flex. Many people use contact cement with wood veneer but even two ply and paper backed veneer can move enough to develop bubbles over time. Solvent finishes and even direct sunlight often soften contact cement under the veneer and result in bubbles.

Edging, Solid Wood

Solid wood edging can be applied to plywood and MDF substrates to hide the substrate edge.

If the solid wood edging is applied before veneering, the veneer will extend to the outer edge of the edging. The glue line between the veneer and solid wood edging will be exposed, but should not be very noticeable. When hide glue was the primary veneer adhesive, veneer that extended to the edge of a surface often chipped over time as the hide glue weakened. If a rigid adhesive is used, this chipping should not occur.

If the solid wood edging is applied before veneering, in time the joint between the substrate and solid wood edging may telegraph through the veneer. This telegraphing can be prevented by using two ply veneer – the second ply prevents telegraphing through the face veneer.

If the edging is applied after veneering, it will cover and hide the glue line between the veneer and substrate. In this case care should be exercised to match the height of the edging and veneer as exactly as possible, because excessive sanding will go through the veneer and expose the substrate.

Edging, Veneer

When hide glue was the primary veneer adhesive, this was seldom done because the veneer edging would be prone to chipping in a few years. With today's better adhesives chipping is not likely.

One way to glue veneer edging may be to use the PVA iron on technique as the very last step of the project, sometimes at the installation site. Cut the strips about 1/4" wider and a couple inches longer than the finished size requirement. It's also a good idea to do some light sanding on the edges for a smoother surface to glue to. Make sure to have plenty of glue on both the substrate and the veneer strips, as it often takes two coats on each. Clamp the veneer upside down on the work table before applying glue or it will curl up, fall to the floor, and contact every piece of dust in the shop. A spring clamp at each end is fine. Be sure the glue is absolutely dry before ironing and that there are no dull spots, indicating a lack of sufficient glue. A blow drier can speed things up, here. When the veneer cools, trim with a plane or chisel. The iron method is not recommended for any project of appreciable width, but it works great for edges. See also the "Glue, Ironing (White and Yellow)" section and the article by Mario Rodriguez listed in the "Resources" section.

Another way, recommended by Craig Tufankjian, is to clamp the veneer edging using a web or band clamp.

> Screw the table top to the side of your work bench, not flat but to the side of your work bench so you can spin the top. Divide your top into three or four sections, measure the length of each section then cut your veneer strips 2 inches longer. At each layout mark where you divided the top put blue tape on the other side of the line. Apply glue to the edge of the top between each section apply the veneer, and put a double layer of laminate on top of the veneer to act as a caul. Use a 2 inch ratchet band clamp to press the edge veneer. When dry take off the band clamp, the veneer should be stuck right to where you applied the blue tape with the extra 1 inch flapping in the breeze. Flush up the top and bottom overhang about two inches along the edge. Take off the blue tape and square up the joint in preparation for the next section of veneer. Spin the top to line up the next section , make one square edge on your next veneer strip and tape it to the one you just glued on. Keep repeating until your at you last piece.

The exposed veneer corner can be replaced with a narrow square cross section of stringing, glued into a routed rabbet formed after all the veneers have been glued to the tabletop.

Epoxy

When vacuum pressing using epoxy as the adhesive, make a trial with maximum vacuum of 10-15" HG because epoxy is a "high saturator" and will have more bleed through than other adhesives.

Fan, Marquetry, Drawing

Determine the overall size and shape; oval or round; quarter, half or full. Draw the solid center, and a line showing where shading begins on each section of the fan.

Determine the number of sections and draw the section dividing lines. Using a circle drawing template, determine the desired radius for the arc at the outer end of each section.

Draw a circle of that radius with its center at the end of each of two consecutive section dividing lines. Draw a circle of the same radius with its center at the intersection of those two circles. This third circle marks the convex or concave end of each section.

Flitch
A part of a log, trimmed and ready for slicing into leaves of veneer.

French Edge
A thin strip of wood inserted in a rabbet along the edge(s) of a veneered surface. An example would be a rectangular dining table with veneered top, bottom, and both sides and ends. Whether the vertical or horizontal surfaces are veneered first, the edges are prone to chipping.

After all six surfaces are veneered and sanded, use a cutting gauge to mark the outlines of the rabbet to minimize chipping. The rabbet should be at least 1/8" square but no more than ¼" square along the edges, use new router bit. Fill with a slightly oversize strip of similar or contrasting wood, using white or yellow strips of packing or blue masking tape as clamps. Butt joint is less likely to splinter than scarf joint.

A French edge also can be used on round tables, although the minimum diameter may be 36" or so, and the rabbet no larger than 1/8" square.

Glues
The four common veneer glues today are white, yellow, urea resin, and epoxy. The first two are semi flexible, the latter two are very rigid. Rigid should always be used on:

1. Horizontal surfaces – will show any unevenness
2. Delicate veneers such as burl and crotch
3. A panel consisting of multiple veneers such as a center field with inlays and/or banding
4. Oily veneers such as teak
5. Large panels requiring more glue open time.

Ironing dried white/yellow can be successful especially on narrow edges up to 1.5" wide. See also the "Edging, Veneer" section and the "Glue, Ironing (White and Yellow)" section.

"There is a general misconception that white and yellow glues need air circulation to bond which is not true. They need it to cure but not to bond. White and yellow glues achieve their initial bond through pressure and capillary action drawing the water in the glue away from the glue line and pulling the glue into the cell structure. This process does not require air to work but it does require that the surface be able to absorb water (this is why white and yellow glues do not stick to the water resistant paper coating on MDO). This is why you can remove the clamps from glued boards in as little as 5 minutes provided you don't try to work them. This is the bond phase. The cure happens when the water in the wood finally leaves. In a vacuum press the bond phase takes place in the press and the cure phase happens after the wood is removed. Think about a conventional steel platen press. There is no more air circulation in one of these presses, except maybe a 1/4" around the edge, than there is in a vacuum press. A vacuum press also draws the glue into the cell structure where conventional presses rely on pressure only."

Glue, Applying
A general rule of thumb for all adhesives is to apply enough so that a finger drawn through the glue would leave a small but noticeable ridge on each side. A better indicator is that there should be moderate bleed through of open grain veneers (oak, walnut, mahogany) after vacuum pressing. Moderate bleed through means that about 10% of the veneer surface uniformly shows dried glue on its surface. (Normal sanding in preparation for finishing will generally remove all traces of this bleed through.) See the "Glue Bleed Through" section.

With one special exception, glue should never be applied over tape. Any veneer or masking tape on the glue side of the veneer should be removed before any glue is applied. The one exception is three hole veneer tape sometimes applied over seams on the substrate side of two ply veneer. See the "Veneer, Two Ply" and "Veneer Tape" sections.

The working time for white and yellow glues is typically only about five minutes. The working time for urea resin usually is at least 20 minutes, but depends upon the ratio of liquid to catalyst.

Best applicator is a 9" black foam paint roller pad. Look for these in paint centers. For small jobs, a 9" black foam roller pad can be cut into short pieces on a chop saw and used on a 4" paint roller.

Typically glue is applied only to the substrate, not the veneer. The moisture in any glue, and especially in white and yellow glues, will be absorbed as soon as it touches the veneer, and uneven absorption and grain will cause the veneer to begin buckling.

If applying two ply veneer to a substrate, the face or show veneer has been stabilized (by being glued to a cross grain backer veneer) so it won't buckle. Because of this, the glue can instead be applied to the back of the two ply instead of the substrate if desired.

The back of paper backed veneer is not very absorbent, so it is okay to apply a thin layer of glue to both the substrate and the back of the paper backed veneer.

If using polyurethane, use much less glue. Be sure to wrap everything with plastic as polyurethane will stick to the vacuum bag.

When applying urea resin with a roller, place a flexible plastic liner in the roller pan. Simply let the glue cure, then flex the liner and it will easily separate from the glue. If the glue is mixed in a flexible plastic container, the same can be done with it. A third option is to mix the glue in a paper cup as used for soup at deli counters; pour the glue onto the substrate and spread with the roller, then throw away the cup.

Glue, Ironing (White and Yellow)

Apply the glue to both surfaces and let dry to the touch (usually about 30 to 60 minutes). Bring the two pieces together and heat with an iron on the cotton setting. Then press together firmly with a block of wood to give even pressure. The heat of the iron will stress the top surface and may cause cracking. This is sometimes one of the best ways to apply edge banding, especially if the pieces are small. See also the "Edging, Veneer" section.

Glue Bleed Through

Four factors affect the amount of glue that bleeds through veneer:

1. Thickness of the veneer
2. Porosity of the veneer
3. Viscosity of the glue
4. Thickness of the glue layer

The thicker the veneer, the less bleed through. Veneers 1/16" thick usually will not allow any bleed through. Also, paper backed and two ply veneers will not usually allow any bleed through.

Open grained woods such as mahogany and walnut allow more bleed through. Close grain woods such as cherry and maple allow almost no bleed through.

A thin glue such as just mixed urea resin will more easily permeate veneer. Thicker glues such as white and yellow glues will usually not bleed through. Pro-Glue's liquid resin is somewhat thicker than others, and reportedly has less bleed through. Unibond can be mixed with Unibond Blocker, a thickening agent, to reduce bleed through.

Epoxy tends to bleed through more than other glues because it is a penetrating glue.

The thicker the coating of glue on the substrate, the greater the amount of bleed through.

With Unibond (without Blocker) and a porous veneer, the amount of bleed through can indicate whether the glue coating on the substrate was too thin, correct, or too thick. With commercial walnut and mahogany veneer, Unibond (without Blocker) bleed through should cover perhaps 10% of the total surface area, spotting uniformly.

Generally, the coating of white and yellow glues on a substrate should be about as thick as a correct coating of urea resin.

Drag a finger through the glue film applied to the core. If a small ridge of glue is left on each side of the drag, the glue film is about a "normal" thickness.

Proper scraping and/or sanding of the veneer surface after gluing usually removes bleed through sufficiently so that staining and finishing is not affected. Can test for excess glue by wiping the sanded surface with water – dried glue should show up as a lighter area

The catalyst in some glues, including Unibond and Titebond II, can cause chemical staining of some woods: maple, beech, some walnut, and others. If a discoloration occurs in the areas of bleed through and does not disappear with sanding, chemical staining may be occurring. Staining seems to be less likely with Pro-Glue. Adding Unibond Blocker to Unibond thickens the glue, reducing bleed through and staining.

A little bleed through is desired, to show that the correct amount of glue was applied to the substrate. The bleed through is mainly on the surface of the veneer, and normal scraping/sanding of the veneer will remove it sufficiently so that it does not stand out after staining and finishing. The one problem area is the large pores on very light or dark woods such as mahogany, oak and walnut. A very light or white dried glue will stand out in the pores of walnut, for example. This is the reason there are three catalysts for Unibond and two for Pro-Glue.

Since bleed through will fill the pores of open woods such as mahogany, oak and walnut, make sure to use the correct catalyst to color the urea resin. Aniline dye powder (either water or alcohol based) can also be used to tint both. See the "Pro-Glue" and "Unibond" sections.

Veneer could be sized with 4 parts water to 1 part yellow or white glue to greatly reduce the amount of bleed through. The sized veneer would have to be dried in the same way as when using flattening solution.

Glue Clamping Time
White and yellow glues generally should be vacuum clamped 1-2 hours if the work is flat and unstressed. The clamp time should be increased to overnight when clamping curved work.

In general, the vacuum clamp time can be determined by putting a small amount of the adhesive in a plastic bag and the plastic bag on top of the press. When the glue sample is rigid the work usually can be unclamped.

Glue Open or Working Time
Most white and yellow glues start to cure within 5-10 minutes, which is a primary factor limiting their use for veneering.

Two part epoxies are exothermic, meaning they release heat as they cure, and the increased temperature speeds the curing time. Thus they have to be kept in a VERY thin layer after mixing.

The open time for urea resin glues depend upon the mixing ratio, the ambient temperature, and the thickness of the mixed glue (its curing is also exothermic). See the "Unibond" and "Pro-Glue" sections.

Ground
See the "Substrate" section.

Honeycomb Core
Resin coated paper honeycomb can be used to make a strong but lightweight panel, sometimes called a torsion box.

Honeycomb can be skinned with any rigid material in any thickness all the way down to just plastic laminate, but skins under 1/4" can create a panel that has a hollow tinny sound. For table tops a minimum skin of 1/4" is recommended.

Panels must have some kind of solid border or edging around the edges to prevent the honeycomb from crushing, and to provide a surface to adhere the edging to. This edging can be solid wood, plywood, particle board or MDF. Honeycomb has a small amount of compression, so the edging should be slightly thinner than the honeycomb.

Although white or yellow glues can be used to bond the honeycomb to the skins, urea resin glue is the best choice for a premium stable panel.

When using a vacuum press to lay up the panel be sure to turn the vacuum level down to around 15" HG on the gauge. A vacuum press can crush honeycomb at full vacuum. It will not do this immediately, but a half an hour to an hour later the

panel may be crushed in the middle area. Once the panel has been pressed and thoroughly dry, further pressing on that panel can be done at full vacuum.

After the panel is first pressed be sure to stand it up on its edge to permit air flow to both sides for at least 12 hours. A panel laid down on one side will not allow the moisture inside to get out evenly and usually will warp.

If the desired thickness cannot be reached with one layer of honeycomb, it can be stacked in multiple layers to achieve thicker panels. A skin of some kind must be used between layers of honeycomb. This skin can be as thin as possible, but something must be used between each layer of honeycomb. For a stable panel it is best to use the same thickness honeycomb for all layers.

Thickness of the outer skins of the panel doesn't dramatically affect strength of the panel. Tricel Honeycomb literature says the thicker the honeycomb (single layer), the greater the overall strength of the panel, so 1" honeycomb core stronger than 3/4" honeycomb core stronger than 1/2" honeycomb core.

If the project requires seaming a skin, insert a 1" wide piece of solid wood in the honeycomb under the seam. If veneering the skin, use a two ply veneer to keep the seam from telegraphing through.

A panel at the approximate same thickness will be stronger with two layers of honeycomb over one. For example, a panel with a core of two layers of 1/2" honeycomb separated by a thin plywood skin them will be stronger than a panel with a core consisting of a single 1" honeycomb.

Inlay

Thin strip of veneer on edge (about 1/28 to 1/42" thick) inserted after surface veneered. Groove created using a scratch bead. The advantage of this approach is that a groove cut along seams after pressing will effectively remove any gaps in seams.

Can also be a thin strip of veneer taped to the main body of the veneer before pressing... These thin strips can be effectively cut with a straight edge and sharp veneer saw as demonstrated in the Paul Schürch video listed in the "Resources" section. See also the "Veneer Band" section.

Luster

A natural quality of wood referring to how much light is reflected back from the surface of a board or leaf of veneer. The amount of reflected light varies with the angle of the surface of the wood to the grain.

"Although luster can vary from board to board, and even within a single board, certain types of wood generally have more luster than others. Mahogany, birch, koa, and rotary-cut bird's eye maple veneer can be especially bright; zebrawood, some rosewoods, and gumwood can appear devoid of luster … Light is scattered more by figured wood than straight-grained wood. Straight-grained woods produce luster in fairly defined areas, while figured woods such as fiddleback, quilted, and pommele may give bright highlights from a much wider field, with darker areas often adjacent to and highlighting the bright ones." From "Inner Fire" by Thomas Schrunk. See the "Resources" section.

The rougher the surface, and the lower the sheen of the finish, the less the light is reflected and the less noticeable the variations in the luster.

Luster also can be affected by the direction of wood pores in relation to the surface of the veneer. Wavy figure has changing pore direction, so luster will change over the surface of wavy veneer.

Mahogany Crotch Veneer

The most likely of all veneers to check. A rigid glue is essential. Best to apply the mahogany crotch veneer first to a backer veneer. Do not use a flexible glue or checking and fissuring will occur after pressing. See the "Veneer, Two Ply" section.

Mahogany crotch will always bleed through in the center flame. Using flattening solution with yellow glue first will reduce the amount of bleed through.

See also the "Veneer, Crotch" section.

Maple
Definitely use the white catalyst with urea resin glues!

Use a little less urea resin with maple, as it can stain the wood yellow, especially curly maple (but not always – try a sample). Curly maple more porous and more prone to bleed through. If using Unibond, the Unibond Blocker definitely recommended with curly maple, to try to avoid bleed through which can stain maple yellow. Although a good idea on every veneering project, a test pressing with some of the same veneer to be used in the project is especially recommended when working with maple veneer.

Maple is especially sensitive to the amount of glue used and how fast the sandwich is placed in the bag and under vacuum. Maple swells excessively when it comes in contact with PVA glue, more so than any other veneer. Of the maples, birdseye is usually the worst because it is rotary peeled.

Get the panel in the press and under pressure as soon as possible once the veneer has come in contact with the glue. Second, use a glue like urea resin that has no tack. The veneer may swell but it doesn't get locked down in any areas. Once the veneer gets "locked" to the substrate in spots the surrounding veneer can't level itself out as the vacuum pressure increases.

Maple, Birds Eye
The eyes in this veneer have tapered sides, like a funnel. Because of this tapered shape, they shift slightly towards one side of the veneer, and feel like tiny bumps. If they continued shifting in this direction, they could eventually pop out of the veneer. Always glue the bumps side (wide end of the funnel shape) to the substrate to lock the eyes in permanently. See also the "Maple" section.

See also the "Veneer Face Side" section.

Oak, Red
Use a medium brown catalyst.

Platen
The grooved base sheet above the bottom of the bag on which the lower caul, lower veneer, substrate, upper veneer and upper caul (together comprising the veneer "sandwich") rest. Melamine is the best choice, because adhesives won't stick to it. The platen typically is left in the bag between pressings.

Platen should be 3/4" thick (no need for greater thickness). Top surface must be grooved in both directions to allow air to reach the vacuum intake hose. About every 10" is sufficient. Groove width 1/8", which is normal saw blade width. Wider width might allow bag to be drawn down into groove. Depth of 1/8" sufficient to minimize blocking by wood chips and/or glue squeeze out. If vacuum pump starts cycling off for just a few seconds and starting again, air in the bag is having too much difficulty reaching vacuum hose – check for blocked grooves.

Pro-Glue
Developed by Paul Schürch, Pro-Glue is a urea resin glue like Unibond 800. It is available as a powder pre-catalyzed product. The powder is available light and dark, which can be combined to yield intermediate tans.

Aniline dye can be added to further tint Pro-Glue.

Once the adhesive is applied, the substrate and press should stay above 70 degrees F.

See also the "Urea Resin Glue" section.

Rubber Sheeting
For uneven thickness commercial veneers, simply laying 1/4" caul on top will not adequately press the thinner veneer. 1/16" rubber sheet under the top caul will compress enough so that the adjoining veneers of uneven thickness are adequately pressed to the substrate.

Rubber sheet not needed for when combining resawn veneers of differing thickness. Top caul not even needed. Resawn veneers are much stiffer because of their extra thickness and the pressure of the bag directly onto the resawn veneer will be

sufficient. Add a sheet of 4 mil plastic between the resawn veneer and the bag so that glue that bleeds through does not stick to the bag.

Rubber sheeting can usually be purchased from an industrial rubber supply company. Search the Internet for "natural gum rubber 1/16"."A roofing supply company likely will have 1/16" rubber roll roofing which is not the same but may work. Insert a layer of 4 mill plastic between veneer and the rubber so the glue will not stick to the rubber."

Another option is heavy canvas. See also the "Canvas" section.

Sand Shading

Most resources recommend "silver sand, available from most pet stores" for the medium. Pet stores are not familiar with silver sand and do not carry it. One site found on an Internet search engine said silver sand was crushed mica but did not offer a definitive source. Beach sand should NOT be used because of the included salt. Try clean white play sand.

The heat source is very problematic. Most electric hotplates today, even those rated 1000 watts and more, may not get the sand hot enough because the hotplates have lower maximum temperature thermostats. Keep the layer of sand fairly thin, ¼" to 3/8".

An alternative heat source that works very well, although it poses an increased fire risk (and may be objectionable to insurance companies) is a propane or similar camping stove.

Sheet Goods

Plywood, MDF, particle board, melamine board, baltic birch plywood and bending plywood usually can be found in stock at lumber stores selling to cabinet and woodworking shops. The usual sizes for Baltic birch are 5' x 5' and sometimes 4' x 8', the usual size for the other plywoods is 4' x 8', and for MDF and melamine board 49" x 97". Larger suppliers will carry MDF in one or more additional larger sizes, such as 5' x 10'.

MDF and particle board are considered the best veneering substrates because they are very flat, have no grain direction, and no interior voids. Baltic birch would be the next choice because it's many plies make it less likely to warp, and it should have no interior voids. (There can be significant differences in quality between Baltic birch from Finland and Baltic birch from Russia. If there is any question, rip a test sheet into strips to check for interior voids.) All plywood however is less flat than MDF and particle board, and can cause surface irregularities to telegraph through the veneer finish.

When creating a substrate larger than the standard 4' x 8' (sometimes 4' x 10' or 5' x 10') it will be necessary to have one or more seams in the substrate. If creating a torsion box using resin coated honeycomb, apply some glue to the seam edges, and then glue, assemble, and press the torsion box like any other. If the surface is to be veneered, use a two ply veneer so that the seam in the surface of the torsion box does not telegraph through the surface veneer.

Masonite is not recommended for veneering work because it has an oily residue that limits glue adhesion.

See also the "Bending Plywood" section.

Stringing

Joint one edge of a piece of 3/4" MDF. Clamp a sacrificial scrap to the side of the table saw fence and with the blade below the table top set the fence to almost completely cover the blade. (A flat top grind works best, but a dado set chipper likely would work also.) Turn on the saw and raise the blade 1/4" or so, then turn off the saw. Re-adjust the fence so that only the desired width of the blade will be exposed (1/16", 1/8", of any other width). Raise the table saw blade about 1/32" above the table top, and then saw a rabbet into the edge of the jointed MDF. In similar fashion, make additional rabbets of different widths on the other three edges. Joint one edge of a 2nd piece of 3/4" MDF to be the veneer saw fence. To make the stringing, first make sure the edge of the veneer is perfectly straight. Place the depth gauge over the edge of the veneer so that it is covered to the desired stringing width. Without the gauge or veneer moving, place the saw fence (MDF) against the depth guage (MDF)and remove the latter, so that only the desired stringing is exposed. Cut the stringing free with the veneer saw and repeat as often as needed. This technique can also be used to cut cross banding.

Stringing as narrow as 1/16" can be difficult to tape in a pre-gluing assembly. Some people find it easier to assemble and glue the panel and after full cure use a scratch stock or small router to make a groove and insert stringing. It is difficult to

set router to make consistent dado depth of 1/28" or whatever thickness of stringing. Also, very narrow router bits tend to flex from side to side when routing a dado. Scratch beader is recommended instead of a router.

Paul Schürch's video shows how to use blue masking tape to hold thin veneer strips in place for veneer taping in a pre-gluing assembly. See the "Resources" section.

See also the "Veneer Band" section.

Substrate
The center material to which the veneer is glued. Plywood was the traditional substrate, but today's MDF and furniture grade (not construction grade) particle board, because they are so flat and smooth, are better choices. Medite is a lighter and flatter form of MDF. Masonite is not recommended because it has an oily residue that limits glue adhesion.

To fill holes, etc use Durhams Rock Hard Water Putty, a powder mixed with water. Allow at least one hour for the Durhams to cure. In high humidity, may take several hours to cure completely. Best to leave slightly higher than the surface of the substrate, and then sand flush when cured.

To trim a glued up veneered panel to final size, a high ATB 80 tooth (10") blade works well. Raising blade about 1" above top of panel may further reduce chipping.

One might consider lightly sanding with 80 grit paper both surfaces of the substrate, to remove dirt, bumps, et cetera.

Starbursts
This decorative veneer assembly is used most often for circles, but can be used for ovals, squares, quarter-rounds, half-rounds, and arcs. The last can make for a stunning bed headboard.

Starburst matches are created using pie-shaped pieces of veneer cut from consecutive leaves of veneer. On circles, the pie shaped pieces are equally sized – the center angle and the width at the circumference are identical on all the segments. On ovals, either the center angle or the segment width at the circumference must vary from segment to segment - most people feel the oval starburst looks best if the widths of the segments at the circumference are equal, rather than the center angles of the segments. (The varying widths of oval starburst segments would seem to preclude using book matching on ovals.)

The pattern used to assemble veneer into the starburst is generally either slip matching or book matching, depending upon the desired result. If using ribbon grain veneer with the grain oriented towards the center, slip matching will eliminate light and dark luster of adjoining pieces. See the "Veneer Matching" section.

Starburst, Making a Circular
Starburst Matches

There are two basic types of starburst matches, the book match and the slip match. The book match, yields mirror images at each seam.

The slip match usually employs very straight grained striped material to produce a radial effect like the spokes of a wheel. Veneer which possesses a figure which swirls off to one side of the leaf, when assembled in a slip match, produces a 'revolving' or whirlpool effect. Book matches, which can be made with almost any type of veneer

The front and back sides of a leaf of veneer reflect light differently. The book match starburst relies upon both light refraction and matched figure for its effect.

There are other types, such as 'slip and turn' in which all veneers are slip matched, then alternate leaves are inverted; casual matching employs several different types of veneers, such as five mahoganies, for eye appeal.

Selecting Material for a Starburst
Fancy figured crown cut veneers, swirls, burry butts and curls make the most dramatic book matched starbursts; veneers with strong interlocked grain with a pronounced ray figure are also excellent for book matching or slip and turn inverted matching; plain straight grained oak, teak, elm, ash, rosewood and sapele are most effective when slip matched.

Preparation

Make sure two good straightedges are available that are slightly longer then the lengths of cuts to be made. A good straightedge is a 3/4" piece of MDF about 3" wide that has been carefully jointed. To test a straightedge, trim the right hand edges of a couple leaves of veneer, turn one leaf over onto its other side, and bring the two trimmed edges together. Any inconsistency will be doubled.

If using a veneer saw to trim the leaves of veneer, make sure the veneer saw is razor sharp. If the veneer is especially fragile (burls, for example) a scalpel may make a better cut.

Make sure the leaves of veneer to be used are in sequential order and all oriented the same. Examine both sides of each leaf carefully for damage or discoloration. It can be helpful to have one or two extra leaves in case of disaster. Using a pencil or chalk, lightly number the leaves beginning with one. Flatten the leaves if necessary.

Circle starbursts almost always consist of identical pie shaped **pieces**. The **point** of each piece is the center of the circle; the two straight **edges** are radii of the circle, and the end is a portion of the circumference of the circle. The **interior angle** is the angle formed by the two sides at the point.

When planning a circle starburst, the maximum required width of each piece depends upon the length of the radius (r) of the circle and the number of pieces (n). This maximum width can be **approximated** as the circumference (c) of the circle (c = 2 * pi * r) divided by the number of pieces (n). (This approximation is slightly greater than the actual width.)

The actual width of each starburst piece is the length of a "chord" of the circle, a straight line connecting the outer ends of the two edges. The chord's length (l) more exactly is l = 2 * r * sin(a / 2) where the interior angle (a) of each piece is a = 360 / n. Substituting, the maximum width can be found as l = 2 * r * sin(180 / n). Some common values are:

Circle Diameter (inches)	Circle Radius (inches)	# of Pieces	Piece Width (inches)	Circle Diameter (inches)	Circle Radius (inches)	# of Pieces	Piece Width (inches)
30	15	8	11.48	36	18	8	13.78
	15	10	9.27		18	10	11.12
	15	12	7.76		18	12	9.32
	15	16	5.85		18	16	7.02
	15	20	4.69		18	20	5.63
	15	24	3.92		18	24	4.70
	15	28	3.36		18	28	4.03
	15	32	2.94		18	32	3.53
42	21	8	16.07	48	24	8	18.37
	21	10	12.98		24	10	14.83
	21	12	10.87		24	12	12.42
	21	16	8.19		24	16	9.36
	21	20	6.57		24	20	7.51
	21	24	5.48		24	24	6.27
	21	28	4.70		24	28	5.37
	21	32	4.12		24	32	4.70
54	27	8	20.66	60	30	8	22.96
	27	10	16.69		30	10	18.54
	27	12	13.98		30	12	15.53
	27	16	10.53		30	16	11.71
	27	20	8.45		30	20	9.39
	27	24	7.05		30	24	7.83

27	28	6.05	30	28	6.72
27	32	5.29	30	32	5.88

Decide how many pieces will be used to make the starburst. Common numbers are 16, 20, and 24. A number divisible by four will make for somewhat easier final trimming and assembly of the starburst. Each piece is cut from a leaf of veneer, and each piece is given the number of its leaf.

The pieces in a circular starburst are identical shapes. The interior angle and the outer width are the same for all the pieces. Make a template for the starburst pieces that is very slightly wider at the circumference than a perfect piece would be. This extra width will provide about 1/4" trimming allowance when the starburst is assembled.

The template for a 24 piece starburst would be about (.25/12)" = .021" = 1/48" wider **at the circumference** to allow for a 1/8" trimming allowance on each side of a half circle. The template for a 32 piece starburst would be about (.25/16)" =.0156" = 1/64" wider at the circumference to allow for the same trimming allowance. The extra width lies on the chord of each starburst piece, meaning that a separate template would be made for each combination of number of pieces and circle radius.

The accuracy of a template can be tested using a full size circle and two straightedges. Draw a diameter of the circle and position the template with its point at the center of the circle and one edge just covering one half of the diameter. Holding the template firmly against the circle so that it does not move, slide one of the straightedges against the other edge of the template. Holding that straightedge firmly against the circle, remove the template and slide the second straightedge against the first. Holding the second straightedge firmly against the circle, slide the template against the second straightedge with the point of the template at the center of the circle. Repeat the process as needed to see how much the template overlaps the other half of the diameter. (The use of two straightedges instead of just drawing pencil lines seems excessive, but the frustration of having a starburst that does not close justifies this attention to accuracy.)

For oval and semi-oval (demilune) starbursts, it is not possible to have pieces with an equal interior angle and an equal outer length. It is usually thought that pieces with an equal outer (chord) length are more attractive than pieces with an equal interior angle. In the former case, there would be little value in making the several needed templates. It would be faster to accurately draw a full size pattern and trace the outer length onto each leaf of veneer as it is cut.

In a completed starburst, adjoining pieces meet at a **seam**. This seam, and how the figure and grain in the adjoining pieces match up, is often a significant element of the overall effect of the starburst pattern.

The pieces are not usually assembled in perfect numerical order (1, 2, 3, 4, …) because there would be a large interval or **jump** where the final piece completes the starburst and joins up with piece #1. The grain and figure in veneer not only moves or **shifts** slightly between leaves, but also changes in size and appearance or **evolves**. If the grain and figure simply shifted from leaf to leaf, the appearance would be identical between leaves but simply moved closer to one edge or end and it would be easy to cut identical pieces from consecutive leaves. However, because the grain and figure evolve there will always be some variation between leaves. The amount of grain and figure evolution between the first and last leaves is perhaps more important than the grain and figure on any one leaf.

For example, in a 24 piece match if the pieces were assembled in perfect numerical order, the seams would be between 1&2, 2&3, 3&4, 4&5, 5&6, …, 23&24, and 24&1. The first 23 seams would be very good matches, because they were between consecutive leaves of veneer. The last seam however would be between pieces 1 and 24, representing a 23 piece jump. It probably would stand out against the other 23 seams and greatly reduce the attractiveness of the overall starburst.

To make the starburst more attractive, the one very large jump is replaced with several smaller ones. A 24 piece starburst with an 8 piece jump would begin with the first eight pieces in ascending order (1-8), skip or jump the next 8 (9-16), and continue with the next eight pieces in ascending order (17-24). There are no further pieces, so the sequence continues backward in the same manner through the previously skipped pieces until the starburst is completed. Thus the complete pattern for a 24 piece starburst with an 8 piece jump would be 1, 2, 3, …, 8, 17, 18, 19, …, 24, 16, 15, 14, …, 9 (1-8, 17-24, 16-9). Moving around the circle (clockwise or counterclockwise, it doesn't matter which direction the pieces are assembled), the 24 seams would be 1&2, 2&3, … 7&8, 8&17, 17&18, 18&19, …, 23&24, 24&16, 16&15, 15&14, …, 9&1. Twenty-one of the 24 seams would be between consecutive leaves; 8&17, 9, 24&16, and 9&1 are seams between pieces that skip or jump 8 intervening leaves.

A better pattern (i.e. smaller jumps) is a 24 piece starburst with a four piece jump: 1-4, 9-12, 17-20, 24-21, 16-13, and finally 8-5. The smaller the jump, the better the seam matching, and the only disadvantage to using a smaller jump is the need to more carefully lay out the individual pieces.

Draw on paper a circle about 4" in diameter, and divide it into as many equal pie shaped pieces as will be in the starburst. Arbitrarily choose one of those pieces and label it #1. Moving either clockwise or counterclockwise, number the remaining pieces using the selected jump pattern. This will be the starburst **map**.

Due to the nature of slicing veneer from a log, there is always a smooth side and a rough side to each leaf. The smooth or **front** (F) side generally looks more shiny than the rough or **reverse** (R) side, and can be identified that way. See also the "Veneer Face Side" section.

In addition, on each side of each leaf the end that was towards the **top** (T) of the tree is usually more shiny that the end that was towards the **bottom** (B) of the tree. Decide which end of which side will be considered to be the front bottom, and at that end number the leaves of veneer consecutively 1F, 2F, 3F, … For dark veneer, a white or yellow coloring pencil is easier to read. If there is concern that the pencil marking may permanently stain the veneer, apply a piece of blue masking tape to each leaf of veneer and write the label on the tape.

The interior angle of the pieces on the map have an interior angle of 360 divided by the number of pieces. Using a pair of hinged mirrors opened to this angle, find a desirable pattern on the **front** side of the **second** leaf of veneer and mark it lightly in pencil. (The reason to use the second leaf will be explained below.)

Overlay this second leaf onto the last leaf, matching the grain and figure as best possible, and make sure that the pattern has not moved off the side or end of the last leaf. Lightly mark the location of the second leaf's pattern on the last leaf.

An observer's eye tends to notice most the grain and figure matching at the center of the starburst. Study closely the amount of evolution of grain and figure between the second and last leaves. A consistent grain and figure at the center can be more attractive than a more dramatic piece of veneer that suffers significant evolution around the center of the starburst. Greater evolution can be visually more acceptable when further from center.

When the final pattern position has been identified on leaf 2, place the template on it and carefully outline its two edges in pencil.

Again position the hinged mirrors on the final pattern marked on leaf 2 and decide if the pieces in the starburst will be book matched. If so, closely examine in the mirror the two seams for what will be piece #2. Grain and figure matching will probably be more important on one edge of piece #2 than the other. Decide which edge of piece #2 is more important for grain and figure matching and mark it with a check.

Beginning with seam 1&2, make a list of every other seam (1&2, 3&4, 5&6, …) shown on the map. Note that every seam in this list is between consecutive leaves. All of the seams with jumps are not on this list.

If the starburst is a bookmatch, the first seam in this list will be either 1F/2B or 1B/2F. These two possible seams, 1F/2B and 1B/2F, correspond to the two seams on leaf #2 that were reflected in the mirrors. Choose the seam (1F/2B or 1B/2F) that will position the edge checked (as the most important for grain and figure matching) against piece #1. On the map drawn previously, label the first two pieces 1F and 2B or 1B and 2F to produce the chosen seam. Continue labeling the pieces around the map, alternating between F and B. Using this approach, the most important seam (for grain and figure matching) will always be between consecutive leaves.

The starburst will be assembled into two half circles before final assembly. On the map, find the last piece that will join with piece #1. Extend this seam through the center of the circle to form a diameter, and note the other seam on the diameter. Using blue masking tape, place a large X on both sides of the four pieces of veneer that will make up these seams.

First rough cutting of the eventual pieces about one wider on each edge can make lining up the individual pieces to match the grain and figure much easier than working with full leaves.

Cutting the Pieces One at a Time

Starburst patterns are often made from crotch or other highly figured veneer. The more figure, the more tension in the veneer and the more likely the leaves are slightly buckled. When cutting an edge of a piece, always position the straightedge on the interior side of the edge, so that it flattens the veneer that will be part of the starburst, and forces any buckling into what will be the offcut. Very accurate cutting is essential. Begin each cut with a light first pass to score the veneer without any tendency to follow the grain. Gradually increase the pressure on each pass, so the veneer is cut with three or four passes.

If the points of the pieces may tear or break off during cutting or handling, the area of the point can be reinforced with veneer tape before making any cuts. If the entire leaf of veneer is very fragile, veneer tape can be applied to one or both sides before each cut.

If a cut edge is rough or uneven, lightly dress it with 80 or 120 grit sandpaper on a solid block.

The template pattern was carefully traced onto leaf #2. Cut one of the edges of piece #2 and draw a short line perpendicular to this edge (on the remaining part of the leaf) at what will be the point. Make sure that the remaining part of the leaf is still labeled 2F or 2B.

Position piece #2 on each of the other leaves in turn, best matching the grain and figure. In pencil, lightly mark the cut edge of piece #2 on each leaf and mark with a short perpendicular line where the point will be. Make sure the short perpendicular line crosses the traced edge. The perpendicular line will insure that the point of the template will be returned to the same place on the leaf of veneer when the second edge is marked and cut.

Set aside the four leaves marked in blue masking tape with an X. On the remaining leaves, cut the marked first edge. As each leaf is cut, make sure that the remaining part of the leaf is still labeled (3F or 3B, 4F or 4B, …).

Working one leaf at a time, slide the previously cut edge tight against the straightedge. Firmly hold the edge against the straightedge while positioning the template on the leaf and against the straightedge, with the point of the template aligning with the perpendicular pencil mark on the cut edge. Firmly hold the template on the leaf while positioning the second straightedge against the other edge of the template. The second straightedge is on the offcut. While holding it firmly on the leaf, move the template to the side and position the first template against the second. Firmly hold the second straightedge on the leaf while removing the first straightedge, and cut the second edge. . As each leaf is cut, make sure that the pie shaped piece is still labeled (3F or 3B, 4F or 4B …).

Referring to the circle map, determine which edges of the four leaves marked with an X will be the outside edges of the two half circles. These outside edges will be cut slightly wider than the template so there will be additional extra allowance for final trimming. If the edge traced from piece #2 is one of these outside edges, position the template on the leaf and trace the other, inside edge. Cut these four leaves on their inside edges only. As each leaf is cut, make sure that the remaining piece is still labeled (3F or 3B, 4F or 4B, …). Position the template on each of these four leaves with the point of the template aligning with the perpendicular pencil mark on the cut edge. Holding the point of the template in position, rotate the template slightly so that the piece will be about 1/4" wider at the circumference of the starburst. Mark these wider second edges. Using the straightedge, cut these second edges from the four marked leaves. As each leaf is cut, make sure that the remaining piece is still labeled (3F or 3B, 4F or 4B, …).

Stacking and Cutting Multiple Leaves Simultaneously

Align the leaves to match the location of the point and edges. Hold together with several pieces of blue masking tape. If desired, the stack can be further secured with 23 gauge pin nails with the tops and bottoms of the nails clenched or bent over in the same direction.

With a straightedge on the stack along one edge, cut through the stack using multiple passes. Dress the cut edge if necessary.

Carefully position the template on the stack and mark the location of the second edge. Again use a straightedge to make the second cut.

Assembling the Starburst

Gaps in seams can be seen more easily when assembly is done on a contrasting background. If the veneer is dark, assemble on a piece of white melamine or white laminate or white paper on a smooth surface. If the veneer is very light, assemble on a piece of black laminate or black paper on a smooth surface.

Using the circle map, lay out the pieces for one of the half circles. Make sure each piece is showing the correct side (F or B) and that the pieces are in the correct order. Carefully align the tips of the first two pieces, and place a 2" veneer tape strap across the middle of the seam. Place tape straps on each side of the first, about 4" away. Continue working out from the middle of the seam. Tape the first three or four pieces together this way, so that the first straps have time to dry. Add straps anywhere the seam is not tight, then apply hinge tape to within about an inch of the tips. Continue until the half circle is assembled. Leave the tips exposed until the edges of the half circles are trimmed. Cover with a 3/4" piece of plywood or MDF to keep the assembly flat as the tape dries.

Assemble the second half circle and cover until dry.

Using a straightedge, trim the excess off one half circle. Position it on the other half circle, mark where this second half circle should be trimmed, and make the final cut. Tape the two half circles together. Keep covered until ready to glue to a substrate. Ideally, the assembled starburst would be immediately glued to either a substrate or a backer veneer, as humidity changes will make the starburst buckle almost immediately.

Support Surface, Vacuum Bag

The support surface for a vacuum pressing bag needs to be approximately the same size as the bag, usually 4' x 8'. A torsion box can be made from 1/4" plywood skins and 1" resin coated honeycomb, but unsupported spans of more than about 3' probably will flex.

Veneer is not thick enough to create a laminating effect on the substrate, so if the substrate is flat but the platen in the vacuum bag is not, the substrate will bounce back to being flat after it comes out. Likewise, if the substrate is warped but platen table is flat, when the veneered panel comes out it returns to being warped. If the substrate is laminated with something thicker, like 1/8" material, then the flatness that it is when its pressed is the way it will stay. The longer a panel is left under vacuum the flatter it seems to stay. Panels left in overnight always stay the flattest."

A pretty flat surface can be effected by laying a couple straight 2x4's across a pair of sawhorses and then laying 2 or 3 sheets of 3/4" plywood (MDF would be better since it is heavier and flatter) on them. With a stretched string, check for flatness along the length and width of the top sheet. Use winding sticks to check for twist. Thin strips of wood can be used under the support surface to shim as needed.

Torsion Box

See also the "Honeycomb Core" section.

A torsion box is two sheets of plywood or MDF with a core of ribbing (usually strips of wood stood on edge or a honeycomb of some material. When this sandwich is glued up it makes an extremely stable, strong and light weight panel for its size. Excellent for tops with long unsupported areas.

When making a torsion box using resin coated honeycomb, include a hardwood strip at least 1" wide around the outside edge of the honeycomb (between the two outer panels). This strip protects the honeycomb and provides a surface to hold screws, et cetera.

When making a torsion box using resin coated honeycomb, apply a rigid adhesive to the inside of the lower panel, lay on the wood strips and honeycomb, apply a rigid adhesive to the inside of the upper panel, lay it on top of the core, and then press the overall sandwich until the adhesive cures.

A torsion box consisting of 1/4" plywood outer panels and 1" resin coated honeycomb core is stiff, but will flex if supported only at the two ends.

Fine Woodworking articles on torsion box construction, by Ian Kirby and Kim Carleton Graves, are listed in the "Resources" section.

Unibond

Developed by Darryl Keil, Unibond 800 is a urea resin glue like Pro-Glue. It is available as a two part product (liquid resin and powdered catalyst). The liquid resin is a very light tan and the powdered catalyst is available in light, medium and dark, which can be combined to yield intermediate tans.

Unibond can be tinted with aniline dye (either water or alcohol based). Add to the aniline dye powder just enough of the solvent (water or alcohol) to make a paste and then incorporate the paste into the Unibond. To make a very white Unibond, add titanium dioxide to the light powder catalyst.

The instructions give different ratios of the liquid resin and powdered catalyst, using either volume or weight ratios. Within limits, the more catalyst added to the liquid, the shorter the open and clamping times. Always mix the hardener powder into the liquid resin.

If mixing a higher ratio of powder to liquid, some small clumps of powder may remain after mixing. Let the mixture sit for 5 minutes and then re-mix to break them up. The dark is more prone to small clumps than the regular or white.

Coverage guidelines are about 15 square feet for a cup of Unibond, and about 31 square feet for a pint. If using a foam roller to spread the adhesive, expect the roller to absorb about 1 ounce of Unibond.

The instructions give a working time of 30 minutes at 90 degrees F, 45 minutes at 85 degrees, 60 minutes at 75 degrees, and 120 minutes at 65 degrees. They also give a clamp time of 1 hour at 95 degrees F, 2 hours at 85 degrees, 3 hours at 75 degrees, and 5 hours at 65 degrees. They further state that Unibond should not be used below 65 degrees F.

The clamp times in the instructions are for flat unstressed work, like veneer. Curved laminations should remain clamped at least eight hours.

Occasionally Unibond will stain a veneer when it bleeds through, especially maple and (less often) cherry and walnut. ALWAYS VACUUM PRESS A SMALL SAMPLE OF THE VENEER WITH A HEAVY COAT OF UNIBOND TO TEST FOR POSSIBLE STAINING!

The amount of staining can be reduced by adding Unibond Blocker to the adhesive. Blocker thickens the glue, reducing bleed through. See also the “Glue Bleed Through” section and the “Unibond Blocker” section.

Unibond 800 will work very well on paper backed veneer. Because most paperbacks are not overly absorbent apply a light coat on both the paper and substrate. This assures a good bite into the paperback. On raw veneer apply glue only to the substrate.

Bleed through on walnut with other than the dark catalyst for Unibond 800 can result in light colored glue filled pores.

Unibond will stick to dried Unibond.

See also the “Urea Resin Glue” section.

Unibond Blocker

“… a white powdered filler designed to minimize or eliminate bleed through of Unibond 800 glue on standard commercially sliced veneer. The amount of bleed through blocked depends on veneer species, cut, and thickness. … 1.5 lbs used at full strength will mix with approximately 1.25 gallons of Unibond 800.” (from Vacuum Pressing Systems flyer)

Urea Resin Glue

A type of adhesive often used for veneering because it dries very rigid, has a workable open time, and can be easily sanded. All examples of this type of adhesive contain formaldehyde, and users should study the product’s MSDS before using and take appropriate safety precautions. The most popular examples are Pro-Glue, Unibond 800, and Weldwood Plastic Resin Glue. See their respective sections.

A kitchen electric mixer’s whisk is an excellent tool to mix the resin and powder, and can be mounted in the chuck of a cordless drill. Just don’t forget to clean promptly. They can be ordered from the manufacturer’s parts department.

When a clump of hardener appears during spreading, push it with your finger and run the roller over the spot again.

Excellent way to spread is with black foam roller pad on paint roller. For small jobs, buy 4" roller handle and cut the 9" foam roller pads into shorter pieces.

An electric heating blanket over the vacuum bag is an easy way to warm the contents, shortening the clamping time.

To see when urea resin glue is sufficiently hardened on flat veneer panels, put a small amount in baggie and the baggie on top of the vacuum bag. When the mixed urea resin glue in the bag is the consistency of stiff rubber, the veneer sandwich can be removed from the vacuum bag. Just be sure that the glue in the baggie is a THIN layer – the glue curing is an exothermic process and if thick the heat buildup will speed the curing. If the vacuum bag is being heated with an electric blanket, place the baggie between the electric blanket and the vacuum bag.

After removing from the vacuum bag a panel glued with urea resin, stand the panel on edge 12-24 hours and allow it to continuing curing before sanding.

The temperature at which the Unibond liquid resin is stored at has a big affect on the shelf life. When the shelf life is up it begins to thicken. The liquid resin should be about the consistency of maple syrup; if it's noticeably thicker, like molasses it's too old. Store in a cool place to maximize shelf life.

Best place to store the liquid resin is in a fridge that does not have food consumables stored. Don't need to allow time for the liquid resin to warm up before using since a thin film will be spread on a warm substrate.

Vacuum

Above 20" of vacuum is usually sufficient for flat pressing veneer. A maximum of 15" of veneer should be used when pressing a plywood or similar skin to resin coated honeycomb. 25" is the maximum for most vacuum pumps.

WHEN VACUUM PRESSING EPOXY, MAX PRESSURE 10-15" BECAUSE EPOXY IS "HIGH SATURATOR."

Vacuum bagging helps glue bonding in two ways – high clamping pressure and the vacuum helps draw the glue into the pores of the veneer. Maximum glue penetration occurs in the first few minutes of vacuum, so a gradual drop to about 18" before the pump starts again does not weaken the bond. Once maximum glue penetration is achieved (in the first few minutes) the vacuum is only for maintaining clamping pressure.

Vacuum Bag Leak

A leak that makes the pump cycle every 30 seconds will be much easier to find than one that recycles the pump every 5 minutes. Disconnect the pump from the bag and test the pump, just to be sure the leak is not in the pump or hoses. Once established that the leak is not in the pump and hoses, turn off all noise in the shop and listen carefully over the surface of the bag. Be sure to check along the seam of the bag, if it's vinyl, and where the closure at the end is, as any particles there will cause a leak. If that does not yield anything take a dye soaked rag and blot it on any suspicious spots; dye will be drawn through any hole and make a mark on the platen. Also be sure to check the underside of the bag, sometimes an object gets on the table the bag is sitting on and grinds a hole in the underside of the bag. Any glue and chips on the area of the bag where the closure goes will cause a leak also, be sure to keep this area of the bag clean.

Vacuum Switch

Should be adjustable 15-25" and should have about 4-7" of dead range (between when it shuts off and when it re-starts). See also the "Vacuum" section.

Veneer, Backer

Veneer applied to the underside or back surface of the substrate, needed to balance the stress on the substrate. Even 3/4" plywood or MDF will curl slightly if only veneer one side. Backer veneer should be similar in wood characteristics to the face veneer. If applying starburst, diamond, or other veneer pattern on face, don't have to apply the same pattern to the back – just straightforward backer veneer.

As the glue under the veneer dries, it shrinks to some extent, tightening and pulling the substrate on that side; if there isn't the same pull on the other side to balance this out, the panel warps. Seasonal humidity changes will penetrate the panel

differently from the two sides if one has the additional barrier of glue and veneer that the other side does not. This will also cause warping. The veneer tries to expand and contract with humidity changes, this too will effect panel stability.

If the substrate is thin and the panel is a side panel in a solid frame, it might be able to tolerate some warping, but if a door panel both sides of the substrate should be veneered.

Backer veneer is sometimes called "balance veneer."

Backer grade mahogany is stable (uniformly straight grain, no knots or splits or figure), usually wide leaves (less time taping leaves together), and takes glue very well; i.e. very good for backer veneer.

The lower ply of two ply veneer is also called backer veneer.

Veneer, Balance
See the "Veneer, Backer" section.

Veneer, Crotch
In addition to the interruption to the wood fibers from stump to tree top, the tree forms compression and/or tension growth in reaction to localized gravitational and other stresses at the fork. Compression and tension grain is inherently less stable than regular grain. In addition, crotch veneer is sliced in a slightly rounded path, so that the veneer was not a flat section from the tree. Because of these factors, crotch veneer almost always has to be flattened before it can be used.

See also the "Mahogany Crotch Veneer" section.

Veneer, Dyeing
Commercial dyeing of veneer is a very specialized process, and hobbyist dyeing seldom produces acceptable results. From A Complete Manual of Wood Veneering, a vacuum is first used to extract free air and water from the veneer, along with tannins, resins, et cetera. Up to 120 psi of pressure is then used to push the dye into the veneer, after which the color is chemically fixed.

Black is one of the hardest colors to give veneer.

Use a light wood such as maple or anigre Use a light fast salt-based fabric powder dye such as RIT or Dharma and mix with distilled water. Put the veneer in a pan big enough to allow the veneer float freely. Maintain between 160-180 degrees F until color has completely penetrated, which could be several hours. Check for penetration by feather cutting the wood. After full penetration, wash off the veneer with cold water to fix the color. Wipe off and dry between cauls, changing paper to dry the veneer."

Tight grained wood might require heating the dye and veneer in a pressure cooker.

Veneer, Labeling
With most of the veneer matches, it is vital to keep the individual leaves numbered sequentially. It is also important to distinguish the face and reverse side of each leaf. With the inverted slip match, it is also important to distinguish the two ends of each leaf.

At minimum, as soon as a sequence of leaves is received they should be numbered starting from one. Ideally, the number would be written in the same place on the face side of the leaves. See the "Veneer Face Side" section. For many wood species, a simple #2 pencil works well. If the veneer is dark, soft yellow chalk can be used.

Many veneer matches combine the face sides of some leaves with the reverse sides of others. In that case, each side of a leaf is given its sequence number with either a "F" or "R." If the label is always written in one corner, it will also serve to distinguish the two ends of each leaf.

Veneer, Handling
As soon as veneer is received, it should be inspected and the leaves consecutively numbered. Any existing splits should be reinforced with blue masking tape if the veneer will be used soon, or with veneer tape. If the veneer is likely to handled often, the ends should be reinforced similarly.

Veneer should be stored in an area of constant temperature and low humidity. Leaves should be covered with a board, MDF, plywood or similar to keep flat. Burl and other smaller pieces should be placed between pieces of stiff corrugated cardboard and the corners taped with packing or masking tape.

Veneer, Paper Backed

Paperbacked veneer is usually in large sheets, like 4' x 8'. The typically smaller leaves of veneer have been joined together and strengthened by the paper backing. It is ready to apply to the substrate but does not allow grain matching, book matching, … as the leaves of veneer have already been assembled.

The veneer face in paperbacked veneer is extremely thin – too thin to be sanded or scraped.

Urea resin glue will work very well on paper backed veneer. Because most paperbacks are not overly absorbent apply a light coat on both the paper and substrate. This assures a good bite into the paperback.

Paper back veneer is very thin, usually thinner than "raw" veneer (which are just wood). The very thin wood face is permanently pre-glued to a paper backing and the assembly is glued to a substrate. Paper back veneer is usually available in the more common woods and comes in standard sheet sizes 2x8, 4 x 8 etc. Because it is made from veneer bonded to a paper backing, the sheet size is made up of leaves matched at the factory.

Many hobbyists apply paper backed veneer with contact cement. This is not recommended. Most finishes, because the veneer/paper sandwich is so thin, will penetrate to the substrate and weaken the contact cement bond, forming bubbles.

Veneer, Resawn

Resawn veneer is generally only made when a commercial raw veneer is not available. Keep resawn veneers as thin as possible, 1/16" would be ideal. Can always glue it down thicker and then run the panel through a wide belt sander to bring the thickness down. The thicker the veneer is, the more it acts like a board and is more likely to expand and contract, causing splitting and related problems.

If used as a veneer over a solid wood substrate, resawn veneer should be aligned with the grain. Probably best to glue the veneer joint edges together before pressing. See the "Veneer Joint, Reinforcing" below.

Rubber sheet not needed for when vacuum pressing resawn veneers of differing thickness. Top caul not even needed. Resawn veneers are much stiffer because of their extra thickness and therefore do not need a top caul. Add a sheet of 4 mil plastic between the resawn veneer and the bag so that glue that bleeds through does not stick to the bag.

Veneer, Trimming

There are a number of ways to trim veneer in the workshop. A scalpel and good straightedge almost always can produce a perfect edge, but is very slow. A sharp veneer saw and good straightedge can usually produce a good edge.

A shop-made clamping system and router as demonstrated in the"Working With Veneer" video can often produce a good edge in a stack of veneer. Another type of shop-made clamp and jointer or hand plane as demonstrated in the "Decorative Veneering" video can often produce a good edge in a stack of veneer. See the "Resources" section. Some have had success using a Fein tool and another type of shop-made clamp. There are some discussions and pictures posted in the veneering forum. See the "Resources" section. Finally, several people have had excellent results cutting a good edge in a stack of veneer using a Festool circular saw and Festool guide fence.

If chipping, splitting or tearing is occurring, consider reinforcing the veneer with veneer tape on one or both sides before trimming.

80 grit sticky backed sandpaper on a block of MDF or plywood can be used to lightly dress as needed the edge after trimming.

Veneer, Two Ply

The three instances when two ply veneer is commonly used are: when the face veneer, like crotch mahogany, has a strong tendency to check or crack; if the veneer is too fragile to work with; and when the substrate is a curved surface not perfectly smooth (such as bending ply).

Backer grade mahogany veneer is an excellent material for the back side of two ply veneer, because backer mahogany is available in wider leaves and is extremely stable.

The show side of the primary veneer is taped with solid veneer tape. The back side of the backer veneer (that will be glued to the substrate) is taped with 3 hole veneer tape to allow more glue contact between the substrate and the back of the backer veneer. The primary and backer veneers are glued at right angles to each other.

Apply the adhesive to the front side of the backer veneer. Lay on the bottom caul. Position the primary veneer on the backer veneer. Immediately cover with the top caul, place in the bag and draw the vacuum. As soon as the primary veneer contacts the adhesive it can begin absorbing moisture and buckling.

If the substrate is thin, consider applying a two ply to both sides to minimize warping. The back side two ply could be simply two layers of backer mahogany at right angles to each other.

If the two ply was made using a rigid glue like urea resin, the smallest radius it could later be bent to is about 10". If the two ply is applied to the curved substrate the same day (before the urea resin has fully cured) it can be bent to a tighter radius.

See also the "Bending Plywood" section.

Veneer Band
A band is a narrow decorative feature often found near the outer edge of tabletops and similar. It can be a single strip of contrasting veneer, for example a 1/16" wide strip of holly veneer. It can be a three piece assembly, for example outside bands of 1/16" dyed black veneer with a center strip of ¼" cross-grain padauk. It can be a more complex shop-made pattern that is bandsawn from hardwoods glued into various designs. Or it can be a purchased decorative strip.

It can be made part of the tabletop's veneer sheet as it is being constructed, or glued into a routed groove made after the tabletop veneer was glued to the substrate. The former is very well presented and explained in an article and video by Paul Schurch listed in the "Resources" section.

Veneer Border
A contrasting veneer at the outer edge of tabletops and similar, and often used with a veneer band. The grain direction of the border can be picture framing (parallel to each edge of a rectangular piece), radial (on a round or oval piece), diagonal, or cross grain. It is expected that a veneer border usually is made as part of the tabletop's veneer sheet as it is being constructed. This is well presented and explained in an article and video by Paul Schurch listed in the "Resources" section.

Veneer Bubbles
After glue is cured, wipe down veneer with damp sponge. Any unglued areas will bubble up. Can use a syringe to inject superglue and clamp to repair.

Veneer Bundle
A group of consecutive leaves of veneer from a flitch. Typically 24 or 32 leaves.

Veneer Cutting
(Taken in part from The Complete Manual of Wood Veneering."

The two basic methods of cutting veneer from a tree are slicing and rotary peeling. With the former, the quarter or half log is moved back and forth (horizontally or vertically, depending upon the equipment design) past the knife edge. In the latter, a quarter, half or entire log is rotated in a circle past the knife edge.

Slicing methods include crown cutting, flat crown cutting (both of which yield arches and cathedrals in the veneer), quarter cutting and rift cutting (both of which produce ribbon grain veneer).

Log-in-the-round rotary peeling mounts the log centered on the axis of rotation of a lathe and produces a long sheet of continuous veneer. The action is like unrolling a roll of paper towels. This method is used to produce the interior plies of plywood, the surface plies of construction plywood, and birds eye veneer.

Eccentric rotary peeling mounts the log off-center on the axis of rotation of the lathe. Stay-log rotary peeling mount the entire log just off the axis of rotation of the lathe. Stay-log half rounding and stay-log back half rounding mount half-logs at a distance from the rotational axis of the "lathe". With all of these four rotary peeling methods, each rotation of the "lathe" produces a discrete slice of veneer.

("Stay-log" apparently is a reference to mounting methods and equipment to allow the half or full log to be rotated in a circle even though none of the log is within the axis of rotation.)

Each of these cutting methods is illustrated in The Complete Manual of Wood Veneering.

Veneer Figure

The combination of wood species (ash, makore, et cetera), veneer slicing method (flat, quarter, back cut half round, et cetera) and figure all combine to determine the look of typical leaves of veneer. Atypical conditions, minerals taken in by the tree roots, diseases and other factors produce atypical leaves of veneer.

See also the "Veneer Grain" section.

(Taken in part from The Complete Manual of Wood Veneering.

Ribbon figure is simply quarter or rift sliced veneer with its alternating annual early- and late-wood. (As a quarter log is quarter or rift sliced, the angle of cut with a true radial line varies, so the ribbon figure evolves through the quarter log.)

Wavy and curly grain produce curl, fiddleback, and beeswing figure.

Block mottle figure and roe figure occur when wavy and spiral grain occur in the same log.

Blistered and quilted figure result from irregular grain.

Other common figures include pommele and plum pudding.

Veneer Flattening

Veneer should be flattened whenever it is buckled, and even when seams are hard to tape because of light curling.

Make sure that consecutive numbering of the leaves of veneer is not lost during the flattening process.

As an alternative to a commercial flattening solution, one can mix together:
2 parts white or yellow glue
3 parts water
1 part pure glycerin (usually obtainable from a pharmacy)
1 part denatured alcohol

One approach is to apply flattening solution to both sides of the veneer liberally. Simplest applicator is 3" or 4" foam brush. Let soak for a minute or two. Place 2-3 layers of newspaper on the table. On top of this place a layer of fiberglass window screen, the soaked veneer, another layer of fiberglass window screen, and 2-3 layers of newspaper. Continue by adding more screen, veneer, screen, newspaper, stacking as high as needed. Flip each leaf of veneer end for end so the wavy parts cancel each other out. Place this "sandwich" in the vacuum press with bottom and top cauls (1/4" minimum.) and apply full vacuum pressure. Change the newspaper 3 times the first day and leave under full vacuum pressure overnight. After being in the vacuum press overnight the fiberglass window screen is no longer needed as the veneer has dried sufficiently so that it will not stick to the newspaper. Change the newspaper 3 times the second day but do not put the sandwich in the press, just place weight on top of the top caul to hold the stack down. On the third day the veneer should be ready to use. Best to confirm with a pin type moisture meter that the veneer is dry.

As an alternative to soaking the buckled veneer with flattening solution, lightly mist on each side with flattening solution. Stand the veneer on edge out of bright sunlight, allowing air to circulate around both side, for 20 minutes. The veneer should be flexible enough to begin flattening. Flip each leaf of veneer end for end so the wavy parts cancel each other out. Place the stack between cauls and gradually increase pressure until the veneer is flat. Leave for about eight hours. Then

build a stack alternating a couple sheets of unprinted newspaper (or other absorbent paper) and veneer. Place this "sandwich" in the vacuum press with bottom and top cauls (1/4" minimum) and apply full vacuum pressure. Change the paper every few hours until the veneer is dry, which may take up to five changes over a few days. Best to confirm with a pin type moisture meter that the veneer is dry.

The veneer will stay flat for months provided it is stored flat with light applied pressure. Newspaper between the leaves is no longer needed.

Local pharmacies often carry smaller quantities of glycerin, and might be able to order gallons.

Veneer Face Side

The "face" side of a leaf of veneer is the upper side of a leaf when it is sliced from the log (or remainder of the log). (Depending on the orientation of the log's center and the veneer knife, the face side of the leaf may be towards the bark side or heart side of the log.)

When veneer is sliced, the veneer knife passes between the leaf and the remainder of the log. The knife forces the leaf to curl out slightly. The face side is forced into "compression" and the back side stretched into "tension." This tension usually causes cracks to form in the back side that may extend up to a quarter of the overall thickness of the veneer. The face side is sometimes referred to as the "tight" side and the back side the "loose" side.

The face side should feel smoother, such as when rubbed against one's cheek. When flexed along the grain, a leaf of veneer will bend more easily if the back is on the outside of the bend – the tension cracks along the grain open to make the leaf more flexible.

In a slip match, the face side is almost always the "veneer show side." One uniform exception is birds eye maple veneer. The individual eyes are horizontal slices of a conical section, and because the way this veneer is sliced the diameter of the face side of an eye is larger than the diameter of the back side of an eye. If this veneer were glued to the substrate with the face side out the individual eyes could pop out, so birds eye maple veneer should always be glued with the face side towards the substrate.

When assembling veneer leaves into sheets, it is almost always important to be able to identify the face and reverse side of each leaf. Along with the sequence number, each side of each leaf should be labeled with an "F" or "R." See the "Veneer Leaf" and "Veneer Sheet" sections and the "Labeling Veneer Leaves" section.

"Face side" and "reverse side" refer to opposite sides of every leaf of veneer in regards to how it came off the log during slicing. "Show side" and "glue side" refer to opposite sides of a leaf of veneer that is visible in a finished piece of furniture or marquetry, and usually but not always correlate to "face side" and "back side." The terms "show side" and "glue side" are not usually applied to the backer sheet of two ply veneer. See the "Veneer Show Side" and "Veneer Glue Side" sections.

Veneer Glue Side

On a piece of veneer that is visible in a finished piece of furniture or marquetry, this is the side of a oiece that is closest to the substrate. The other side of this piece of veneer is the "veneer show side." These two terms are not used with the backer sheet of a two ply veneer. Usually, but not always, the glue side is also the "back side."

Veneer Grain

The combination of wood species (ash, makore, et cetera), veneer slicing method (flat, quarter, back cut half round, et cetera) and figure all combine to determine the look of typical leaves of veneer. Atypical conditions, minerals taken in by the tree roots, diseases and other factors produce atypical leaves of veneer.

See also the "Veneer Figure" section.

(Taken in part from The Complete Manual of Wood Veneering.)

Grain "is the natural arrangement of the wood fibers in relation to the main axis of the tree . . ."

Generally, the fibers run more or less vertically and straight, from the roots to the top of the tree. They also slope ever so slightly from the bark of the tree to its center (the diameter of the tree decreases moving from the ground to the tree top.)

Irregular grain commonly occurs around knots, stumps, forks, et cetera.

In wavy grain the wood fibers "form short, undulating waves in regular sequence."

In curly grain the wood fibers "form short, undulating waves in irregular sequence."

In spiral grain the wood fibers "form a spiral around the circumference of the tree . . ."

In interlocked grain "the angle of the fibres (sic) change from a right-handed spiral to a left-handed spiral and back again at intervals of a few years."

Veneer Joint, Reinforcing

Sometimes it can be difficult to keep a taped joint tight, especially if the substrate is curved both convex and concave along the joint. Machine the veneer leaf edges as normal, then tape the glue side with blue masking tape. Fold the two leaves of veneer back against themselves and smear a bit of white or yellow glue along the edges of the veneer. Unfold so that the sheet is flat, and with a damp sponge wipe off any glue on the face side. After an hour, remove the blue masking tape, apply solid veneer tape to the face side of the joint, and lightly sand the glue side of the joint with 80 grit sandpaper to remove glue residue.

Veneer Leaf

A leaf of veneer is the result of one slice or rotary peeling of a quarter, half, or full log. See the "Veneer Cutting" section.

Generally, a single leaf is not wide enough for the intended application, and thus must be matched with sequential leaves to form a sheet. Sometimes only a part of a leaf is needed. This smaller part cut from a veneer leaf is referred to as a veneer "piece." See the "Veneer Matching" and "Veneer Sheet" sections.

Veneer Matches

Always use sequential leaves of veneer for matching. The grain and figure in veneer not only moves or **shifts** slightly between leaves, but also changes in size and appearance or **evolves**. If the grain and figure simply shifted from leaf to leaf, the appearance would be identical between leaves but simply moved closer to one edge or end and it would be easy to cut identical pieces from consecutive leaves. However, because the grain and figure evolve there will always be some variation between leaves.

One of the most common methods of assembling veneer is the bookmatch. The identical area is cut from two consecutive leaves of veneer, the pieces brought together as they came off the log, and then opened along one common edge like opening a book. The grain and figure of the two leaves matches across that common edge. This is a two piece or two way bookmatch; using veneer labeling it is 1F-2R or 1R-2F.

(Identical areas are cut from consecutive leaves of veneer by taping the leaves together and cutting through both at once. Using small common landmarks in the two leaves, such as small knots or other figure, overlay the two leaves to match the figure and grain and firmly tape them together. Then cut the desired area.)

In a four way book match, many would place the leaves (clockwise or counterclockwise) 1-2-3-4 (the odd leaves face up and the even leaves face down or versa vice) but this means the edges of 1 and 4 meet. The grain may have moved over the course of 4 leaves and this match not very good. An alternative is to place the leaves 1-2-4-3 (clockwise or counterclockwise) so that each pair of adjoining leaves is either consecutive leaves (1-2 and 3-4) or one leaf jumps (1-3 and 2-4).

In a four way book match that is 1-2-4-3 clockwise stack the four leaves so that the common edges of 1-2 and 4-3 are on the same side of the stack. Line up the grain exactly and tape the stack together. Joint that common edge. Tape the 1-2 joint and the 4-3 joint and position 1-2-4-3. Turn over 4-3 (keeping the common 1-2-4-3 edges together), then lay 4-3 over on top of 1-2, match grain and line up the two taped joints. Joint the final common edges. If the final jointing is not perfectly perpendicular the book matching will still have tight joints. The resulting match can be abbreviated 1R-2F-4R-3F or 1F-2R-4F-3R.

Another common veneer matching technique is slip matching. It again starts with identical areas of consecutive leaves. The leaves are all kept the same side up and slid sideways. The left edge of the second leaf is matched to the right edge of the first leaf, the left edge of the third leaf is matched to the right edge of the second leaf, and so on. This match is abbreviated 1F-2F-3F- . . .

An inverted slip match is created by first laying out the leaves of veneer into a slip match, and then rotating every other leaf 180 degrees clockwise or counterclockwise. The same side face or reverse) of all the leaves remains up, but the top and bottom edges alternate.

A running bookmatch would be pairs of bookmatches in a sequence of four or more leaves of veneer, for example 1F, 2R, 3F, 4R or 1R, 2F, 3R, 4F and so on. This match likely will look best using an even number of leaves, so that the centerline of the assembled sheet is a bookmatch.

The diamond and reverse diamond matches are described in both The Complete Manual of Wood Veneering and a Kim Carleton Graves article, both listed in the "Resources" section.

The box and cross matches are described in an article by Frank Pollaro listed in the "Resources" section.

The sunburst match is described in its own section.

Most of these matches can be previewed using a pair mirrors. The mirrors can be hinged at one end using masking tape, or using cabinet hinges to join pieces of plywood to which the mirrors have been glued.

Veneer Piece
Sometimes less than an entire leaf of veneer is used. This smaller section from a veneer leaf is a veneer piece. The most common use of pieces would be a starburst match, which is a sheet made up of a number of identical pieces from consecutive leaves.

Veneer Sheet
Several leaves or pieces of veneer (usually sequential) brought together to make a longer and/or wider surface than possible with an individual leaf. A slip match is a number of sequential veneer leaves taped together. A starburst sheet is a number of identical pieces cut from sequential leaves of veneer to make a very decorative surface. Accurate labeling of individual veneer leaves or pieces is essential for successful assembly into a sheet.

See also the "Labeling Veneer Leaves" and "Veneer Leaf" sections.

Veneer Show Side
The side of a piece of veneer that will be visible after the veneer is glued to the substrate. The "glue" side is the other side. Solid (no hole) veneer tape is always applied to the show side.

Veneer Tape
There are multiple versions of veneer tape because of the particular needs of mass production. 30 gram tape is easier to sand off but is somewhat too weak. 50 gram is much stronger but not as easy to find. 40 gram is a good compromise for the custom woodworker and hobbyist. White is the most common and can be used exclusively, but remnants of brown veneer tape are easier to see during sanding on light colored veneers.

Veneer tape is made solid, with two rows of holes, and with three rows of holes. The most common is solid, and is generally used by the custom woodworker and hobbyist. Two hole is somewhat easier to remove after pressing veneer to the substrate, but is weaker. Three hole tape is used only when veneer tape must be used on the glue side of the veneer. The middle row of holes should be directly over the veneer seam to permit better glue adhesion with the veneer. See the "Veneer, Two Ply" section.

The most common widths of veneer tape are 3/4" and 2". The former is used to tape the joints when assembling sheets of veneer. 2" veneer tape, only seen solid, is more convenient when reinforcing delicate veneer (such as burls), especially prior to cutting, and marquetry. 2" tape also works well when reinforcing (against splits) the ends of leaves of veneer that might be handled often. Some veneers are prone to splitting when cut across the grain. Applying veneer tape to one or in

difficult situations both sides will eliminate this problem. Just remember that any veneer on the glue side must be removed before gluing the veneer sheet to the substrate.

The adhesive on veneer tape is a water based vegetable or hide glue. This makes the veneer tape easier to remove after the veneer is glued to the substrate. The tape is made of paper, which shrinks slightly as it dries and pulls the seam tighter.

Veneer tape and dispensers are available from several suppliers. See the "Tools, Equipment and Suppliers" section.

The tape should feel slightly slimy when applied to the wood. That indicates that it has been sufficiently wetted. If the tape comes off later, after drying, it probably was not sufficiently wetted before application.

To tape a seam between pieces of veneer, first bring the two pieces together to be sure they meet without gaps. Forcing a poor seam together will cause the assembly to buckle and make problems during glue-up.

Begin with a 2 to 3" piece of wetted 3/4" tape in the middle of the seam, perpendicular to the seam. This is sometimes called a **strap**. To improve adhesion to the veneer, immediately rub the tape 3 or 4 times with a soft bristle brass brush (www.schwoodwork.com is one source).

Working from the middle towards each end, apply another strap every 3 to 4". The last straps usually would be within 1/4" of the end of the seam. If assembling a starburst, the last strap can be an inch from the point.

When all the straps are down, apply the **hinge**, a long piece of 3/4" tape along the seam and brush into the veneer. If the first piece doesn't cover the entire seam, lap the pieces 1/2 to 1".

After the straps and hinge are applied, cover the seam for a few minutes with a piece of MDF or plywood while the moisture evaporates from the veneer.

Tighter seams can be obtained by first taping the glue side with blue masking tape with straps and hinges. Then apply veneer tape as before to the show side and cover with a caul until dry. Before applying glue, be sure to remove all the masking tape from the glue side. Blue masking tape is used because it has a lower tack and is easier to remove without damaging the veneer.

Veneer Tape, Removing

Some people wet the veneer tape and remove it before initial sanding, others remove the bulk of the tape with initial sanding and then wet the tape and remove it. In either case, after wetting the tape a couple times the adhesive and paper softens, and the tape can be easily removed with a flexible putty knife.

If the veneer is oak or cherry, use distilled water to wet the tape. Iron in tap water can produce black tannin stains in these woods. For the same reason, test the putty knife on some scrap cherry or oak veneer first to see if it will similarly produce black tannin stains.

After the bulk of the veneer tape has been removed, liberally moisten the entire veneer surface. Any areas of veneer not thoroughly glued to the substrate will appear as bubbles when the veneer is damp. After drying, they can be tacked down. See the "Veneer Bubbles" section.

Veneer Thickness

Raw veneer today is generally about 1/40" thick. While very thin, it is thick enough to allow sufficient sanding after glue-up. It is much thicker than paper backed veneer, in which the wood is only about ___" thick and is too thin for any power sanding after glue-up.

Some sources offer limited selection of 1/16" thick veneer – this is intended for use not for veneering but for making bent laminations.

Veneer Wrinkling

Usually caused by moisture (white and yellow glues cure or harden by evaporation of the dissolved water), too much glue, glue applied directly to the veneer, too much time between applying glue and applying clamping pressure.

Cherry and maple are more prone to wrinkling

Veneering a Curved Surface
For a radius of 3-7" (not sure of the limits), if wanting to make a two ply because of crotch or other unstable veneer, consider using urea resin to glue the two ply. After a few hours the urea resin is set but not yet rigid. While the urea resin is still somewhat flexible, press the two ply onto the curved surface. This allows pressing the two ply onto tighter radii.

Walnut veneer seems to be the best choice for curved surfaces such as steering wheels. Wet slightly before beginning, and expect to massage the veneer through the vacuum bag.

Veneering a Cylinder
Apply the glue to about three quarters of the cylinder, lay on the veneer and overlap the veneer joint in the center of the unglued area. When the glue has dried on the first pressing, knife through both layers of veneer (double cut) to get a good joint, then peel the veneer back in the un-glued area, apply more glue, tape the veneer joint and press again. If using a vacuum press be sure to support the inside of the cylinder so the bag doesn't crush it and use an 1/8" bendable ply cover sheet between the veneer and bag.

If using band clamps instead of a vacuum press, use two layers of a 3/8" bending ply to distribute the pressure between the band clamps.

Veneering Drawer Fronts
If veneering over solid wood, always run the veneer grain the same direction as the solid wood, so both will expand and contract in the same direction. Cock beading was used traditionally (in part) to disguise the glue line between the veneer and solid wood backing. As the veneer adhesive was hide glue, the cock bead was also used to protect the edge of the veneer as it was more prone to chipping and lifting off. Seasonal expansion and contraction of solid wood, especially in modern draft-free houses with summer air conditioning and central heating, likely will produce some splitting in the veneer.

Walnut
Walnut veneer very occasionally is stained yellow by Unibond bleed through. Although a good idea on every veneering project, a test pressing with some of the same veneer to be used in the project is especially recommended when working with walnut veneer.

Weldwood Plastic Resin Glue
This is another powdered urea formaldehyde glue. It is mixed with water to use. Throw away if the powder has become lumpy.

If any moisture gets into this container during storage the glue will have lower adhesion. Try to obtain from a reputable supplier who knows how old the product is.

It does not seem likely that one can control the set speed, since the catalyst and resin are pre-mixed in the powder.

It has been said that the product is very difficult to mix completely without lumps.

Work Surface
A work surface covered with a layer of plastic laminate is an excellent glue up table as any dried residue can be scraped off. A solid core door is very flat and "scratch and dent" solid core doors sometimes are available at a minimal price.