



Sheet Goods for the Woodshop

How panel products are made and used

by William Duckworth



Photo: courtesy of Columbia Plywood Corp.

I became a woodworker almost by accident. Living alone, just out of college and far from home, I started to build furniture for myself because I couldn't afford to buy it. The living room of my three-room tenement apartment, a fifth-floor walkup in New York City, was my shop. The most basic hand tools were all I had to work with. When the downstairs neighbors had heard enough noise, they'd start banging on their ceiling with a broomstick, so even my working hours were limited. Materials? I made everything out of pine—it's all I could buy at the local lumberyard.

I fell in love with the process so much that I started building furniture for friends at no charge. It took a few years before I realized I might be able to do this for a living. So I quit my job, rented a small space in a nearby basement and paid \$350 for a Sears Best 10-in. tablesaw.

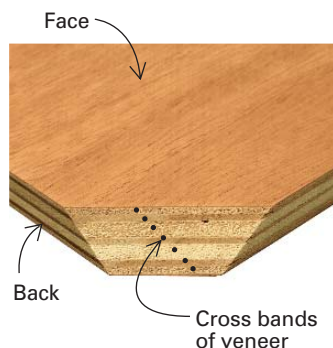
One of my first commissions was a wall of bookcases. I'll never forget my astonishment when a friend of mine suggested I consider making them with birch plywood. My local lumberyard didn't stock it. I didn't even know what it was. That soon changed, and I started using birch plywood all the time. It wasn't long before I graduated to oak, ash, walnut and mahogany panels.

Hardwood plywood has transformed the furniture and cabinet trades. I don't share the belief that woodworking projects are necessarily inferior if not entirely constructed of solid lumber. Lumber and veneered sheet goods can work well together in a fine finished product. Purists who eschew the use of manufactured veneer panels are blind to the realities of the marketplace. These products are the backbone of the business of modern cabinetmaking. They save time and, in some applications, actually improve the quality of the end result. For those who believe otherwise, I would argue that,

This press is hot. Workers at a manufacturing plant in Oregon unload a plywood press that can glue 24 sheets at 240°, 150 psi.

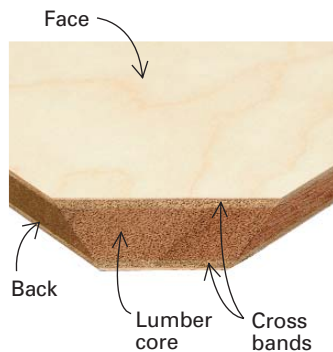
Core construction and material performance

Plywood characteristics are based on research by the Hardwood Plywood Veneer Association and the Architectural Woodwork Institute. Values are averages only. The face species in these samples are (from top) plain-sliced Honduras mahogany, rotary-cut birch, rotary-cut bird's-eye maple and plain-sliced ash.



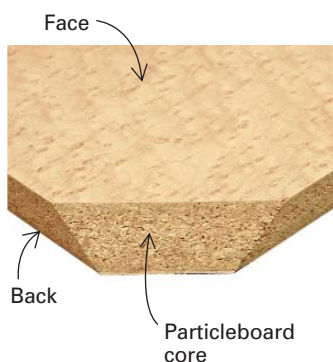
Veneer core

Flatness: Fair
Visual edge quality: Good
Surface uniformity: Good
Dimensional stability: Excellent
Screw holding: Excellent
Bending strength: Excellent
Availability: Good



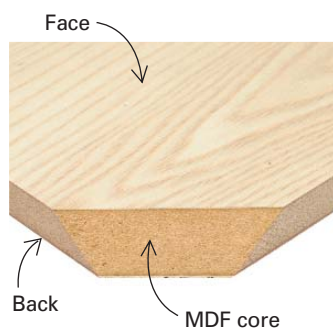
Lumber core

Flatness: Good
Visual edge quality: Good
Surface uniformity: Good
Dimensional stability: Good
Screw holding: Excellent
Bending strength: Excellent
Availability: Limited



Particleboard core

Flatness: Excellent
Visual edge quality: Good
Surface uniformity: Excellent
Dimensional stability: Fair
Screw holding: Fair
Bending strength: Good
Availability: Good



Medium-density core

Flatness: Excellent
Visual edge quality: Excellent
Surface uniformity: Excellent
Dimensional stability: Fair
Screw holding: Good
Bending strength: Good
Availability: Good



given access to the technology, Thomas Chippendale or Duncan Phyfe would have jumped at the chance to use a plain-sliced, book-matched Honduras mahogany panel with a medium-density fiberboard (MDF) core. Whether they were making tabletops, desks or the carcasses of small chests of drawers, these two were businessmen as well as artists. Can anyone doubt that the same would be true for the Shakers?

Core follows function

I surveyed the following owners of custom woodworking shops to get an idea of which panels they used for what purposes: Lars Mikkelson of Santa Margarita, Calif.; Sven Hanson of Albuquerque, N.M.; Ron Barzyk of Madison, Tenn.; and partners Marcus Santora and Janis Melone of New Haven, Conn. Each shop has its own particular niche, from residential furniture to commercial case goods, so preferences varied widely. In all cases, though, I asked about panel products meant for interior applications only and those most commonly available to the small shop (see the photos at left).

Veneer core is lightweight and strong—Veneer core is what most people mean when they refer to plywood. (The Architectural Woodwork Institute defines plywood as any panel product made from three or more layers of wood or wood products.) Like Lars Mikkelson and Sven Hanson, who both use it for case work and shelving, I prefer veneer core for wall-hung uppers or floor-to-ceiling cabinets, where weight might be a problem. I also use it for applications like torsion boxes, where strength is important.

Ron Barzyk says quality standards have declined in the veneer



Final grading at the sanding station at a Columbia Forest Products plant in Klamath Falls, Ore. The birch panels on this machine, called a star grader, will soon be bundled and shipped.

core he's bought in the last two years: more voids and a poor second face, or back. My own gripe about veneer-core panels is that I never met one that was flat and stayed that way. Once exposed to a change in temperature and humidity in the shop, veneer-core plywood often warps.

Ideally, each panel should be manufactured with an absolutely symmetrical construction from the center of the panel. That means the panel should be made from the same materials on either side of its centerline. Materials should contract and expand at the same rate. Somehow, in the real world, it never seems to work that way.

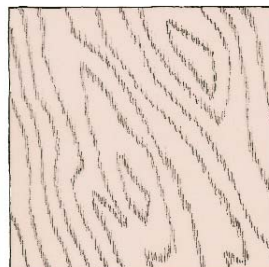
Poplar and aspen make the best cores. Less desirable are those made from meranti and virola, which are less stable. Virola is a species harvested in Panama and Guatemala. The logs are often stored in ponds to prevent them from rotting, and they sometimes absorb a fungus from the mud. When the logs are dry, the fungus prevents the absorption of glues in the manufacturing process. This problem results in cores that can come apart. The fungus also happens to smell bad: Virola is nicknamed stink oak.

Lumber core costs more—Lumber core is the most expensive and the least available. The core stock can be either hardwood or softwood, depending on the manufacturer. Basswood is the best.

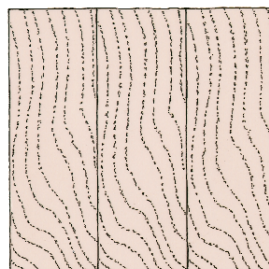
According to industry standards, which are published by the Hardwood Plywood and Veneer Association (HPVA) and based on procedures set forth by the American National Standards Institute (ANSI), lumber-core grades are regular, sound and clear (the best). Regular grade allows butt joints within the core; sound requires full-length or finger-jointed pieces and allows discolorations, re-

Veneer faces laid up five ways

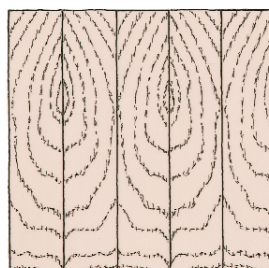
The way veneer is cut from the log makes a big difference in the way it looks when it's applied to a panel and how much it costs.



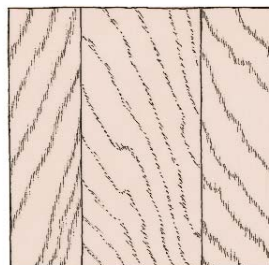
Whole piece rotary cut: A single sheet of veneer is cut from the tree like paper towels off a roll. This method produces the least waste.



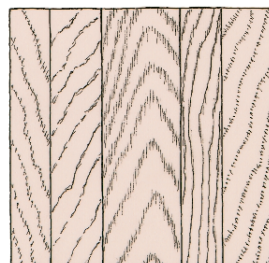
Slip match: Sheets of veneer pulled from a flitch are joined side by side with the same face side up.



Book-match: Every other sheet of veneer is flipped as it's pulled from the flitch. This pattern results in the best-looking panels. Book-matched panels also are the most expensive.



Pleasing match: The veneers in this category match in color more than grain characteristics.



Random or mismatch: Veneers don't match either in color or grain pattern.



MDF-core birch cases with alder faces—From left to right, Ron Barzyk, his son Brook and Floyd Parker of Madison, Tenn., dry-fit wall-unit cases. Barzyk prefers MDF core over any other.



ApplePly doesn't have to be banded. Thin, uniform plies become part of the design in case work by Janis Melone and Marcus Santora, partners in a New Haven, Conn., shop.

MDF takes a crisp edge when machined. Lars Mikkelsen of Santa Margarita, Calif., uses MDF with no face veneer for work that will be painted, like this door panel.



Photo: Scott Gibson

pair patches and sound knots; clear is the same as sound except that no knots are allowed.

Sven Hanson uses lumber core for drawer cases. He bevels the top edges of drawer sides to make the core appear more like solid lumber. He cautions anyone who lives in a dry climate to check lumber-core panels with a moisture meter. Industry standards allow plywood leaving the manufacturing plant to have a moisture content of 12%. That's twice the figure recommended for interior woodwork in Sven's neck of the woods.

Ron Barzyk found a source for some panels with a pine lumber core that he likes to use for toe kicks under cabinetry in kitchens and baths. It holds up well to wet floor conditions. Other uses for lumber core include flat-panel doors and shelving that will not need edge treatment.

Lumber core stays flatter than veneer core, but it's hard to justify using it when it can cost twice as much as a panel with the same face veneer on another core. A 3/4-in., 4-ft. by 8-ft. birch panel with a clear basswood core sells for more than \$80 and walnut for \$125. You could get the same veneers on particleboard for about \$35 for birch and \$75 for walnut.

Particleboard core is heavy in the hand—Sometimes referred to as flakeboard or chipboard, particleboard core is composed of small particles of wood and wood fibers bonded together with synthetic resin adhesives under heat and pressure. It is manufactured

in low, medium and high densities. None of the four shops uses it as a plywood panel (with a hardwood face and back). Ron Barzyk likes the core material only when he's making countertops with plastic laminate. Sven Hanson commented that it's good for garage shelving, but I don't think he meant that to be taken literally.

Particleboard is the least expensive, and it has an excellent rating for flatness and surface uniformity. So why don't they like it? One problem is weight. A 3/4-in., 49-in. by 97-in. panel weighs about 93 lbs. Unless you have a separate scoring blade on your tablesaw, particleboard will sometimes chip out in small pieces on the edge. It will warp easily under even moderate loads, like a bookshelf full of paperbacks. It does work well as a core material for solid-core door manufacturers. It would be a good choice for a well-supported tabletop. And it does make good use of natural resources: What was once waste material has become core stock.

MDF core is the answer to many needs—Ah, MDF, now that's another beast altogether. We've sung its praises in these pages before (see *FWW* #104, pp. 51-55). Like particleboard, MDF is made from small wood fibers bound by synthetic resins under heat and pressure. It's also less expensive than veneer-core and lumber-core panels, but it costs more than particleboard and weighs about the same. However, if you try to break the same size scrap of each over your knee, you'll discover the tensile strength of MDF is much greater than that of particleboard. It will deflect under load more readily than veneer core.

MDF holds a screw well, properly piloted, and it machines beautifully. Crisp and clean edges result when it meets up with a sawblade, a router bit or a shaper cutter (carbide is a must). When you order a 3/4-in.-thick panel, that's exactly what you get—not the 23/32-in. or even 11/16-in. sheets that sometimes show up in a delivery of veneer core or lumber core.

Lars Mikkelsen appreciates the way the smooth, flat and uniform substrate provides a fine surface for the veneer. The smooth surface won't telegraph the cross-grain patterns you sometimes get with veneer core and lumber core. Sven Hanson says thermal-set glue on edge tape holds well on the dense edges. Ron Barzyk uses MDF-core plywood for all his cabinetry, whether stained or painted, including shelves and door panels. Marcus Santora and Janis Melone use it only occasionally. They don't like the really fine dust kicked up when machining it.

What size, how much and where to get it

Plywood mills can make more than the standard 4-ft. by 8-ft. panel, up to a maximum sheet size of 5 ft. by 12 ft. You pay a premium for those larger sizes, and most distributors stock them in only a few species. I once placed a special order for a large conference table: four sheets of plain-sliced walnut, 1 1/4-in.-thick MDF core, 10 ft. by 5 ft. (the grain ran with the width, not the length), flitch-matched. They were beautiful, but they cost around \$300 a sheet. Any domestic hardwood, from ash to wormy chestnut, that's available in lumber also is available as the face veneer on plywood. The same is true for what makers and sellers call exotics, woods grouped by the location of their origin—Africa, Asia, Australia, Europe and South America.

Lumber core is only available in 3/4 in., 1 in., 1 1/8 in. and 1 1/4 in. thicknesses. Veneer, particleboard and MDF cores are standard in the following sizes: 1/8 in., 1/4 in., 1/2 in., 3/4 in., 1 in., 1 1/8 in. and 1 1/4 in. Other thicknesses exist, but they're not commonly stocked.

Prices run the gamut from particleboard core, MDF, veneer core

What's new or different?

Innovations abound in the sheet-goods industry. Boise-Cascade (208-384-6610) recently came out with a product called Electrically Conductive particleboard. Loaded with carbon, it's designed to discharge static electricity and meant to be used in computer rooms and medical and military facilities.

The Baltek Corporation (201-767-1400) offers a panel fabricated with a core of plantation-grown end-grain balsa. It's extra light and very strong. And the Norfield Corporation (203-792-5110) offers a product with similar characteristics made from a core of rigid honeycomb plastic. It's available from 1/4 in. to 3 in. thick and can be sold in small quantities.

Tim Smith of F.W. Honerkamp Co., a large plywood and lumber distributor in New York, tells me that his company is selling a lot of pre-finished panels made by States Industries. Called Nova by the manufacturer, the finish is a formaldehyde-free, ultraviolet-cured topcoat over four coats of a sanding sealer. The manufacturer will apply it to any kind of core panel.

I saw two products at the Woodworking Machinery and Furniture Fair in Anaheim, Calif., this past summer that looked very interesting. The first, made under a

variety of trade names (Classic Core, Armorcure, Fiber-Ply), has been around since 1986. It has a combination core (veneer-core plies in the center with outer layers of 1/8-in.-thick particleboard or MDF) over which face and back veneers are glued. It's been very slow to catch on, and I can't figure out why. Lars Mikkelsen is the only person I've spoken with who uses it, and he loves the stuff. You get strength, reasonable weight and a smooth substrate under the veneer.

The second new product I saw in Anaheim is manufactured by Weldwood of Canada. It's called Longlac Multi-Core (LMC), and it's different from any other panel product. The core of a 3/4-in.-thick panel consists of 7/16 in. of aspen flakes, or wafers, highly compressed and glued together with waterproof phenolic resins. I would characterize it as a sort of disoriented strand-board core. On either side of the core are cross bands of aspen veneer and face and back veneers. LMC is light and strong like veneer core, but it stays flat like MDF and particleboard-core panels. It's rated far better than any other core for screw holding through the face and about the same as veneer core for edge screws.

Formaldehyde emissions are one-sixth those of MDF. The aspen used for the core is a species that regenerates quickly, which makes for more environmentally friendly forestry management. Bob McKenna, a salesman for Atlantic Plywood in Woburn, Mass. (a large wholesale plywood distributor), tells me that his company is selling a lot of this product. He says that the cabinet shops love its low cost and its good machinability. They use it mainly for case work but also for doors. —W.D.



Fiber-Ply (left) and Multi-Core are strong and less expensive than standard veneer-core plywood.

to lumber core, in that order, no matter what the face species. In general, prices will range from \$35 for rotary-cut birch on a particleboard core to \$125 for plain-sliced walnut on a lumber core. That's the least and most you should expect to pay for any commonly stocked ¾-in. panel.

Birch and walnut are respectively the most common and the most dear of domestic-species plywood panels. All other face veneers on different cores will fall somewhere between those figures. Quantity matters, too. If you're buying 10 sheets or more, you should be able to get a price break.

There was a time when many distributors would only sell their products on a "to the trade" basis. Some of them have changed that policy. If you can't find what you want at the local lumberyard and your fingers have walked through the yellow pages with no success, there's a source book you might find useful. It's called *Where to Buy Hardwood Plywood and Veneer*. It costs \$5 and is published by the HPVA (P.O. Box 2789, Reston, VA 22090; 703-435-2900). About a third of its 120 pages is devoted to advertisements. The rest of the book includes background on the HPVA, information about available veneer species and names, addresses and phone numbers of manufacturers and distributors throughout North America. If you don't live close to a distributor, go to some professional cabinet shops nearby and ask them to buy plywood for you. Be nice, offer to pay a handling fee.

Grading veneers toward a standard—In the past, every manufacturer had its own system of grading panel products, which has led to a lot of confusion. Hardwood plywood makers and suppliers may be moving toward a revised and realistic agreement when it comes to grading sheet goods, which should benefit the end user (see the photo on pp. 40-41). Now, except for a few holdouts, most manufacturers have begun to comply voluntarily with standards published by the HPVA and ANSI. The latest version, approved in January 1995, can be purchased for \$15 from the HPVA. It is a 24-page booklet that details face, back and inner ply grades.

Specifications on grading can be complex. Tolerances vary among the face species, so it takes some study to know what you're ordering. This booklet also spells out terms for allowable formaldehyde emissions, moisture content, sanding and grade marking on each panel shipped. It's the source for the Architectural Woodwork Institute's *Quality Standards*, the book professional shops use to communicate construction details to the design trades. If you buy plywood, it's worth the money to know how to specify what you want.

Thicknesses keep getting thinner—With the advent of improved veneer cutting and handling machinery and the desire (environmental and economical) to stretch expensive natural resources as far as possible, veneers really are getting thinner. When I first started working with wood, 1/8 in. was the standard. It seems hard to believe, but furniture manufacturers buy and use more veneer than the plywood mills. So the equipment manufacturers use determines, to a large extent, the prevailing thickness standard. Nowadays, it's 1/32 in. But in response to European competition, they're gearing up with machines that can safely handle veneers up to 1/4 in. So that's likely to be where we're headed. Put away those belt sanders, the future is drawing near. □

William Duckworth ran a custom cabinetmaking shop before he became an assistant editor of Fine Woodworking.

Panel products designed for special jobs

Plywood manufacturers compete to come up with panel products that will serve their customers' needs. The items listed below are among some of the more successful results.

Melamine saves finishing time:

Melamine is a panel whose surface is plastic-impregnated paper fused to a substrate by heat. It's a curse to many woodworkers. They hate its heavy core and sharp edges, but their customers love it because it's easy to clean and maintain. It's well-suited for kitchen and bathroom cabinetry. Melamine is most commonly available with a particleboard core, although Sven Hanson has a source that supplies him with an MDF core. It responds with less chipout and holds edge tape better. A ¾-in. standard sheet, 49 in. by 97 in., costs about \$25.

ApplePly is not apple:

This product was developed in Oregon by States Industries. It's designed to compete with the makers of Baltic- and Finnish-birch panels from Europe. The original versions came in odd sizes (roughly 5 ft. sq.) and were often way out of square and warped. ApplePly cores are made from 1/16-in.-thick western red alder veneers. Seven plies make a 3/8-in.-thick panel and 13 plies make a 3/4-in. panel (face and back are sanded to 1/32 in.). The face is maple or birch. The decorative edge is considered an asset because of the uniformly thin and light-colored veneers. Of the shops surveyed, only Marcus Santora and Janis Melone use it, and they use it for almost everything. I have used it in a 5/8-in. thickness for drawers; the core has no voids, and 1/2-in. screws for slide hardware do not tele-

graph through the other side. A 1/2-in.-thick, 4-ft. by 8-ft. panel costs about \$65.

Three-eighths-inch bending lauan for curves:

Also called wacky wood and wiggle board, 3/8-in. bending lauan was developed for curved work (see the top photo below). It's made from two thick but pliable veneers with a sandwiched sheet of thread-thin cloth between them. It will bend easily to a radius of 3 in. Sales of this product have overcome those of 1/8-in. bending poplar ply, which was the only bendable plywood until this hit the market in 1986. A sheet will run about \$30. —W.D.



Photo: Margaret Seally

Bending lauan for curves. Sven Hanson assembles the core of an apron for a demi-lune gate-leg table.



Melamine for hospital built-ins—These cabinets were built by Jacob Cabinets in Nashville, Tenn.