

Medium Density Fiberboard

**MDF**

*f r o m   s t a r t   t o*  
**FINISH**

COMPOSITE PANEL ASSOCIATION<sup>SM</sup>



# MDF FROM START TO FINISH

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## Fabricating MDF

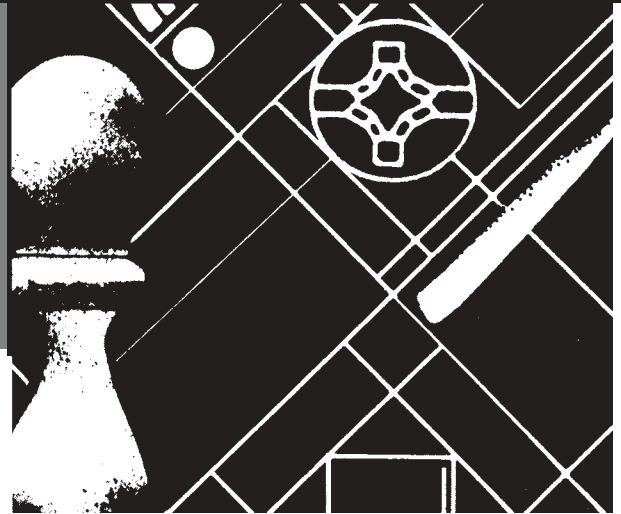
Medium Density Fiberboard (MDF) has been one of the most rapidly growing composite panel products to enter the world market in recent years. The combination of increasing population and decreasing prime timber supply suggests a continuing shift to the use of composite panels, among which MDF offers many advantages.

The surface of MDF is flat, smooth, uniform, dense and free of knots and grain patterns, all of which make finishing operations easier and consistent, especially for demanding uses such as direct printing and thin laminates. The homogeneous edge of MDF allows intricate and precise machining and finishing techniques for superior products, such as stereo cabinets and relieved door fronts and mouldings. Trim waste is significantly reduced when using MDF compared to other substrates. MDF's stability and strength are important assets, with stability contributing to better holding tolerances in cut parts. Its strength allows the parts' size or thickness to be reduced in some instances. MDF is an

excellent substitute for solid wood in many interior applications except when the higher stiffness of solid wood is required.

MDF is made in much the same manner as particleboard with a few important differences. Prior to refining, the wood furnish is "cooked" in a moderate pressure steam vessel (digester). During this step, the wood changes both chemically and physically, becoming less susceptible to the influences of moisture and less brittle as the lignin softens. During the refining step, the wood is "rubbed" apart into fiber bundles instead of being mechanically "broken" apart as in particle preparation. Since the fibers are all basically the same size, they need no screening, but can have the resin binder added directly after refining and/or drying. The most common binder for MDF is urea formaldehyde. Other types of resin can be used to provide special properties such as moisture and fire resistance. The wood-fiber-resin combination is then formed into a homogeneous mat of random fiber orientation and hot pressed, completing the rough manufacture.

Further mill processing steps include sanding, sawing and quality inspection prior to shipment. Many MDF mills also provide cut-to-size or other value-added services for their customers.



# Sanding

Most uses of MDF require a flat, smooth surface of uniform caliper which is attained through sanding. Manufacturers of MDF use multiple-head, widebelt sanders to prefinish their panels and maintain a caliper of  $\pm 0.005$ " (inches) or better.

Panels are generally available with 100, 120 or 150 grit finishes, and sanded to  $\pm .005$ " variation or less for first grade industrial board. Different uses and finishes may require finer sanding.

The homogeneity of MDF offers many advantages for edge and surface finishing operations. Sanding and machining operations generate fine resin-coated particles of wood dust. MDF manufacturers recommend using efficient, relatively high air volume dust removal systems to prevent dust buildup. Such systems insure compliance with workplace air quality standards, and remove loose particles from the surface to prevent scratching and streaking. Some major coated abrasive manufacturers produce special anti-static treated sander belts to help reduce airborne dust particles and dust build-up on panel surfaces.

Most common overlays can be put on MDF with no further sanding at the layup site. Cleaning is important, however. Finishes requiring extreme smoothness, such as direct printing or very thin films, may require extra touching with 150 to 400 grit belts. Belt speeds in excess of 5000 surface feet per minute (SFPM) are most desirable for fine finishing. Direct grain prints, thin paper laminates, films, foils or paints are the most demanding of surface quality. Boards with less than  $\pm .005$ " variation in thickness and at least 120 grit finish will perform well in these applications. The factory surface usually provides

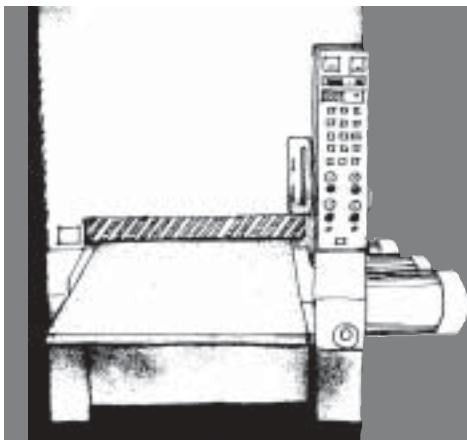
excellent adhesion for either wet or dry glue lines without further sanding. In some cases, scuff-sanding can be detrimental to glue bond quality.

Belts with resin-bonded, synthetic abrasives on medium to heavy-weight cotton or synthetic backings have proven most cost efficient for sanding MDF. Zirconia alumina and ceramic aluminum oxide are preferred for primary heads while silicon carbide is preferred for secondary and finish heads. Other abrasives may be useful for certain applications.

Technical advances in aluminum oxide products have resulted in their increased usage in a wide grit range. Aluminum oxide belts dull rapidly but the burnishing effect that results when sanding MDF is sometimes desirable. Closed-coat aluminum oxide cloth belts are generally in the 100 to 220 grit range.

Resin-bonded belts resist degradation from heat, moisture, and loading better than the old glue-bonded belts, especially with very dense or hard-surfaced boards. The choice of "open" vs. "closed" coated belts depends on the finish required, grit size, dust removal capacity, belt speeds, feed speeds, and board characteristics. "Modified closed coat" is normally used in MDF manufacture to minimize the loading or filling tendencies.

Good care and storage of belts and board are essential. Heavy, one-sided sanding should be avoided to prevent warp. Communication of customer requirements with MDF manufacturers and equipment suppliers is the best way to obtain optimal sanding results.



## Machining

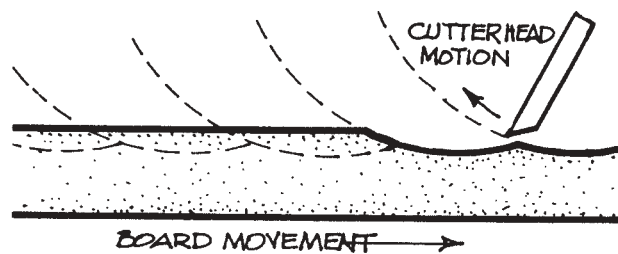
With the proper selection of equipment and cutting tools, MDF can be machined into intricate patterns as easily as natural wood. The homogeneous nature of MDF results in clean, sharp reproduction of designs free from fuzzing or chip-out, provided properly designed carbide, ceramic and other composite materials, or diamond tools are used.

Because MDF is made with different wood species, types and amounts of binders, and is available in different densities, the design and machining of products should consider these variables. Good planning can result in substantial savings in material and labor during subsequent finishing steps. It is strongly recommended that only the highest quality cutting tools be used on MDF since it is generally denser than most natural woods and contains thermosetting resins which are abrasive. Most tool manufacturers are knowledgeable in MDF fabrication and have tools designed specifically for MDF.

Sawing MDF generates fine dust, and tablesaws should be connected to a vacuum system. Individuals working with wood products on the job or in the home shop should wear at minimum the following safety equipment: a half-mask respirator (filter) that is NIOSH approved and has a HEPA filter rating printed on the package, side-shielded safety glasses, a long-sleeve shirt and gloves.

### EDGE SHAPING & ROUTING

One of the advantages of MDF is its sharp, clean edge-machining with minimal treatment prior to finishing. Edge-banding or mouldings can be eliminated with the right finishes, and MDF can be



WASHBOARD  
CUTTER EFFECT

machined to configurations similar to natural wood. Several contoured designs used by a cabinet manufacturer are illustrated on page six.

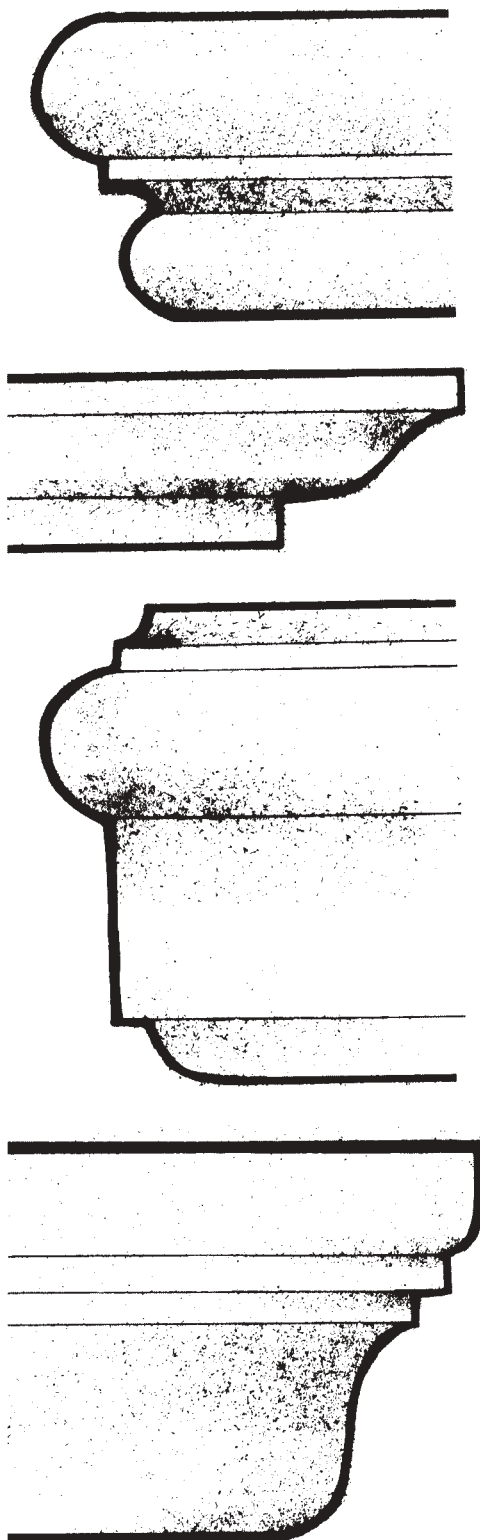
Feathered or sharp, protruding edges should be avoided. Tooling angles are generally greater for MDF than for natural wood, with hook or rake angles between 10 and 25 degrees, depending on the board and design. Face shear angles are usually 10 degrees. Proper tool mounting and balance, and minimal shaft vibration and sleeve wear are important.

Some manufacturers find that tooling angles of 5 to 15 degrees with a back clearance of .040" to .060" (5/32 carbide) produce better results and tool life. Mounting profile cutterheads at angles of 30 degrees to 45 degrees also extends tool life.

The illustration above shows the "washboard" effect in a typical shaping operation, and how the surface develops. The curves indicate the actual path taken by the knife tips as the cutterhead moves forward creating a wave-like surface.

On most woodworking machines the cutterhead is stationary while the workpiece moves past it. However, the washboard effect may also be observed on machines with moving cutterheads. If the feedspeed is slow or if there are many knives in the cutterhead, then the ridges will hardly be visible. When feedspeeds are fast or when the cutterhead has few knives or rotates slowly, ridges will be farther apart and can be large enough to be objectionable.

A good shaping job needing only a minimum of sanding will require at least 20 cuts per inch for MDF, compared to the generally accepted 16 cuts per



EDGE SHAPES

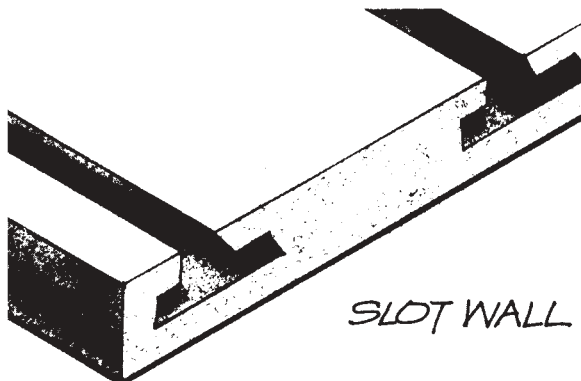
inch for natural wood. The number of cuts depends on the feedspeed of the machine, the rotational speed of the cutterhead and the number of knives in the cutterhead.

Designs requiring heavy stock removal or intricate shaping may require rough-cutting or hogging of excess wood prior to final shaping for increased tool life and improved edges.

However, enough material must be left for the final cut to produce "chips" and reduce dust. This will prevent burning and reduce tool wear. Dust removal is very important.

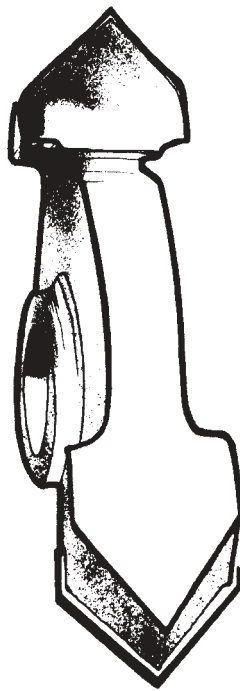
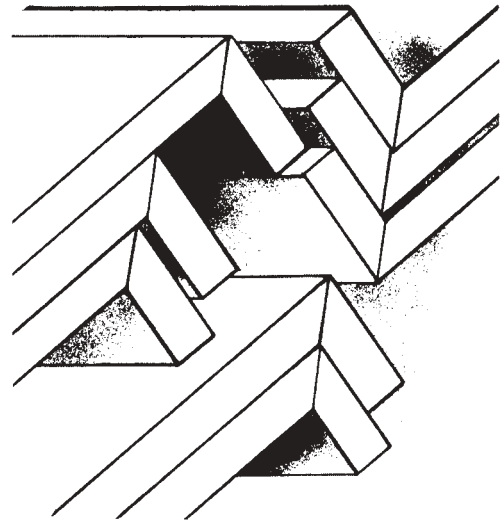
Pin-routing is done with small bits of solid carbide. Heat build up should be avoided, as it can lead to poor machining quality or tool breakage. It is caused by improper dust removal, dull or improperly designed tools, or improper feedspeed. Good cooling and dust removal are necessary to prevent this. Small air jets to the bit, open grid worktables and efficient removal of fine router dust can improve cut quality and bit life. Tougher carbide bits (less than 1/4"), turning up to 23,000 RPM, require different hook angles.

Using ammeters is the preferred way to measure tool dulling. A 10% or greater increase in amp load usually indicates the tools should be changed. Besides preventing heat buildup and subsequent damage, the ammeter also prevents premature production interruptions from sharpening tools too early.



SLOT WALL

## MITERED JOINTS



MITER CUTTING BLADE

### SHAPER CUTTERS

Hook	15 Degrees
O.D. Clearance	20-22 Degrees
R.P.M.	3600/7200
No. Wings Manual Feed	Minimum 3
No. Wings Power Feed	Minimum 4
Carbine Type	PWX
Face Shear	10 Degrees

### MITER-FOLDING

MDF's close tolerances and clean cuts are well-suited to precise miter-folding of vinyl-covered panels. Applications other than simple rectangular "V" folding require extreme accuracy, clean cutting and low tool wear to maintain original contours.

### RECOMMENDED ALLOWABLE SPEED FOR ACHIEVING SURFACE SMOOTHNESS

Cutting Knives	Maximum Feedspeed at Various Cutterhead Speeds		
	3600 RPM	5000 RPM	7200 RPM
1	15 FPM	21 FPM	30 FPM
2	30 FPM	42 FPM	60 FPM
3	45 FPM	63 FPM	90 FPM
4	60 FPM	84 FPM	120 FPM
6	90 FPM	126 FPM	180 FPM

(20 ridges per lineal inch)



## DIAMOND TOOLING

Diamond-tipped cutting tools and saws can replace tungsten carbide tools for some uses. Diamond tools are up to 125 times more wear resistant than carbide. Even with the higher initial cost of diamond tools, they can still be cost effective due to longer tool life, and when used for long runs of mass-produced parts with intricate designs. They have long life between sharpenings, allow for faster speeds, maintain original contours, and can provide a finer, smoother finish than carbide tools.

Diamond tools are brittle and should be used with board products that are free of rocks and metal. MDF works well with diamond tools and saws because of its homogeneous, clean cutting, and rock/metal free characteristics.

Consult your tool suppliers for more information about diamond tools and other tools such as ceramic and ferricide.

## DIE CUTTING

Steel rule dies are often used to cut large quantities of replicate parts from thinner MDFs. The uniform density, stability and high strength of these thinner MDFs offer an alternate material and potential savings to fabricators and users of die cut parts in furniture, automotive and other industries.

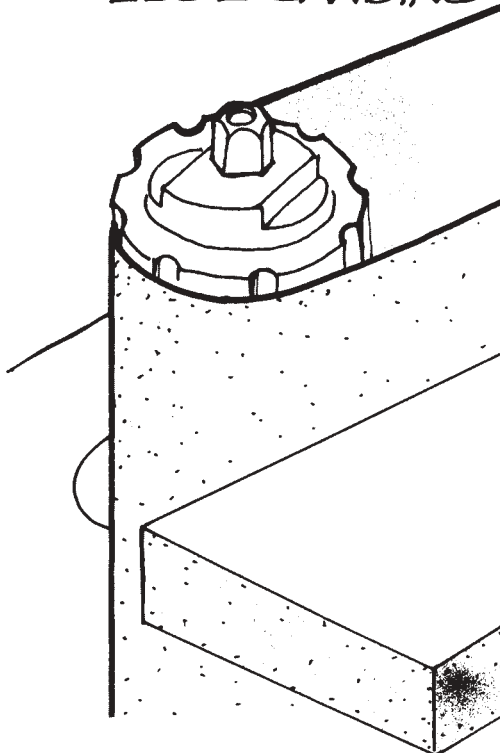
## EDGE-SANDING

Shaping MDF produces a surface that is a series of small ridges, and it is often necessary to sand afterwards. The sanding direction may be important to the final finish. Hand or belt mold-sanding are common. One method uses cut-to-contour abrasive-impregnated plastic wheels—usually an 80 grit garnet or silicon carbide in polyurethane. These wheels are only aids to better shaping and cannot correct a poor initial shaping job.

Each manufacturer's wheel is slightly different, and various levels of performance can be anticipated. The following are suggestions for improved results:

1. The carbide cutter and not the abrasive wheel determines the ultimate shape of the profile. Therefore, the cutter should be kept in excellent condition. Under no circumstances can the abrasive wheel be expected to clean up areas not properly machined within the profile.
2. The spindle shaft should be 90 degrees to the work table surface.
3. If chatter marks are evident in the sanded board look for:
  - a. Operator error feeding the board across the wheel.
  - b. Wheel out-of-round. This usually happens because of uneven pressures exerted by the operator. Variations in board density can also cause this condition.
  - c. Spindle shaft not 90 degrees to the work table surface, or the shaft is wobbling.
  - d. Speed too low.
4. The wheel should be at least 1/4" thicker than the material being sanded.

EDGE SANDING



# Sawing

Abrasive wheels have been most effectively used on irregular shapes. Belt mold sanders have been most effectively used on profile shapes that are straight cut.

Profile shapes that can be completely sanded on one sanding block are preferred because two belt sequences (100-150 grit and 120-180 grit) can be used.

"Scotchbrite®" abrasive pads and discs, "flap sander" wheels and similar systems are also used for edge sanding. The systems vary with end use, mechanization and equipment; finish manufacturers can provide consultation for individual needs. Some users claim that spool sanding gives the fastest cut and best finish for contoured edges and is the least costly when used by a skilled operator. The abrasives are also slotted to conform to the edge shape. Spindle speeds of 800-1750 RPM and grits of 100 to 120 are most popular.

Automated edging machines are available to do the complete job, from shaping to final finishing. Machines are made for both wet and dry finish application.

The matching of machinery and tooling to plant production and quality requirements is essential and becomes increasingly critical as a product nears completion. Blade rotation speed, tooth design, feed rate, and chip load per tooth must be matched to help prevent chip-out, tear out and decreased tool life. Grit, resin content, wood species and density of MDF also affect saw life. Use of carbide-tipped tools is highly recommended for sawing MDF.

Heat buildup is the greatest cause of wear and poor finishing. Changing tools often, cooling, and removing dust with sufficient air are the keys to reducing heat buildup. This assumes that board quality, density and feed speeds are consistent.

In comparison with natural wood, MDF requires tools designed with higher clearance angles, increased hook angles and increased tooth approach angles. The recommended chipload is .003" to .013", and is defined as the measure of lineal stock removed per cutting edge or tooth, and is calculated as shown in the chart at right.

## SAWS & DADO HEADS

Some users believe that saw life is extended and heat buildup reduced using hook angles of 20 to 30 degrees and clearance angles closer to 10 degrees.

For cutting MDF with an applied finish, an alternate 5 degree face bevel and 15 degree top bevel has worked well. Adding a raker every fifth tooth to this combination also works well on overlaid and veneered MDF. For shop or table saw use, an all-purpose combination 50-60 tooth, 10" blade is recommended. The "triple chip" design combines a satisfactory cut edge with increased saw life.

Saw life is enhanced by reduced cutting pressures, generally by use of alternate face bevels and reduction of kerf width. These measures may affect cut quality and may significantly reduce noise levels. Although lowering feed speeds will also reduce cutting pressure, too low a speed will result in edge-burning of the cut, heating, or even burning of the blade and reduced saw life. Feed speeds and chip load per tooth must be maintained within recognized limits of the wood and equipment.

All sawing equipment must be well maintained and kept clean to assure cutting quality. Excessive blade run-out, arbor misalignment and wobble, dirty collars,

malfunctioning holddowns, worn or improper throat plates and uneven feed pressures and/or speeds can have adverse effects.

For polyester and low pressure melamine overlays, large carbide saw suppliers suggest the following guide for the best cutting of overlaid softwood MDF (this is also good for veneered panels).

- Raker every 5th tooth.
- Alternate 5 degree face bevel.
- Alternate 15 degree top bevel.
- 120-tooth 18" saw to 100-tooth 14" saw.
- Speed 3450 to 4200 RPM.

## TYPICAL SPECIFICATIONS FOR SAW AND DADO HEADS

Chip Load/Tooth .003/.005

Radial Clearance 1-2 degrees

Side Clearance 3-4 degrees

Tip to Body .035-.040

O.D. Clearance 20-22 degrees

Hook Angle 15 deg. [radial arm 5 deg.]

Carbide Type PWX

Clearance Angle 15 degrees

$CL = LS \times K / RPM \times CE$

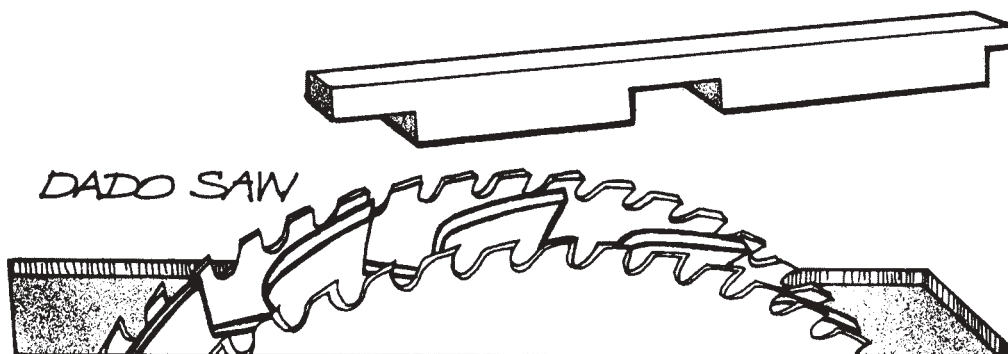
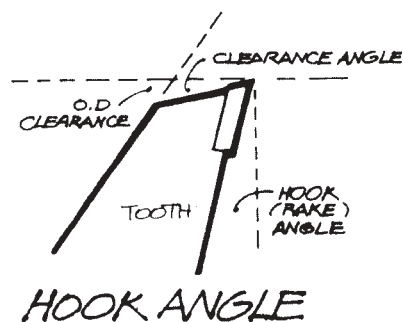
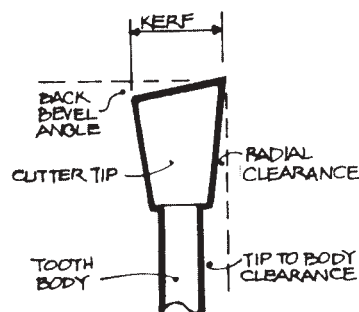
LS = Line Speed or Feed Rate [Ft./Min.]

RPM = Rotation Speed [Rev./Min.]

CE = Cutting Edge [Number of teeth]

K = Conversion factor/minute [12 inches/Ft.]

CL = Chip Load [Inch/cutting edge]



MDF is increasingly being used as a substrate in 3-ply hardwood-veneer "plywood" due to its edge-smoothness, freedom from "telegraphing," and ease of layup compared with typical veneer core panels. Much of this goes to cabinet shops.

Some further recommendations for proper cutting of overlaid panels are listed below. These are intended for a 10" circular table saw blade with 60 teeth at 3600 RPM, a feed rate of 36 feet/minute, and a rim speed of 9,425 feet/minute:



*GANG SET-UP*

## SAWING RECOMMENDATIONS

1. For smooth cuts, with little chip-out and good saw life, use:
  - a. alternate top bevel teeth (15 degrees).
  - b. positive hook (10 degrees).
  - c. 5-degree side clearance.
  - d. 10-degree outside diameter clearance.
  - e. low approach angle (blade projecting 1/2" or less through top of material).
2. For smoother cuts, and less chip-out, but decreased saw life and/or higher initial costs, use a 15-degree top bevel blade and:
  - a. alternate face bevel (10 degrees), hollow ground, or high angle (25 degrees or greater) alternate top bevel.
  - b. increased positive hook (15 degrees).
  - c. increased side clearance.
  - d. increased number of teeth (80).
3. The following will improve the smoothness of cut and reduce chip-out without increasing saw maintenance costs:
  - a. increased rpm and/or rim speed.
  - b. decreased feed speed.
  - c. greater tooth approach angle (blade barely projecting through the surface of the work).
4. For longer saw life, but rougher cuts and more chip-out, use:
  - a. flat top teeth (longest life) or triple chip teeth.
  - b. negative hook or reduced positive hook.
  - c. heavier body blade.
  - d. low outside diameter clearance.
  - e. decreased tooth approach angle (blade raised to highest position).
5. In all instances, the following are important:
  - a. absence of vibration due to:
    - Poor hold downs.
    - Loose nuts.
    - Worn bearings or sleeves.
    - Worn throat plates.
  - b. clean collars.
  - c. smooth "run-out" (no wobble).
  - d. low outside diameter clearance.
  - e. sharp, properly ground teeth.

Remember, a portable "Skil" type saw will chip the upper side of the panel when cut, while a table or hand saw will chip the bottom edge of the cut. A radial-arm saw also chips the bottom side and should have a low hook angle on the teeth for MDF.

# Fastening

Many different fastening systems are currently used for assembling MDF components into finished products. When choosing a system, consider board properties, product type and quality, and stresses each component must withstand.

The excellent machinability and uniformity of MDF allows use of many conventional wood joinery techniques as well as mechanical fasteners. Faces of MDF are generally more dense than the core, hence the design of joints and hardware should reflect this. Continuing R&D is improving existing fastening techniques and hardware. Some types are specially designed for use with MDF.

Wood joints that are suitable for MDF include the tenon, dowel, butt, miter, rabbet, dovetail, dado and finger joints. For greater strength, joints should be designed and machined to utilize as much of the board's outer surface as possible. For example, tenons should be machined off-center and finger joints should be normal to the surface. Typical assembly methods include the use of glues, nails, and staples to add strength and immobilize the assembled work. An excellent description of various methods is included in the CPA Technical Bulletins, *Adhesive Based Corner Joints* and *Mechanical Based Corner Joints*.

## GLUES

Many different adhesives are used in cold-set component assembly, including epoxy, urea-formaldehyde (UF), hot melt, polyvinyl acetate (PVA) and modified PVAs. Epoxy resins have found limited use with MDF, except in vinyl overlays, primarily due to their higher cost. Among hot melts, the polyamides work quite well; these should be carefully selected. Studies of PVA butt joints have shown that the cured glue-line can be stronger than the board itself. Board moisture content should be between 4% and 8% for the most effective gluing.

Continuing R&D by adhesive manufacturers is producing new and improved glues. The urethane-modified PVA glues (slightly yellow) are especially good with MDF, as are the casein-latex types. Isocyanate manufacturers are also developing cold-set formulas for component assembly.

## DOWELS

The use of dowels in fastening parts made from MDF is becoming more common. Spiral grooved or multigrooved dowels are generally preferred over plain dowels, since they allow air to escape from the dowel holes. Holding strength is proportional to depth of dowel penetration. Face pullout strength of dowels is closely related to internal bond strength of MDF panels. Edge strength is related to internal bond only in the probability of splitting along the edge if the hole and dowel size are improperly matched.

Holes in the edges should be 0.005" oversize to prevent the sides from splitting as the dowel is inserted. Holes in the face can be exact or slightly undersize (to 0.004").

When possible, glue should be applied to both the hole and the dowel. Strength increases with the dowel diameter but the dowel should never be greater than 50% of the panel thickness.

## SCREWS

The use of pilot holes is strongly recommended for MDF applications requiring screws. Pilot holes are required when drilling into the edge. Pilot holes should be between 85% to 90% of the root-diameter of the selected screw and drilled to a depth equal to or slightly more than the screw's driven length, especially on the edges. A slight counter-sink may be necessary to prevent pyramiding under flush mounted hardware. To prevent stripping, screws should not be overtightened and the hole must be properly sized. Recommended pilot hole sizes for screws are listed in the accompanying chart.

Drilling clean, accurate holes with sharp drills will enhance the pull strength. This requires a drill operating at a minimum of 3000 RPM. Untapered (sheet metal) screws with constant size shank are superior to tapered wood screws. Wood screws are not recommended for MDF. Special MDF screws have been developed. These are straight shank screws with a small root diameter and a widely spaced "aggressive" thread pattern. Three sub-types of screws have been developed to accommodate different densities of boards or to meet a particular clamp load.





PARTICLEBOARD  
SCREW  
-ASYMMETRICAL  
THREAD

## SCREW HOLDING VALUES FOR WOOD

	Face	Edge	Combined
Western red cedar	285	295	290
Western hemlock	320	320	325
White fir	275	285	280
MDF 3/4"*	325±	250+	300
Douglas fir	350	385	365
Ponderosa pine	305	370	340
Fir plywood	366	318	342
Red oak	656	657	657
Red alder	582	462	522
Black walnut	622	554	598
Black cherry	815	824	820

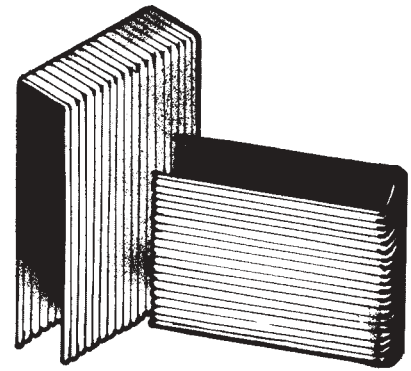
\* ANSI A208.2 Grade MD

## MINIMAL SCREW PULL VALUES - ANSI A208.2 GRADE MD

Minimums Required for MDF	Face	Edge
Board ≤ 0.825"	325 lbs.	250 lbs.
Board > 0.825"	300 lbs.	225 lbs.

## MDF PILOT HOLE SIZE RECOMMENDATIONS

Screw No.	Pilot Hole Drill Gauge No.	Hole Diameter (inches)
0	66	0.033
1	57	0.043
2	54	0.055
3	53	0.059
4	51	0.067
5	47	0.078
6	44	0.086
7	39	0.099
8	35	.0110
9	33	0.113
10	31	0.120
11	29	0.136
12	25	0.149
14	14	0.182
16	10	0.193
18	6	0.204
20	3	0.213



Screw holding strength increases more with depth than with diameter of the screw shank. If a choice is available, use a longer screw for more strength, particularly on the edges. Holding power increases with increased panel density.

MDF panels hold screws as well as many natural woods. The ANSI minimum values for face and edge screw pull on 3/4" MDF are listed to the left, along with some typical values for wood with the same #10 AB sheet metal screw. Most MDF manufacturers exceed these minimums by several pounds.

Because of its good screw holding and gluing properties, MDF is widely used as stile and rail material in flush doors, replacing more expensive clear, natural wood. These frame parts are "ripped and flipped" to use the board face as the door edge, which gives better screw holding and dimensional stability qualities to the door edge.

## NAILS OR STAPLES

Nails or staples may also be used to fasten a joint, often in conjunction with glue. A fairly common occurrence in MDF edge stapling and nailing is splitting in a plane parallel to the surface. The use of a fine wire gauge nail or staple will generally alleviate this problem. For example, on 3/8" drawer sides assembly, a fine wire 11/16" Haubold 40-29 or 40-18 coated staple and a Senco JN5 or 3/8" LN 2532 are fasteners that have produced good results without edge splitting. Wire gauges should be 14 and under for edge stapling. Legs should be inserted at an angle to the face, not on the same plane.

Coated staples hold better than smooth staples. Proper air pressure on the gun is important to control penetration and holding power. Staples should not be driven within 3/4 inch of any corner. For surface applications, larger wire gauges should be used. Nails and staples should be driven at right angles to the surface, otherwise they may bend due to deflection of the points. Tools should be adjusted to drive the staple just flush with the surface. Excessive pressure produces objectionable tool marks or splitting.

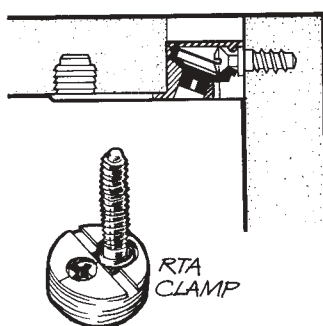


# Laminating & Finishing MDF

Nails should not be driven within 3/4 inch of any corner, and ring-shank nails should be used to avoid fiber raising around the nail head. Do not use ordinary smooth finish nails. While not known for its nail-holding ability, MDF performs well in many uses. Test results, comparing nail-pulling to pins, were comparable for MDF and Douglas fir plywood. The following results are given in pounds of force required to produce failure by pullout.

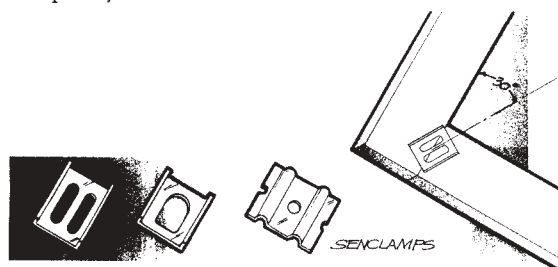
## COMPARISON OF NAIL-HOLDING ABILITY

	5/8" fir Plywood	11/16" MDF
Smooth small pin 3" X 0.120"	93	101
Large pin 4.25" X 0.162"	64	59



## CLAMPS AND OTHER FASTENERS

A wide variety of special fasteners, designed for use with MDF, are available. Many of these are clamp type for use with Ready-to-Assemble (RTA) furniture/cabinets. Clamp type fasteners are specially designed for strength and appearance but may also be completely concealed.



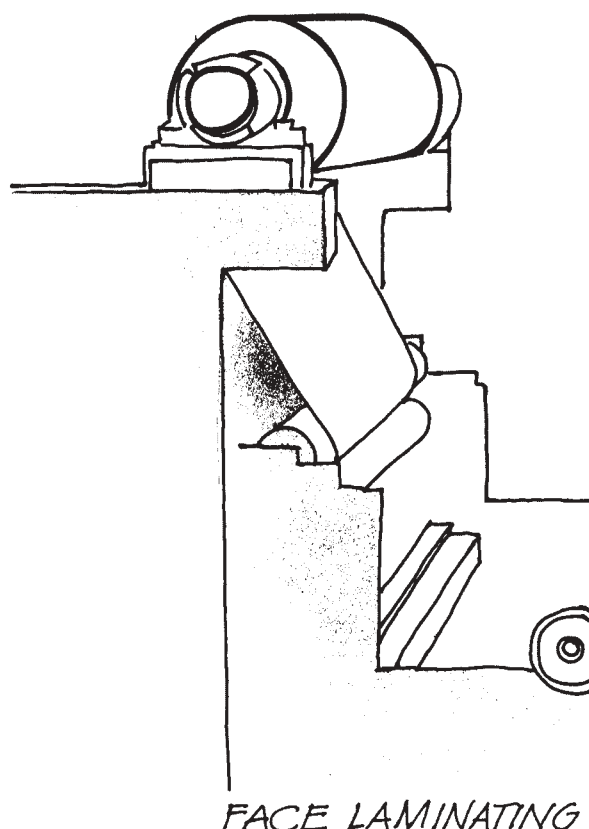
Another method of fastening MDF corners and butt joints is the "Senclamp" type fastener, which can be used with or without glue.

For a more thorough discussion of fasteners, see CPA's Technical Bulletin, *Mechanical Based Corner Joints*.

MDF has become a premier substrate for wood veneer, vinyl films, low and intermediate basis weight papers, resin-saturated papers and heat transfer foils. MDF's smooth surface, edge-finishing qualities, dimensional stability, flatness, close tolerances, dent-resistance, lower glue usage requirements, and lack of grain-telegraphing have contributed to its wide acceptance. Good bond strength, screw-holding, and resistance to compression and warp also make MDF an ideal substrate.

## Faces

Many properties of MDF make it desirable as a substrate for laminates and overlays, the most important of which is its face and edge qualities. As veneers and papers have become thinner, substrate quality is more important.



FACE LAMINATING

## LOW PRESSURE LAMINATES

MDF works well as a substrate for LPL papers-melamines, polyesters and phenolics. Uniform density, smoothness, and caliper are prime requisites. The so-called "quick-cycle" melamines are particularly demanding of good corestock in large sizes because of the higher press temperatures, short press times, and brittleness of the papers. Melamines are noted for their hardness, scratch-resistance, and color stability. Polyester papers in general are more wear-resistant, tougher, less brittle, easier to handle and store, and less demanding in processing. Phenolic impregnated papers are primarily used as backer sheets or where plain, solid colors are applied. The physical properties of low pressure laminates will vary with the manufacturer, percentage of resin, weight and quality of paper, and the laminating conditions in the plant. In addition, some press manufacturers offer continuous hot-presses for application of low pressure laminates.

With a well sanded surface and proper moisture control, MDF shows almost no telegraphing of wood particles. The smooth, hard surface supports and adheres evenly to the film, resists dents and damage, and resists compression in a secondary pressing operation. Because MDF is usually bonded with urea-formaldehyde (UF) resins, secondary pressing conditions are important to control bond degradation, excessive warp, blows, compression, and moisture in the finished panels. This is particularly important if phenolic or high temperature melamine papers are applied. Some MDF products use special adhesives that are not susceptible to degradation during laminating. With higher platen or press temperatures, the faster the press cycle the better. Heat is needed only at the face to fuse the resin. Deep penetration of heat into the panels is undesirable.

Problems that occur with excessive heat include:

1. Panels tend to compress more and vary in caliper.
2. Blows may occur, especially with thin panels.
3. Warp may increase.
4. UF bonded boards tend to degrade in bond strength.
5. Papers tend to precure.

High press temperatures can cause precuring of saturated papers and increased warp. Hence, press loading, closing, and unloading times are very

important. In addition, old papers and inadequate caul cooling can cause precure problems. Phenolics and melamines require a higher temperature than polyesters to bond properly.

## MELAMINE

temperature:	300 to 315 degrees F (149 to 158 degrees C)
time:	25 to 60 seconds plus degassing time and close time
pressure:	300 to 350 psi (2069 to 2413 kPa)

## HIGH DENSITY PHENOLIC

temperature:	290 to 310 degrees F (143 to 155 degrees C)
time:	210 to 240 seconds, plus degassing time and close time
pressure:	175 to 210 psi (1260 to 1450 kPa)

## POLYESTER (RANGE)

temperature:	280 to 335 degrees F (138 to 168 degrees C)
time:	50 to 220 seconds, plus degassing time and close time
pressure:	175 to 225 psi (1207 to 1550 kPa)

## POLYESTER (IDEAL)

temperature:	300 to 320 degrees F (149 to 160 degrees C)
time:	60 to 90 seconds, plus degassing time and close time
pressure:	185 psi (1276 kPa)

The above conditions apply when both sides are similar papers. If the backer sheet is slower curing, like a phenolic, then the slower of the two papers will determine the press conditions. Hence, difficulties may occur with different face and back papers. Light phenolics may be cured at 330 degrees F (165 degrees C) in 90 to 120 seconds with good equipment. Precure is reduced by better matching with other overlays.

## PANEL MOISTURE

Panel moisture content should not be more than 6 to 7 percent for good laminating. Saturated papers are such good vapor barriers that little moisture



escapes throughout the surfaces during pressing. Conversely, after pressing they provide resistance to moisture entering the panel. High moisture content may contribute to bond-degradation, so shipping and storage conditions are important. High moisture in the papers can also be a problem. Very low humidity in uncontrolled storerooms causes dryout, brittleness, and poor paper fusion by precuring the resins.

Papers, plant conditions, cauls and equipment all may differ radically from mill to mill. Cauls may vary from steel to aluminum to melamine sheets and may be hung in the press or inserted with the panels. Some mills use soft compressible sheets behind cauls to absorb platen defects; some use cauls on one side only. Some mills use heavy, embossed release papers, or embossed cauls to achieve greater realism for wood grains. Cauls can influence cure, appearance, handling, and grade-out of the final product. Caul temperature, finish and cleanliness are very important.

## FLATNESS

Ensuring flatness and preventing warp are important to laminate users. These factors are important in controlling warp:

1. Buy flat panels and stack new board flat with proper support.
2. Store panels and laminates under reasonably uniform, protected warehouse conditions; avoid extremes of temperature and humidity.
3. Balance the overlay sheets properly by type, weight, etc. Be sure they are evenly conditioned. The ideal is 70 ( $\pm$  5) degrees F and 35% ( $\pm$  5%) relative humidity for one week.
4. Load and close the press as quickly as possible. Use cooled cauls on the bottom side when they are used for panel insertion.
5. Don't let the finished panels sit on the platens or hot cauls very long in the open press before unloading.
6. Stack hot boards flat and well-supported while cooling in small, covered piles, and allow them to cool to 120 degrees F or less before sawing. If available, use conveyor cooling, with all panels exposed on both sides for even cooling.
7. Don't press any longer or hotter than necessary.
8. Use as few openings in a press as possible; too many openings tend to increase precure by slowing the closing time.

9. Be sure the grain and machine direction of the paper run the same way on both sides.
10. Retain adequate volatiles in the paper; be sure they are not over aged and dried out.
11. Be sure the press conditions are set to adequately cure both sides when using different papers. Utilize uniform press temperatures for both top and bottom platens.

Warping can be caused by many things besides the substrate. The linear change in papers and plastics is often greater than the movement of MDF under similar conditions. For more information on preventing warp in laminated panels, see CPA's Technical Bulletin *Warp in Laminated Particleboard and MDF*.

## VENEER OVERLAYS

MDF can replace veneer core in many applications. This is mainly because of its smooth edge, routability, lower glue requirements, ease of layup, and less downgrade. Thin, expensive veneers need not be cross-banded, and show-through is virtually eliminated; veneers as thin as 1/50 to 1/80 inch (0.5mm) can be used successfully. Veneered MDF panels are generally flatter but heavier than veneer core plywood. The weight is not a problem in small, cut-to-size uses and gives the feeling of heavy, solid hardwood to furniture and cabinets. Balanced construction is essential to good performance.

The main advantages of MDF core for these high quality industrial panels are similar to those for low pressure laminates:

1. A flatter panel, in most cases, than veneer core plywood.
2. Consistent quality core for good bonds, even glue absorption, and resistance to compression.
3. Less glue usage and higher labor productivity in lay-ups.
4. Less downfall from mislays, sand-through, corelaps, mistrims, and grain telegraph.
5. More uniform caliper and moisture content in the finished panel.
6. Use of thinner veneers and no cross-bands, with less sand-through and less bleed-through due to lighter glue spreads.
7. Shorter press times due to less glue, uniform thickness, no inside gluelines.
8. Improved routability, and edge-finishing compared with cross-lapped veneer.



VENEERS

Long hot press times are also detrimental to the core panels when laminating with veneers. The time to cure the two applied gluelines is all that is necessary. Conditions will vary seasonally and among mills but a general statement for average press conditions is as follows:

**Using 1/28" (0.9 mm) Birch Veneer and UF Glues**

glue spread:	60-70 lbs/MDGL (0.30 kg/m <sup>2</sup> 2sides)
press temperature:	240 degrees-250 degrees F(115 degrees-121 degrees C)
press time:	2 1/2 to 3 minutes
pressure:	150 to 175 psi (1034 to 1207 kPa)
Board m.c:	6% ± 2%

The result will be a well-bonded, acceptably flat-panel if properly balanced and stored before and after pressing. The finished panel is usually very stable, and checking of face veneers after layup is almost non-existent.

**WARP**

Warp is seldom a problem with MDF substrates when care is taken. Common causes of warp are:

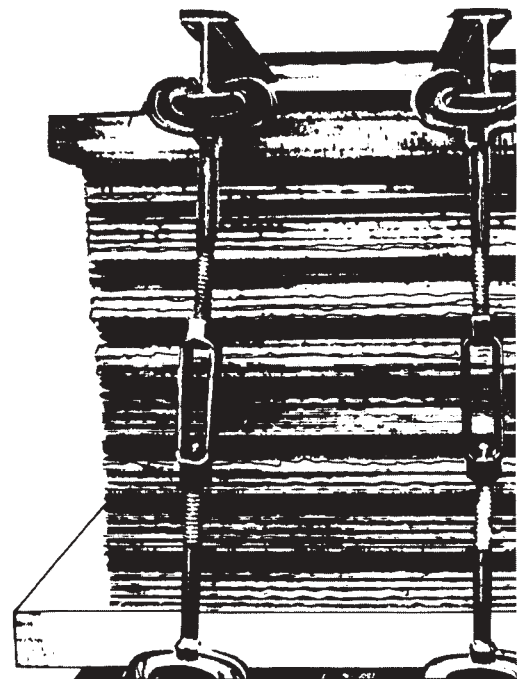
1. A very thin core with thick face veneers.
2. Poor stacking of panels before and after pressing.
3. Unbalanced glue spreads on the two sides of the core.
4. Too heavy a glue spread or too low glue solids content.
5. Inadequate cure of the glue in the hot-press
6. Overdrying in the press before, during or after pressing.
7. Too slow loading or unloading of the press.
8. Pressing two thin panels in one opening.

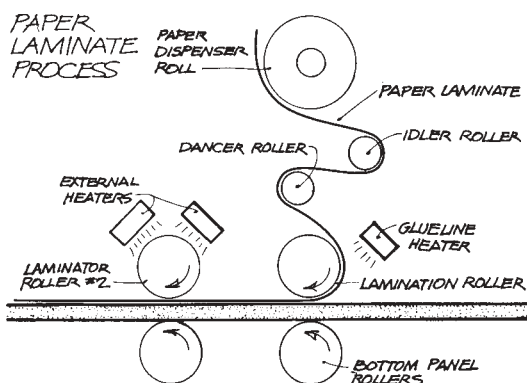
9. Uneven heating of platens within or between openings.
10. Different moisture contents, species, density or thickness of face veneers which unbalance the panels.
11. Veneers containing stress wood such as cross-grain, burls, and tension wood produce twist on drying.
12. Unbalanced sanding—leaving a non-balanced panel when finished.
13. Unpiling and sawing board before adequate cooling.

**COLD PRESSING**

Cold pressing veneers to MDF is common on small, custom-made parts. This is generally done in small batches using contact cements, polyvinyl or casein-latex glues. Each operation is special. Clamp times as low as 5-10 minutes are possible, but adequate set time is essential before machining. These same techniques apply when using high-pressure laminate overlays on MDF with cold glues, but set times under pressure are usually longer because of slower moisture evaporation. Thin, flexible veneering and paper wrapping of moulding and trim are growing in popularity and are discussed elsewhere. Cross-linked isocyanate resins are also being used with success in cold laminating on MDF.

Any high value overlaid panel must be carefully handled in cutting. (See section on Machining and Sawing.) Again, production volumes require high quality saws and tools for MDF.





## STRENGTH PROPERTIES

Strength properties of MDF increase when veneer faces are added. Stiffness and MOR values may approach solid wood with proper construction, and MDF performs well in such demanding uses as library shelving. (Unfinished MDF is only about 1/3 to 1/4 as stiff as solid wood of the same thickness.) Only panels constructed with hot-pressed rigid (thermosetting) resins in conjunction with high pressure laminates or veneers provide this extra strength. PVA and contact glues or thin overlay films are too flexible to give much improvement. Paper overlays do not improve these properties as much as wood veneer or high pressure laminates (HPL) (see Appendix 4), but they do add some stiffness.

Technical bulletins on shelf systems, dimensional stability and warp in laminated particleboard and MDF are available from CPA.

## FILM LAMINATING

Smooth surfaces, uniform caliper, good gluing qualities, and fiber integrity are essential to laminating dry foils, thin papers and vinyls to MDF. Stability, flatness, bond strength, and bending strength are also important, if the end-products are narrow strips or mouldings.

"Hot stamp" or "heat transfer" films are popular finishes for MDF, particularly for the edges. Little surface preparation is required beyond good, smooth sanding (150 grit). Several companies are marketing the foils and machines for application to MDF parts. MDF is a particularly good substrate for this use.

The basic principle of this system is a plastic film to which several layers of thermoplastic coatings have been applied. This allows the transfer of the coating from the film to the board in one operation by the use of proper heat and pressure. A release coat on the carrier film facilitates the transfer of the decorative coating. As many as 10 layers of coatings are on the carrier film, so proper machine conditions are imperative. Some systems allow coating of the basic print after transfer to the board to provide heavier film build, print protection and sheen-matching.

Large-panel and edge-finishing machines are available. Other companies supply films. For suitable adhesion most suppliers recommend pre-sanding with at least 150 to 180 grit. However, good results have been obtained on 120 grit production MDF surfaces. The maximum application temperature is about 400 degrees F.

## ADVANTAGES OF FILM LAMINATING

1. No air-polluting solvents.
2. Low energy usage.
3. Excellent print fidelity.
4. Fewer rejects and easier reclaim.
5. Less skilled labor needs.
6. Safety improvement and reduced insurance.
7. More compact floor space. Edge and face can be completed in one pass.
8. Lower initial investment in equipment.
9. Ease of cleanup and color changes on machines (no over spray.)
10. Long shelf life in storage of the films.
11. Filling normally not required on MDF.

## DISADVANTAGES OF FILM LAMINATING

1. Expensive inventory for low-volume designs.
2. Limited choice of suitable substrates and high preparation requirements. (MDF is best choice!)
3. Poor durability with the less expensive films.
4. Inability to cover pits and depressions, bumps, blemishes and surface variations easily without extra filling.
5. Wrinkling of wide films applied at high speeds.

Properties vary greatly with film type. Some of the better top coated films provide performance approaching that of low-pressure laminates. Good qualities include resistance to abrasion, scratching, steam and high humidity, fading and heat.

### **LOW BASIS WEIGHT PAPERS**

Very thin, tissue-like papers are used because they offer high fidelity and lower emissions, require less equipment, and provide operating simplicity and lower cost comparable to wet printing. These excellent prints, originally from Japan, are usually laid on a glue line of clear vinyl or urea resin applied to the basic panel and rolled flat. When applying water-based adhesives to the board surface, the water should be flashed off as rapidly as possible to prevent fiber swell. Cold rolls and then hot nip rolls or platen presses can be used to smooth and cure the glue. Most of these papers are top-coated after lamination, eliminating the need for spray booths after fabrication. Some mills use UV or EB curing of the glues and top coats applied to the papers. Without good impregnation and top coating, these papers tend to have poor scar and moisture resistance.

The substrate is very important to the final finish with thin paper overlays, and the smooth, dense surface of MDF is well-suited for several reasons—flatness, low porosity, good adhesion, and non-telegraphing of defects. Plywood and particleboard may require UV or conventional filling to use these papers.

### **VINYL FILMS & HEAVY PAPERS**

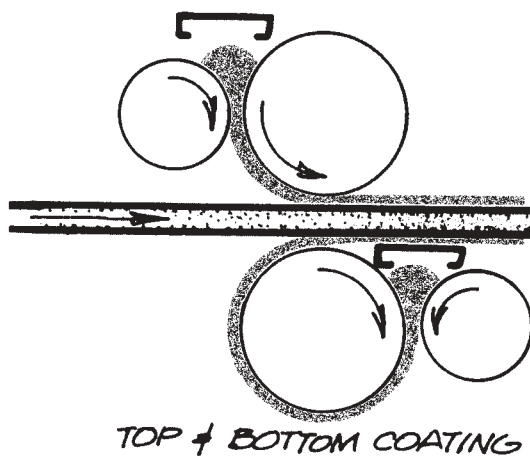
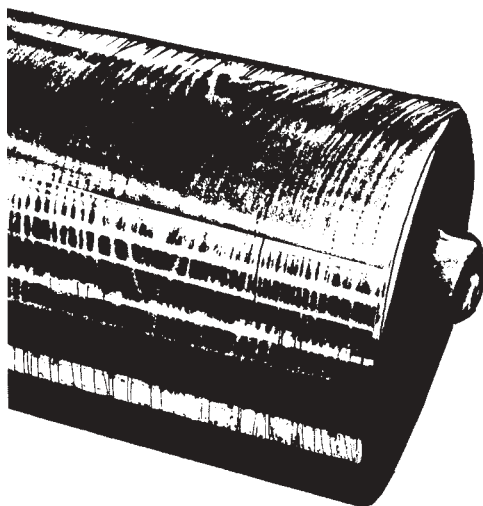
The systems used with vinyl films are almost as varied as the number of plants, and individual plant methods are well-entrenched. Paneling, moulding, miter-folding and kitchen cabinet operations are the main applications for these films. A number of glue and film suppliers provide good information for process improvements and trouble-shooting in this well-established industry.

MDF is not commonly used in applications where particleboard will suffice with heavier coverings. MDF competes mainly where the vinyl films and papers are very thin or greater strength and smoothness are needed, such as in mouldings and trim. The smooth finish after shaping, strength in small sections, glue-savings, cleaner cuts and stability are MDF's primary advantages over other composite panel substrates. Edge cuts require greater glue spreads than face laminating. The adhesives used are primarily two-part epoxies, cold-set ureas, modified PVA's, isocyanates, casein-lates and contact cements. The selection lies mainly with the user's needs for quality, production volume, cost, and the equipment available. Thermoplastic web glue also may be used.

Coated, impregnated and precured papers have gained popularity as overlays. They offer the user a greater variety of properties, designs and costs than some other methods. They include very low basis weight papers of 23 to 30 g/m<sup>2</sup> up to 60 to 120 g/m<sup>2</sup> heavy papers.

Several types of resins—UFs, melamines, acrylics, polyesters and polyurethanes—are used for coating or impregnation and are cured prior to application to panels. They are usually rolled to provide good contact and to set the resin (glue) bond of the paper to the board. Common conditions include pressures up to 100 psi and 275°-350° F (136°-177° C) at the nip when using water emulsion glues. Actual conditions depend on the weights and types of papers, the type of board and the types of rolls used to laminate.

## GRAIN PRINTING

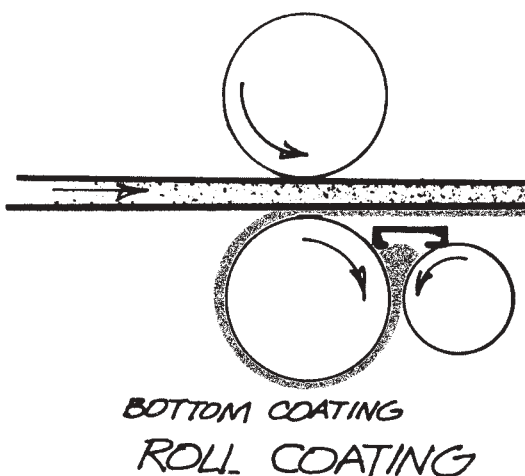
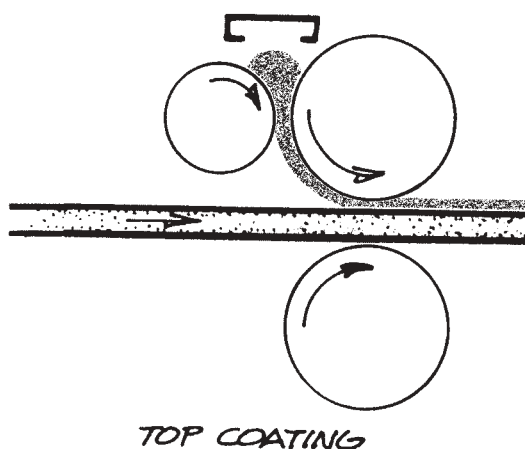


## WET GRAIN PRINTING

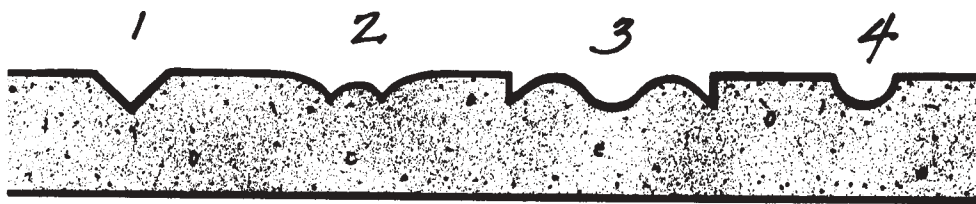
Wet grain printing or flat line finishing of MDF is a well-established process. MDF has made considerable inroads into wet coated panels and print furniture due to its excellent smoothness, stability, caliper, density, and flatness.

Electron-beam (EB) cured finishes applied as wet films are growing in use. The low porosity and smooth, dense surface make MDF attractive to EB finishers. Finished panels are usually solid-color, higher gloss items for industrial and commercial applications. They are durable and attractive, but require complex machinery to produce.

The fillers are usually cured with UV while other coats are cured with EB. Prints are accomplished by laminating thin printed papers over a color toned filler and then applying a top coating. The papers are similar to those mentioned above. A liquid print system is available for coating uneven forms and curved surfaces. It deposits a wet film dissolved in water onto the substrate and is particularly adaptable to odd shapes and molded pieces to which normal print rolls and films will not conform.







## EMBOSSING

Furniture manufacturers are using embossing—pressing cast die patterns into the MDF surface—to produce three-dimensional designs. MDF's even texture and consistent properties make it an excellent material for embossing, and technology has advanced rapidly into new areas such as embossings on veneer or paper overlaid MDF and "cut through" embossing.

Die pattern design and construction have an important role in the embossing of MDF. In general, the larger the die contact area and the deeper the die penetration, the more difficult it becomes to achieve good results. Examples of acceptable embossing designs are illustrated above and include:

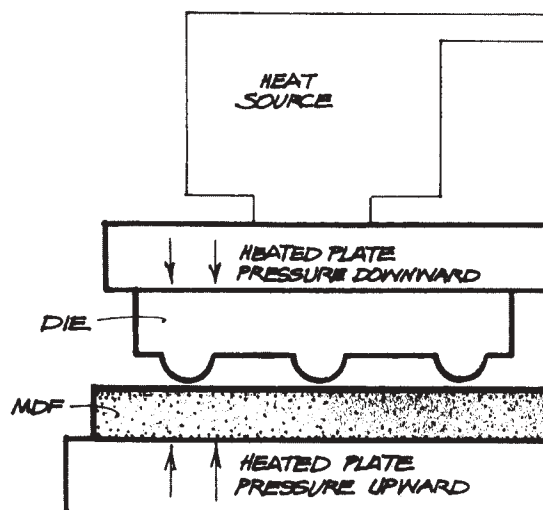
1. Sharp V-groove less than 50 percent of MDF thickness.
2. Bead with long radius shoulder.
3. Stepped penetration with sharp entry from board surface. Pre-routing of wide, deep patterns gives best results. Penetration should never be more than 60 percent of board thickness.
4. Shallow round-bottom groove, no preroute necessary.

Avoid straight (perpendicular) penetrations and squared-off bottoms. Designs should be made in conjunction with die manufacturers. Flaking of short radius shoulders can be reduced in several ways including the use of boards with higher surface density and/or pre-testing the surface of some boards

with a plasticizing agent (i.e., linseed or other oils). Die construction should be of a hard alloy casting, chrome plated, polished smooth on all contact surfaces, and kept clean. The use of a die release agent is often recommended. The use of a paintable mold release agent will help keep the die surfaces clean and the embossing sharp.

A large variety of embossing presses are available. Many factors must be considered in press selection including production rate, method of heating, operating temperature, pressures, closing speeds and the type of control system.

Many MDF suppliers can provide technical assistance to embossers including custom engineering of MDF board properties and advice on press operating parameters for optimal results.



**EMBOSSING PROCEDURE**

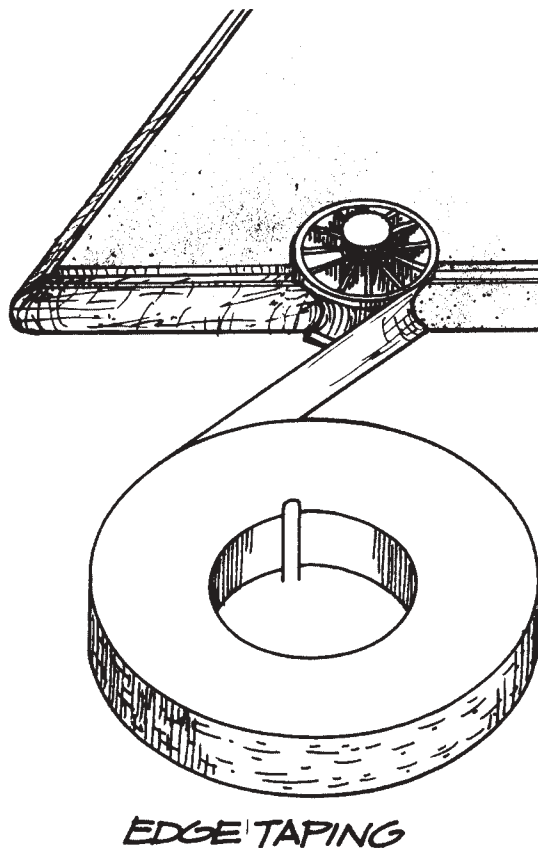
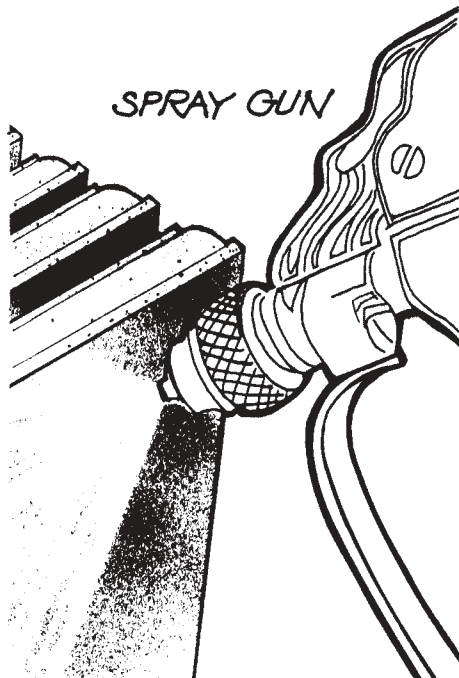
# Edges

A prime asset of MDF is that edge banding is not required in order to produce a high quality shaped edge. Improvements in edge finishes and methods can result in cost savings and better appearance for a wide range of shaped designs.

The two most popular edge treatments are wet-coat finishing (either plain or grained) and "hot stamped" foil-transfers. In addition, veneers, tapes, films and papers are being used to treat the edges of MDF after face-finishing. Finishing can be done either by hand or automated methods.

Good, sharp carbide or diamond tools are the first requirement for good edges. Proper tool use is the second. Sanding with the right touch, speed and grit materials, either before or after sealing, must be done for a quality edge. Sanding with coped wheels or belts should be done with 150 to 180 or finer grits, using closed-coat silicon carbide, aluminum oxide, or garnet papers. Flexible buffing brushes of "flap" wheels made from fine grit papers or filled, non-woven fabrics such as "Scotchbrite" are available. For small jobs, hand-held non-woven pads are excellent for knocking off fuzz after sealing and buffing between coats. "Spool-sanding" and "finger discs" are other alternatives for difficult contours.

Abrasive-impregnated wheels of medium soft plastic foam, formed to the desired contour for polishing, are popular. The wheels can be made to almost any hardness and grit specification, and the user provides the contour with simple procedures.



## WET COATINGS

Wet coatings require careful preparation of the substrate to avoid pits, porous and fuzzy edges. Many companies offer sealers especially adapted to MDF edges. Sealer choice depends upon board characteristics, edge contours, coating line capabilities, and final quality required.

Attractive edges can be obtained by simply stacking the parts and spraying the edges. Generally the face has already been finished and the over-spray wipes off easily with the proper solvent.

A kitchen cabinet brown edge coating, such as a nitrocellulose lacquer with two heavy coats, lightly sanded with 120 grit in between coats, should provide a quality result.

Another quality system can be achieved as follows:

1. Spray two coats, wet-on-wet, with a lacquer edge-sealer and flash-off.
2. Burnish with "Scotchbrite®" or similar non-woven pad by hand.
3. Spray two coats, wet-on-wet again.
4. Dry and wipe faces clean.
5. Sand and topcoat.

Quick-drying sanding sealers, auto body primers and

Quick-drying sanding sealers, auto body primers and even white vinyl glues have been used successfully for edge-sealing MDF, although the primers can be brittle in nature and subject to cracking.

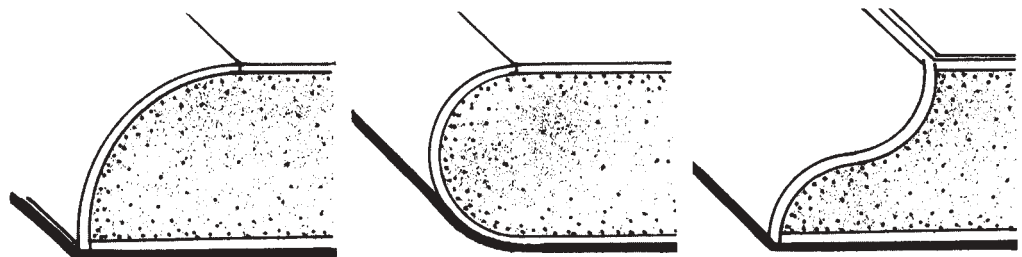
Edges can easily be antiqued by hand, wiping or brushing the "grain" over the proper background coating. More sophisticated print finishes are available for high-quality, mass-produced furnishings. Many are adaptable to the all-in-one complete finishing machines. A number of water-borne, UV and electrostatic coatings are also used for MDF edges. Airless sprays, where higher solids can be maintained, are preferred to air sprays.

### **HOT STAMP OR HEAT TRANSFER FILMS**

"Hot stamp" or "heat transfer film" transfers are popular for MDF edge-finishing because of less cleanup requirements, ease of color change, and improved durability. With good surface preparation, an attractive, low-cost contoured edge can be produced. These are pre-finished, pre-heated, pre-glued strips applied by special machines.

### **HPL STRIPS, PAPER, VENEER TAPES AND PLASTIC MOULDINGS**

HPL strips, paper, veneer tapes and plastic mouldings can be used for MDF edges. For full panels these methods are usually carryovers from earlier particleboard techniques and are being replaced by one of the lower-cost systems described above. For moulding and trim, however, one system applies a flexible veneer tape to complex shapes, giving the appearance of solid wood. The veneer is glued with hot melt, contact, white glue, or a variety of other adhesives. The veneers work well on the smooth, glueable finish of MDF, which has good strength for long, slim pieces such as mouldings.



*EDGE COVERINGS*



# APPENDIX 1

## Formaldehyde in MDF

### FORMALDEHYDE IN WOOD PRODUCTS

Approximately 92 percent of the typical composite panel—including MDF—is wood. The rest is resin—the adhesive that, with heat and pressure, binds the wood particles and fibers into panels with consistent quality characteristics.

In MDF, the adhesive (resin) most often used contains formaldehyde ( $\text{CH}_2\text{O}$ ), a chemical compound found in paints and cosmetics, paper product finishes, insulation materials, “permanent press” fabric coatings, and other household and consumer products. Formaldehyde also occurs naturally in the environment, is produced in small quantities by the human body, and can be released through combustion—such as by automobiles or cigarettes, or by burning wood, kerosene or natural gas.

Formaldehyde is one of the most commonly used and most studied chemical compounds. It is a colorless chemical that is part of a large family of “volatile organic compounds” (VOCs)—those that become a gas at normal room temperature. Formaldehyde is strong smelling in high concentrations.

The use of formaldehyde-based adhesives permits the manufacture of MDF and other composite panels that meet the strength, durability, and other performance criteria specified by most users.

Over the last 15 years, formaldehyde emissions from composite panels have been reduced dramatically. Panels produced today, on average, emit only about one-sixth as much formaldehyde as those produced in the early 1980s.

Voluntary formaldehyde emission limits established by industry have played a major role in bringing formaldehyde emission levels down. American National Standards Institute (ANSI) standard A208.1-1993 for particleboard and A208.2-1994 for

MDF specify formaldehyde emission levels under the ASTM E-1333 Large Chamber testing protocol, and are widely recognized by US and Canadian manufacturers, regulatory agencies, building codes and users alike. Many of these voluntary industry emission levels are more stringent than those required by the US Housing and Urban Development Administration (HUD).

In addition, the US and Canadian composite panel industries—working through the CPA—have voluntarily developed a rigorous quality assurance program designed to limit emissions from MDF panels at the point of manufacture. At least once a quarter, the CPA’s Grademark inspectors choose random samples from participating mills and test them on-site and at the CPA’s government-accredited laboratory. Samples must meet the emission limits specified in the ANSI standards in order to qualify for certification. Participating mills stamp or label their products with the CPA’s Grademark.

In the US, occupational exposure levels for formaldehyde are regulated by the Department of Labor Occupational Safety and Health Administration (OSHA). Through a negotiated rulemaking process that included representatives from labor unions and industry, OSHA promulgated an extensive formaldehyde standard for the workplace in 1991.

The OSHA rule limits occupational exposure to formaldehyde to 0.75 ppm, averaged over an eight-hour workday. It also requires products that will result in further occupational exposure to be labeled as containing formaldehyde if resulting levels can exceed 0.1 ppm. OSHA requires that the products include a cancer-warning label if resulting occupational levels can exceed 0.5 ppm.

In Canada, provincial occupational health and safety government organizations are responsible for establishing occupational exposure limits. As a result, these levels vary by province.

Formaldehyde is normally present at low levels in the air—typically less than 0.03 parts per million parts of outdoor air (ppm). Like many naturally occurring substances, formaldehyde in very high concentrations—well beyond those experienced in everyday life—can cause adverse health effects.

When MDF and other composite panels are manufactured using UF resins, some formaldehyde is temporarily trapped inside the panel after the manufacturing process and is slowly released over time. As a result, there are more emissions when composite panel products are new.

Some people are especially sensitive, however, and may react adversely to formaldehyde. Symptoms are similar to those from colds and the flu. A respected study by the Industrial Health Foundation, published in 1997, recommended an occupational exposure limit of 0.3 ppm (averaged over an eight hour workday) to protect “nearly everyone” from irritation due to formaldehyde. The US Environmental Protection Agency (EPA) has noted that some people may experience irritation when emission levels are above 0.1 ppm.

Likewise, the US Consumer Products Safety Commission (CPSC) has reported that emissions from products containing formaldehyde can cause discomfort, irritation or illness for sensitive people at levels above 0.1 ppm, a higher level than that to which most people are exposed. Symptoms may include headache, fatigue, watery eyes, running nose, burning eyes, nose and throat, and allergic reactions. Some studies have shown that formaldehyde can cause cancer in laboratory animals under extremely high, sustained exposure conditions.

In a 1996 landmark study conducted by the EPA, indoor formaldehyde levels were measured in a newly constructed single family house containing varying “loadings” of particleboard, MDF and plywood used for floor underlayment, cabinets, wall paneling and interior doors. The EPA reported that indoor concentration levels peaked at about 0.075 ppm in the first 10 days, and were below 0.05 ppm when tested at 30 days, at the highest (worst-case) loading.

Individuals who are particularly sensitive to formaldehyde may be able to reduce home or office emission levels from composite panel products by controlling the temperature and humidity as well as the airflow. Formaldehyde levels decrease with lower temperatures and humidity as well as with improved

ventilation. Temporarily increasing ventilation rates may be particularly useful in a newly-constructed environment or one with new furnishings.

Sealing composite panel products with laminates, paints and other coatings should also reduce exposure. Where practicable, users should specify composite panel products that are labeled or stamped to be in conformance with ANSI standards.

## COATINGS AND LAMINATES

Effective barriers can reduce emission levels by 95% or more. Barriers are particularly effective when applied to today's low emitting PB/MDF products.

Barriers are most effective when all surfaces are treated. For maximum emission reduction, edges, notches, and holes also need to be edge banded, laminated, finished or covered with hardware. This is because edge emissions are higher than surface emissions. Filling and sanding edges well before finishing and between coats prevents the wicking-in of wet coatings.

The effectiveness of any application depends upon the thickness of the material applied. Referring to paints, sealers, etc., a one mil (.001”) film applied to all surfaces is considered necessary for effective control, but any sealer thickness is better than none at all. Research has shown that two coats that are each 1 mil (0.001”) thick are up to ten times as effective as one coat 2 mils thick. The second coat will fill many of the pinholes and other imperfections of the first coat.

The listed materials are generally recognized as being barriers in the following order of effectiveness. Their relative effectiveness may vary depending on environmental and other factors.

1. High pressure laminates
2. Phenolic backer sheets (20 mils +)
3. Thick vinyls (6 mils +)
4. Low pressure laminates—melamine or polyester saturated papers
5. Thin vinyls (2-5 mils)
6. Electron beam coating on an ultra violet (UV) cure filled board
7. UV cured fill with paints/prints
8. Oil alkyd, enamel wood primer with oil alkyd, enamel paint
9. Polyurethanes
10. Epoxy sealers/paints

11. Latex-ammonia coatings designed to scavenge formaldehyde in combination with a latex top coat.
12. Oil or lacquer sealer plus a varnish or lacquer top coat
13. Finished wood veneers
14. Unfinished wood veneers applied with formaldehyde-free glue
15. Unfinished wood veneers applied with low formaldehyde glue
16. Shellacs and varnishes
17. Latex paint
18. Quick drying lacquer sanding sealers
19. Penetrating oil sealer/stains
20. Waxes

If you have any questions about formaldehyde emissions from MDF or the effectiveness of specific coatings, contact your panel manufacturer or the CPA. See also the CPA Technical Bulletin *Formaldehyde Emission Barrier Effects*.

# APPENDIX 2

## Glossary of Terms

### ABRASIVE MATERIALS

A mineral substance coating on a sanding belt that abrades or sands the board by removing material.

### ADDITIVE

Any special material incorporated in a panel in the course of manufacture to impart special properties. The term includes preservatives, water repellents, and fire retardants, but not binders.

### ADHESIVE

A substance capable of holding materials together by surface attachment. The term is used to cover the bonding of sheet material and is synonymous with glue. The terms “binder” and “resin” are used for materials concerned in the manufacture of particleboard and MDF.

### ASTM TEST

A test method published by the American Society of Testing Materials. Various ASTM tests are performed by MDF mills for purposes of quality control.

### BACKER

A non-decorative laminate used on the back of composite panel constructions to protect the substrate from changes in humidity and to balance the panel construction.

### BALANCED CONSTRUCTION

A composite panel construction that will not warp when subjected to uniformly distributed moisture changes.

### BLENDING

The application of binder and additives to fibers in the manufacture of MDF.

### BLOW

A localized delamination caused by steam pressure build-up during the hot pressing process. Blows may result from excessive moisture, excessive or poor resin distribution or high press temperatures.

### BOW

The deviation flatwise from a straight line stretched parallel to the length of the panel.

### CALIPER

An instrument for measuring diameters or thickness. Also used as the term describing board thickness.

### CERTIFICATION AGENCY

A qualified independent agency that conducts a testing and evaluation program designed to

determine whether products covered by the program meet applicable product standards.

### CHATTER

A wavy condition across the width of a panel caused by sanding. These markings are parallel to one another between 1/4 and 1/2 inch apart and perpendicular to the sander grit markings. Sometimes they can be felt but always can be seen.

### CHIP LOAD

Bite per tooth, or the amount of material removed by each cutting tooth as it goes through the material being cut.

### CHIP-OUT

Along the top or bottom face edges, the fines or flakes are removed or torn out of the surface.

### CLIMB CUTTING

Machining with the cutting tool rotating in the same direction as the material being cut is traveling.

### CORE

The center layer in a composition (multi-layered) board panel.

### CORE SEPARATION

Actual delamination of the core normally at the center line caused by steam pressure or poor glue distribution and cure.

### CPA

Composite Panel Association.

### CROWNED BOARD

The center of the width of a sanded board is thicker than the two long edges.

### CUP

Deviation flatwise from a straight line stretched across the width of the panel.

### DEFLECTION

Downward bending of a board between supports when a load is applied such as a shelf or floor panel. Usually measured in inches and is greatest in the center of the span.

### DELAMINATION

An actual separation of the panels face layer from the core or a laminate from a substrate.

### DENSITY

The weight of a panel as measured in pounds per cubic foot (mass divided by volume).

**DEPRESSION**

A defect in a finished panel that appears as a concave area on the surface.

**DIRECTION OF GRAIN**

As applied to plastic laminates. A sanded grit pattern which can be seen on the laminate back and is usually parallel with a printed wood grain pattern.

**DULLING EFFECT**

Incompatible solvents showing up as a dull spot on a finished panel.

**EDGE SNIPE**

A narrow tapered condition along the edge of a sanded panel. This taper often cannot be detected visually, but the decreased thickness can be measured with a micrometer or caliper.

**EMBOSSING**

A process by which the surface of the panel product is given a relief effect. This can be accomplished with a pressure roll or a patterned caul in a hot press.

**EQUILIBRIUM MOISTURE CONTENT (EMC)**

The moisture content at which wood neither gains nor loses moisture given the relative humidity and temperature of the surrounding atmosphere.

**FEED RATE**

The rate in which material passes a cutting tool, measured in feet per minute (fpm).

**FILLER**

A high solids finishing material used to fill tiny voids or pits in board surfaces.

**FIBER RAISE**

Face fibers that are raised above surrounding surface appearing as a rough surface. Usually caused by excessive absorption of moisture.

**FLAME SPREAD**

Term relating to spread of a flame along the surface of a material; expressed in numbers or letters and used in describing interior finishing requirements for building codes.

**FOILS**

Cellulose papers weighing between 40 and 140 grams per square meter untreated. The papers may be impregnated with melamine thermoplastic resins, or left untreated.

**FORMER**

Machine that forms the furnish into a MDF mat prior to hot pressing.

**FORMALDEHYDE**

A reactive organic compound, CH<sub>2</sub>O.

**FREE FORMALDEHYDE**

Uncombined or unreleased formaldehyde available for release or emission from a panel.

**FURNISH**

The blended fibers, binders, and additives ready for the board-forming process.

**GRIT SIZE**

Refers to coarseness of an abrasive material on a sanding belt. The lower the grit label, the coarser the abrasive material.

**HARDNESS**

A measure of resistance to indentation of the board surface and is related to board density. Value stated in pounds (lbs).

**HEAT TRANSFER FOILS**

A panel coating system that involves the transfer of a complete coating system from carrier film to a substrate by means of heat and pressure.

**HOOK OR RAKE ANGLE**

Angle on a cutting tool affecting ease in which the tooth penetrates the material being machined.

**HPL**

High pressure laminate. A sheet material formed from multiple layers of kraft paper saturated with phenolic resin; a decorative layer of paper saturated with melamine resin; and a very thin top sheet of paper heavily saturated with a melamine resin. Fused together under high temperature and pressure to produce a stiff plastic sheet.

**IMPACT RESISTANCE**

Ability of a material to withstand sharp blows or violent contact.

**INTERNAL BOND STRENGTH**

An overall measure of the board's integrity illustrating how well the product is bonded. Tested by applying tension perpendicular to the panel surface. Value stated in pounds per square inch (psi).

**KERF**

A slot made by a sawblade. The width of the saw cut.

**LAMINATE**

(n) A product made by bonding together two or more layers of material. (v) To unite layers of material with adhesive.

**LARGE CHAMBER TEST ASTM E1333-1996.**

A controlled environmental chamber test designed to measure formaldehyde emissions from UF bonded wood products.

**LINEAR EXPANSION**

A measure of growth along the length of the board when exposed to conditions from low (50%) to high (80%) humidity stated in percent.

**LOW BASIS WEIGHT**

Laminating papers, often referred to as “micro-papers” or “rice-papers,” that range in weight from 23 to 30 grams and sometimes preimpregnated with resin.

**LPL**

Low pressure laminate. A preprinted or solid color decorative paper that has been saturated with a resin. Under heat and pressure, it bonds to a board surface without need for additional adhesive.

**MACHINE DIRECTION**

The panel orientation that corresponds with the direction which the product moved through the machine that manufactured or machined it. Also referred to as the parallel direction.

**MDI**

Generic term for isocyanate based resins.

**MELAMINE**

A laminate that derives its name from the melamine resin system used to saturate the paper laminate and adhere it to the substrate.

**MF**

Melamine Formaldehyde. Thermosetting amino resin with exterior capabilities commonly used as a saturating resin for paper laminates.

**MODULUS OF ELASTICITY (MOE)**

A measure of the board's resistance to deflection or sagging when loaded as a simple beam. Value stated in pounds per square inch (psi).

**MODULUS OF RUPTURE (MOR)**

An index of the maximum breaking strength of the board when loaded as a simple beam. Value stated in pounds per square inch (psi).

**MOISTURE CONTENT**

The amount of water in wood and expressed as a percentage of dry weight.

**MOTTILING EFFECT**

An irregular appearance in an area or entire surface of a finished board due to heavy application of finishing material, poor drying or incompatible solvents. Also known as “Orange Peel.”

**MUF**

Melamine Urea Formaldehyde. UF resin fortified with melamine.

**OPACITY**

Degree of transparency of a filled board surface. High opacity indicates complete coverage of filler that masks the board surface.

**OVERLAY**

A thin layer of paper, plastic, film, metal foil, or other material bonded to one or both faces of a panel.

**PRESS (MDF)**

Hot press that consolidates the MDF mat into a board and cures the resin binder under heat and pressure.

**PREPRESS (MDF)**

A cold press following the former that helps consolidate the MDF mat prior to the hot press.

**PERFORATOR TEST**

A formaldehyde test developed in Europe as a plant quality control test. It extracts free formaldehyde from MDF with toluene. (European test #ENI20).

**PHENOL FORMALDEHYDE (PF)**

A water resistant thermosetting resin system commonly used to bond softwood plywood, oriented strand board (OSB), exterior particleboard and moisture resistant exterior MDF.

**PITS**

Tiny voids on the board surface.

**PLATEN**

A part of a press consisting of a rigid metal plate, usually heated, for exerting pressure on the mat.

**PRECURE**

Curing of a resin before pressing. It can also refer to incomplete sanding of a pressed board.

**PREFINISHED PANEL**

Panels having factory-applied decorative or protective coatings.

**PRIMARY MARKS**

Occasional deep scratches or marks that feel rough on finish sanded board. Caused by the primary coarse grit sanding heads leaving marks that are not totally removed by finish sanding heads.

**PROFILE**

Variation of density of a panel from face density to core.

**PSF**

Pounds per square foot. Measure of loads distributed over a square foot of board surface.

**PSI**

Pounds per square inch. Measure of loads distributed over a square inch of board surface.

**RECONSTITUTED WOOD**

Wood in forms ranging from logs to coarse residues are first reduced to small fragments and then put back together again by special manufacturing processes into panel products of relatively large sizes and various thicknesses such as particleboard, medium density fiberboard and hardboard.

**RELATIVE HUMIDITY**

Ratio of the amount of water vapor present in the air to that which the air would hold at saturation at the same temperature.



**RESIN SPOTS**

Hard pieces of dark or black material in face layer that are composed of glue and wood dust.

**ROUGH SAND**

Area of a sanded panel that was not sanded with the finish sanding heads. The surface will appear and feel rough.

**RPM**

Revolutions per minute. The turning speed of a motor or cutting tool.

**RUN OFF SANDER BELT**

A corner or edge of a panel that did not get sanded. This area is thicker than the rest of the panel and sometimes has a black marking on the unsanded area.

**SANDER HESITATION**

Sander head marks that appear across the panel width. The marks are low concave indentations with radius of the sander head caused when the panel stopped under a sander head. At times, there will be primary sanding marks on the other side.

**SANDER SKIP**

Area of a sanded panel that was not sanded and surrounding areas were. These areas are usually low indentations in the panel.

**SAND THROUGH**

A condition where the face layer has been sanded off exposing the core.

**SATURATED PAPERS**

Decorative surface papers generally weighing between 60 and 130 grams per square meter. These papers are saturated with resins and partially cured at the point of manufacture. Final curing is done at the time of hot press lamination.

**SCREWHOLDING**

A measure of the force required to withdraw a screw directly from the face or edge of a board stated in pounds (lbs).

**SIZE OR SIZING**

An additive introduced to the furnish for MDF prior to forming, primarily to improve water resistance.

**SPRINGBACK**

Tendency of a pressed MDF panel to return to its original uncompressed state.

**SQUARENESS**

Right angles at the corners or equal diagonals from corner to corner.

**STARVED GLUELINES**

A condition caused by an insufficient adhesive spread to adhere two materials together.

**STEP**

Difference in height between panels when butted together due to thickness variations in panels normally of the same thickness.

**STREAKS**

Line like streaks that appear the length of a panel parallel to the feed direction through the sander. These streaks are narrow, slightly higher than the sanded surface and are caused by metal or rock in previous board stripping grit off the sanding belt (also called grit lines).

**SUBSTRATE**

A material that provides the surface on which an adhesive or coating is spread.

**SWELL**

Thickness increase in a panel which can occur from excessive moisture pick up or wetting.

**TENSILE STRENGTH**

The greatest longitudinal stress a material can resist without tearing apart. Value in pounds per square inch (psi).

**THERMOPLASTIC**

Resins or adhesives that harden at room temperature and resoften upon exposure to heat.

**THERMOSETTING**

Resins or adhesives that cure at room temperature or in the hot press by chemical reaction to form rigid bonds that are not resoftened by exposure to heat.

**THICK AND THIN**

A thickness variation within a panel or between two panels.

**UREA FORMALDEHYDE**

Interior thermosetting resin system commonly used in the manufacture of MDF.

**UNBALANCED CONSTRUCTION**

When individual components or layers of a laminate do not respond equally to changes in moisture thus causing warp.

**UNIFORM LOAD**

A load distributed evenly across a shelf or load panel.

**VINYL FILM**

Made of polyvinyl chloride used for decorative surfacing and may be either clear or solid color. If it is clear, it is printed on the reverse side to protect the print. If it is a solid color, the printing is on the top.

**WARP**

Deviation of a panel from a flat plane due to unbalanced construction, excessive moisture pick up, wetting or other unfavorable exposures.

# APPENDIX 3

## ANSI Standard

In 1994 the American National Standards Institute (ANSI) published a new American National Standard for MDF—ANSI A208.2-1994. MDF producers, users and general interest groups were involved in the development of this ANSI standard. The new standard replaced ANSI A208.2-1986. The most significant changes included:

- inclusion of formaldehyde emission limits
- metrication of all measurement units
- revision of product classes and property requirements.

The standard's physical property requirements are minimum values; many manufacturers may offer products with significantly different properties.

While specifying that metric units shall be the primary values used in determining product performance requirements, the standard provides for the continued use of inch-pound units. Many of the properties, dimensions, and other measurements used in this edition of *MDF From Start to Finish* are in inch-pound units for the convenience of the reader.

### ANSI A208.2-1994 MDF PROPERTY REQUIREMENTS<sup>a,b</sup>

PRODUCT CLASS <sup>c</sup>	NOMINAL THICKNESS mm (inch)	LENGTH & WIDTH TOLERANCE mm/m (in/ft)	THICKNESS VARIANCE		MODULUS OF RUPTURE N/mm <sup>2</sup> (psi)	MODULUS OF ELASTICITY N/mm <sup>2</sup> (psi)	INTERNAL BOND N/mm <sup>2</sup> (psi)	SCREWHOLDING FACE N (lbf)	SCREWHOLDING EDGE N (lbf)	FORMALDEHYDE EMISSIONS <sup>d</sup> ppm
			WITHIN PANEL mm (inch)	BETWEEN PANELS mm (inch)						
			INTERIOR MDF							
HD		±1.0(1/64)	±0.125(0.005)	±0.125(0.005)	34.5(5,000)	3,450(500,000)	0.75(110)	1555(350)	1335(300)	0.30
MD	≤21(0.825)	±1.0(1/64)	±0.125(0.005)	±0.125(0.005)	24.0(3,500)	2,400(350,000)	0.60(90)	1445(325)	1110(250)	0.30
MD>21(0.825)	±1.0(1/64)	±0.125(0.005)	±0.125(0.005)	24.0(3,500)	2,400(350,000)	0.55(80)	1335(300)	1000(225)	0.30	
LD	±1.0(1/64)	±0.125(0.005)	±0.125(0.005)	14.0(2,000)	1,400(200,000)	0.30(40)	780(175)	670(150)	0.30	
EXTERIOR MDF										
MD EXTERIOR	≤21(0.825)	±1.0(1/64)	±0.125(0.005)	±0.125(0.005)	34.5(5,000)	3,450(500,000)	0.90(130)	1445(325)	1110(250)	0.30
GLUE	>21(0.825)	±1.0(1/64)	±0.125(0.005)	±0.125(0.005)	31.0(4,500)	3,100(450,000)	0.70(100)	1335(300)	1000(225)	0.30

a) Minimum properties and maximum tolerances when tested in accordance with sections 3.2 and 3.3. MD-Exterior

Glue panels shall maintain at least 50% of the listed MOR after ASTM D 1037-1991 accelerated aging (paragraph 3.3.4).

b) Metric property values shall be the primary values used in determining product performance requirements.

c) Refer to Explanation of classification, Section 4, paragraph 4.1.

d) Maximum emission when tested in accordance with Section 3.4, Formaldehyde provisions.



## APPENDIX 4

# Properties of Selected MDF and Laminates

Actual test values from a specific MDF, in its raw state and with various laminates

Board Type	3/4" Raw MDF	3/4" MDF/ Poly 25	3/4"*** MDF/ ELM 2S	3/4" MDF/ Birch 2S	3/4" MDF/ Oak 2S	3/4" Fir Ply	3/4" Birch On Fir Ply 2S
Thickness, in.	.750	.752	.756	.744	.754	.748	.752
Density, pcf	47.6	49	47.0	47.6	48.3	33.0	36.0
Internal Bond, psi	118	115	102	106	105	108	123
MOR, psi (par)	5200	5350	5360	6265	6305	8015	10,000
MOR, psi (perp)	5200	5350	3625	3560	3800	4480	5400
MOE, psi (par)	527,000	640,000	749,000	751,000	856,000	1,196,000	1,800,000
MOR, psi (perp)	527,000	640,000	472,000	515,000	451,000	616,000	715,000
Face Screwhold, lbs.	355	360	365	354	354	348	366
Edge Screwhold, lbs.	296	310	275	276	261	315	318
Water Abs., % 24 hrs.	7.8	7.2	3.6**	7.6	6.4	34.3	5.0**
Thick Swell, % 24 hrs.	3.7	4.0	0.3	1.8	1.0	4.8	5.5
% M.C. O.D. at Test	6.6	4.5	6.4	6.9	7.0	5.0	5.0
J. Ball Hardness, lbs.*	1180	1250	1200	1270	1260	655	900
Wt./M ft <sup>2</sup> , lbs.	2990	3100	2950	2950	2950	1920	2200

\* Hardness of oak lumber = 1200 to 1400 lbs.

\*\* Metric property values shall be the primary values used in determining product performance requirements.

# APPENDIX 5

## Metric Values

The 1975 Metric Conversion Act, as amended by the Omnibus Trade and Competitiveness Act of 1988, sets forth that metric (SI) is the preferred system of measurement in the U.S. All Federal agencies must conduct their business in metric by September 1992, to the extent feasible. Metric became the official system of measurement in Canada in 1971.

### THE CONVERSION FACTORS FOR THE UNITS FOUND IN ANSI A208.2-1994

#### DIMENSIONS

1 inch (in)	= 0.0254 meter (m)
1 in	= 25.4 millimeters (mm)
1 m	= 39.37 in

#### MASS

1 Gram (g)	= 0.0022 pound (lb)
1 lb	= 453.59 g

#### FORCE

1 Newton (N)	= 101.97 (g)
1 N	= 0.2248 lb
1 g	= 0.0098 N
1 lb	= 4.4482 N

#### FORCE/AREA

1 Pascal (Pa)	= 1.0 N/m <sup>2</sup>
1 Kilopascal (kPa)	= 0.001 N/mm <sup>2</sup>
1 N/mm <sup>2</sup>	= 145.04 psi
1 psi	= 0.00689 N/mm <sup>2</sup>

#### VOLUME/DENSITY

1 Pcf (mass) per cubic foot	= 16.018 kg/m <sup>3</sup>
1 Kg/m <sup>3</sup>	= 0.0624 lb/ft <sup>3</sup>
1 ft <sup>3</sup>	= 0.0283 m <sup>3</sup>
1 m <sup>3</sup>	= 35.31 ft <sup>3</sup>

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## COMPOSITE PANEL ASSOCIATION MEMBER COMPANIES

ANAFATA  
ATC Panels Inc.  
Bassett Fiberboard  
Boise Cascade Corporation  
Canadian Fibretech Inc.  
CanPar Industries  
Collins Products LLC  
Columbia Forest Products  
CMI/CraftMaster Manufacturing, Inc.  
Del-Tin Fiber LLC  
Fibratech Manufacturing Inc.  
Flakeboard Company Ltd.  
Florida Plywoods, Inc.  
Georgia-Pacific Corporation  
Great Lakes MDF, LLC  
GreenTech Panels, LLC  
Langboard, Inc.  
Louisiana-Pacific Corporation  
Marshfield DoorSystems, Inc.  
Merillat Industries, Inc.  
Norbord Industries, Inc.  
Northern Engineered Wood Products Inc.  
Pan Pacific Products, Inc.  
Panolam Industries International Inc.  
Plum Creek MDF, Inc.  
Potlatch Corporation  
Roseburg Forest Products Company  
Sacopan Inc.  
SierraPine Ltd.  
Stimson Lumber Company  
Tafisa Canada & Company Ltd.  
Temple-Inland  
Timber Products Company  
Uniboard Canada, Inc.  
Unilin US MDF  
Webb Furniture Enterprises, Inc.  
West Fraser Mills Ltd.  
Weyerhaeuser Company

### Composite Panel Association

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## Composite Panel Association

The Composite Panel Association (CPA) was founded in 1960, and represents the North American industry on technical, regulatory, quality assurance and product acceptance issues. Membership currently includes 38 of the leading producers of industry products. Together they represent nearly 95% of the total manufacturing capacity of North American particleboard (PB), medium density fiberboard (MDF), hardboard (HB) and other compatible products.

CPA is a vital resource for both producers and users of industry products. CPA, as an accredited standards developer, writes and publishes industry product standards. It also participates in the standards development work of ASTM and others, sponsors product acceptance activities and works with federal and state agencies and model building code bodies. In addition, CPA conducts product-testing and third-party certification programs and helps manufacturers create in-plant quality control programs.

Outreach and education are also prime goals of the CPA. The Association publishes industry statistics and conducts seminars to assist specifiers, manufacturers and other users of composite panels. CPA produces a series of technical bulletins and develops publications, videos, and other materials to inform key audiences about the attributes of industry products.

The Composite Wood Council (CWC) was formed in 1989 to promote the acceptance of industry products and provide a forum for companies affiliated with the composite panel industry. The Council represents all facets of the composite panel industry and includes furniture and cabinet manufacturers, decorative surfaces manufacturers, laminators, distributors, and equipment manufacturers. CWC's 200-plus international membership participates in a wide range of programs and activities under the umbrella of the CPA.