Membrane Pressing with KYDEX® 3D Laminates

INTRODUCTION

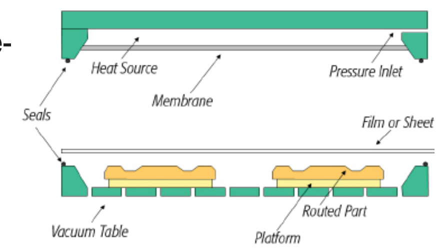
KYDEX® 3D thermoplastic laminates give designers the ability to incorporate compound corners and contoured edges, logos, and wire management holes while eliminating unsightly seams and the need for edgebanding typically associated with HPL/TFM surfaces. Its high impact resistance minimizes costly maintenance associated with other laminates.

3D molding presses allow three-dimensional components to be coated with films, foils, veneers and other moldable surface materials. The process consists of using a heated, elastic membrane, which is under pneumatic pressure, to apply a uniform pressure on a component, which is normally coated with an adhesive. The pressing process is supported by a vacuum. It allows molded parts, surfaces with molded cut-outs and edges to be coated three-dimensionally in one operation using heat. It is also a technique which guarantees a bubble-free bond.

MEMBRANE PRESS

Press Structure

The structure of a membrane press is sometimes described as a three-chamber system which is comprised of the following components:



1. The upper limit of the first chamber is the upper pressure-plate and the lower limit is the membrane. The membrane, which is flexibly suspended, is brought up against the upper heating/pressure plate by a vacuum or by pressure in order to heat it up. A positive pressure is then formed which is used by the membrane to coat the work piece.
2. The top of the second, central chamber is formed by the membrane, while the bottom is formed by the inserted coating material. The coating and membrane are pulled together by a vacuum. The coating material is heated up; after pressing, the membrane is separated from the coating material by a puff of air.
3. The top of the third chamber is formed by the coating, the bottom by the lower pressure plate. The work piece is placed in this chamber.

Substrate Material

Medium density fiberboard, MDF, is characterized by an almost completely homogeneous structure and very low levels of swelling and shrinking: around 4% length- and width ways, and around 6% in its thickness. Because of its excellent surface quality, it is especially suitable for film-coating of broad and narrow molded surfaces. MDF is processed using conventional woodworking machines. When manufacturing furniture finishes, coatings are applied using the adhesives normally used in the woodworking industry. Dust-free, sanded surfaces and cleanly cut edges are essential for the quality of the coating. With MDF, edges and cuts in the broad surfaces are more absorbent than untreated surfaces. This must be taken into account when it comes to the adhesive, which must be applied particularly carefully in these areas.

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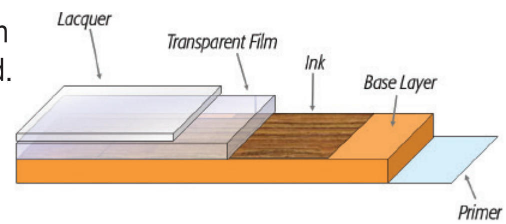
MEMBRANE PRESS CONTINUED

Films:

Rigid polyvinyl chloride films (thermoelastic): an excellent coating material in molding press technology. PVC films are either used as a basis material and given a subsequent paint coating, or used as an outer, visible film. There are hardly any limits on the shapes that can be given to the work pieces. From deeply embossed or milled front-pieces, to polygonal table-tops with rounded edges, all the way to different shaped furniture knobs - anything can be coated. Coating materials can be between 0.15 mm (0.006in) and 5.0mm (0.12in) thick.

The necessary thickness of the film depends on the roughness of the surface which is being coated, the distortion shapes, and the ways in which the finished part is to be used. PVC films begin to flow at around 70°C (158°F), while their ideal distortion characteristics are attained between 80 and 100°C, (176°-212°F). Contrary to public opinion, PVC film does not represent a health risk either in use or processing.

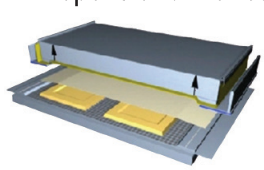


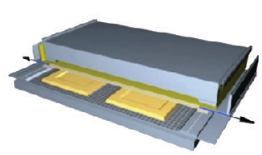
Preparation:

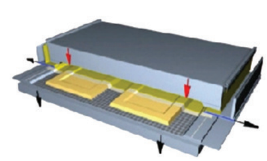
- parts are clean and defect free
- adhesive is dry
- film is free of defects & dust
- proper pedestal size (thickness & relief)
- spacing between parts
- pre-vac
- proper time, temp, cooling (program)

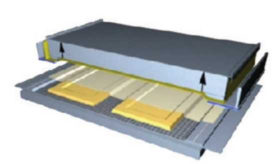
How it works:

1. Parts are produced from MDF or HDF, (usually with panel saws and CNC routers), and then sprayed with adhesive and dried. The press is opened and the membrane is pulled onto the upper pressure plate by a vacuum for heating.
2. Next, the pallet, containing the work piece and covered by the coating, moves into the press. The press closes and hot compressed air separates the membrane from the heating plate.
3. The coating, stretched between the positioning frame and the upper spacer frame, is pulled onto the membrane by a vacuum; it continues to be heated by hot air from the upper chamber. A vacuum is produced in the lower chamber, and a simultaneous positive pressure in the upper; the membrane presses the coating material onto the surface of the work piece, and the heat passing directly through the membrane ensures that the adhesive is activated or cross-linked.
4. The temperature can reach 160°C (320°F) and the pressure a maximum of 8 bar (116 psi). After the pressing process, the membrane is separated from the coating by cold air and pulled back onto the upper plate by a vacuum, where it is heated up again. The press opens and the ready-coated work piece comes out.


Step 1: the membrane is heated


Step 2: the press is sealed and the preheat stage softens the sheet


Step 3: pressure and vacuum occur while heat activates the adhesive


Step 4: the press cools and opens

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KYDEX THERMOPLASTICS

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CONSIDERATIONS

Pre-Vacuum - evacuate expanding trapped air
Set Point Temp - target temp.
Soak Time - time at set point before vacuum
Press Time - time with vacuum and heat
Cool Time - time with vacuum only
Vacuum Level - verifies good cycle
Variables - substrate temp, film thickness, texture, color, environment, adhesive

Trimming and Post-Processing:
Rough cut parts & place on rack
Finish trimming while press cycles
"Lazy Susan" turnstile to aid in trimming
Automatic trimmers not viable for entry-level customers (cost)

Spacing of Molds:
Eliminate wrinkles, webbed corners, torn film & holes
Space products 2x to 3x part thickness
Use corner blocks on outside edges
200% stretch to tear

Pedestals/Pin Systems:
Pedestals allow vinyl to wrap
Pedestal height ~= product height
Pedestal relief ~= 3.2 - 6.4mm (0.126-0.252in)
Pin systems vs. pedestals
Pin systems not viable for entry level customers (cost)

WEMHOENER TECHNICAL SPECIFCIATION

Pressing temperatures: smoothly adjustable up to 160°C (320°F)
Pressure: up to 8 Bar (116 psi)
Vacuum: up to 100 mbar (0.0015 psi)
Pressing times: regulated by a timer. Pressing times are around 40 seconds for thermoplastic films.
Work piece dimensions: min. 30 x 30 mm (1.18 x 1.18in) max. 1,000 x 2,000 mm (39.4 x 78.7in)
Work piece height: up to 100 mm (3.94 in) or on request
Work piece shape: flattened, concave, convex, polygonal, etc.

RECOMMENDATIONS

Press Settings:

The following conditions are based on 0.56mm (0.022in) material:

	Pre-Blowing Time (s)	Pre-Heating Time (s)	Pressing Time (s)	Cooling Time (s)	Top Heater Temperature	Bottom Heater Temperature	Pressure
Friz	1 second	45-55 seconds	40-50 seconds	35-45 seconds	130-140°C 266-284°F	131-149°C 55-65°F	2 Bars (29 psi)
Italpresse	1 second	80-90 seconds	55-65 seconds	30-40 seconds	115-130°C 239-266°F	-	2 Bars (29 psi)
Wemhoener	1 second	45-55 seconds	45-55 seconds	30-40 seconds	130-150°C 266-302°F	-	2 Bars (29 psi)

The following conditions are based on 0.71mm (0.028in) material:

	Pre-Blowing Time (s)	Pre-Heating Time (s)	Pressing Time (s)	Cooling Time (s)	Top Heater Temperature	Bottom Heater Temperature	Pressure
Friz	1 second	90 seconds	65-75 seconds	60 seconds	130-140°C 266-284°F	131-149°C 55-65°F	2 Bars (29 psi)
Italpresse	1 second	120 seconds	65-75 seconds	60 seconds	115-130°C 239-266°F	-	2 Bars (29 psi)
Wemhoener	1 second	90 seconds	65-75 seconds	90 seconds	130-150°C 266-302°F	-	2 Bars (29 psi)

The following conditions are based on 1.0mm (0.040in) material:

	Pre-Blowing Time (s)	Pre-Heating Time (s)	Pressing Time (s)	Cooling Time (s)	Top Heater Temperature	Bottom Heater Temperature	Pressure
Friz	1 second	120 seconds	85-95 seconds	110 seconds	130-140°C 266-284°F	55-65°C 131-149°F	2 Bars (29 psi)
Italpresse	1 second	180 seconds	85-95 seconds	110 seconds	115-130°C 239-266°F	-	2 Bars (29 psi)
Wemhoener	1 second	120 seconds	85-95 seconds	110 seconds	130-150°C 266-302°F	-	2 Bars (29 psi)

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RECOMENDATIONS

Membrane and Lamination Press Manufacturers

Company Name	Phone	Web
Shaw-Almex	404-294-0574	www.almex-online.com
Italpresse Spa	US: 888-743-8505 Italy: +39-035-681122	www.italpresse.com
Wemhoener	+49-5221-77020	www.wemhoener.de
Orma Equipment	+39-035-346290	www.ormamacchine.it
Stiles Equipment Distributor of Wemhoener and Friz Machinery	616-698-7500	www.stilesmachinery.com
Friz Presses	+49-0-7441-58-0	www.friz.de
Euro-Mercury Presses	353-85-7039544	www.euro-mercury-presses.ie
Burkle Presses	+49-0-7441-58-0	www.burkleusa.com
Midwest Group One Distributor of Greco and Orma Equipment	612-721-5347	www.midwestgroupone.com

Adhesives:

PU dispersions:

Use: thermoplastic films

Processing: mostly single component (self-cross-linkers) or two-component (isocyanate cross-linkers)

Characteristics: very good strength levels

EVA dispersions:

Use: thermoplastic films

Processing: mostly two-component (isocyanate cross-linkers)

Characteristics: moderate strength

Many PVC adhesives work well with KYDEX® sheet.

Name	Company	Phone	Web
Helmibond 854 with catalyst #552	Helmitin Adhesives	800-634-8761	www.helmitinadhesives.com
JOWAPAR 151 00	Jowat Adhesives	800-322-4583	www.jowat.com
Bostik 7132R/Boscodur 24T	Bostik	414-774-2250	www.bostik.com
Daubond 6429	Daubert Chemical	800-688-0459	www.daubertchemical.com
RD-4000-B	H.B. Fuller	888-423-8553	www.hbfuller.com
Vy-Lok 1011 with hardener IS205	National Starch & Chemical	800-797-4992	www.nationaladh.com

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TROUBLESHOOTING

Bowing of Parts:

On long and large parts, KYDEX® sheet tends to shrink as it cools, which may cause some bowing in the part.

However, there are some steps that can be taken to combat warping or bowing of the substrate:

- Use a stronger or higher density substrate material.
- Use a thinner gauge of KYDEX® sheet. The thinnest gauge of KYDEX® sheet is .56mm (depended on product type).
- Some parts will allow for structural support on the back side; i.e. melamine, heavier gauge of KYDEX® sheet, etc.

Material Shrinking:

If material is shrinking and not adhering to the edges of the substrate it is an indication that the material is slightly cold. Increase your preheat time approximately 5 to 10 seconds. This will allow the material to reach the proper temperature, which in turn will allow the material to flow easier, producing a good finished part.

Webbing of Material:

If webbing in the formed part occurs, the sheet temperature could be too hot. Drop temperature in five-degree increments. If webbing continues, web catching blocks may need to be used. Place the blocks at the corners of the parts, approximately two fingers in distance from the part. This will pull the material away from the part corners, eliminating webbing.

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