

Smithsonian Hall of Mammals

Smithsonian store shelves feature three-dimensional mammal patterns

Alternative Sought for Laminated, Painted, Glazed Shelving

WASHINGTON, DC - The interior of a new museum store at the Smithsonian Institution's Kenneth E. Behring Hall of Mammals complements the exhibition theme using a landscape of slat wall graduated from top to bottom in orange-gold, reddish rust and dark brown earth tones, and several hundred shelves membrane pressed and miter folded using a protective thermoplastic material in ivory colour, creating seamless, drop-front edges adorned with three-dimensional patterns of tigers, giraffes, jaguars and zebras.

Al Mercogliano, designer/planner for the Smithsonian Business Ventures project, decided against glass shelving, or high pressure laminating or painting of wood shelving, because none withstood high visitor traffic in other Smithsonian museum stores without showing signs of wear.

"Glass shelving," he says, "quickly scratched, cracked or chipped due to the volume of visitors handling the merchandise. We liked the look of light filtering through glass, but the damage necessitated frequent replacements."

He says, "Painted wood shelving also held up poorly and scratched easily, while shelving surfaced with high-pressure laminates chipped and cracked," adding, "Children would pick at the edge-banding and eventually peel it off."

Mercogliano found a solution in the form of membrane pressing and miter folding of heavy gauge, impact resistant thermoplastic sheet, a process that not only upgraded durability of the shelving, but allowed the reproduction of three-dimensional mammal skin patterns not achievable using traditional materials or surfacing techniques.

Mercogliano based his shelving design on the three-dimensional capabilities offered by membrane pressing and the seamless outside edges produced by miter folding. The final configuration incorporated rounded corners for safety and durability, a drop front edge for strength and visual impact, and three dimensional mammal skin patterns for continuity with the exhibit theme.

For the surfacing material he selected KYDEX® 6200 sheet, a proprietary, fire retardant thermoplastic alloy offering Notched Izod impact resistance of 187 J/m (3.5 ft-lb/in) (ASTM D-276), tensile strength of 41MPa (6000psi) (ASTM D-638), Rockwell Hardness of 98 (ASTM D-785), and heat deflection temperature of 78°C at 1.8 MPa (172°F at 264 psi) (ASTM D-785). He specified the sheet in 0.70mm (0.028") thickness to withstand the rigors of high traffic, with a "Haircell" surface texture to resemble animal hide, and an integral ivory colour to render scratches or gouges from severe damage inconspicuous.

He contracted with East Coast Cabinets, Inc., Pennsauken, NJ, to fabricate the shelving. Using dimensional drawings and mammal skin artwork provided, the company created a program for CNC routing of three dimensional skin patterns into the surface of the 190mm (0.750") MDF substrate, and of the shelving perimeter.



The Hall of Mammals Museum Store utilizes several hundred shelves that have been routed with mammal patterns and membrane pressed using KYDEX® sheet, then miter folded using the sheet as a hinge to form a seamless, drop-front edge that improves rigidity, durability and visual appeal.

Design and Production of Membrane Pressed Shelving

KYDEX, LLC

ISO 9001 and 14001 Certified

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All top and side surfaces of the machined substrate were sprayed with adhesive, then placed in a membrane pressing machine that heats the thermoplastic sheet and fuses it to the top and sides of the routed substrate using a combination of physical pressure above the sheet, and vacuum below. After the part cools and excess sheet is trimmed from its bottom edge, the backside is CNC routed with a 90° V-groove miter which is sprayed with adhesive and closed using the film as a hinge, forming the sculpted, drop-front edge of the completed shelf.

"The finished miter folded shelf is solid as a rock," explains Joe Romano, president of East Coast Cabinets, continuing, "Carving these patterns into solid wood would cost a fortune, and would lack the durability provided by the protective surface cladding."



The museum store at the Smithsonian Institution's Kenneth E. Behring Hall of Mammals complements the exhibition theme using a landscape of slat wall in graduated earth tones, and three-dimensional shelving that is membrane pressed and miter folded with KYDEX® sheet in ivory colour.

The most vulnerable areas of a membrane pressed component in high traffic environments are the corners, edges and high spots - the same areas where heated thermoplastic sheet tends to thin-out as it conforms to the contours of the routed substrate, reducing impact resistance where it is needed most. The durability of a membrane pressed component is therefore related not only to its mechanical properties at room temperature, but its ability to resist thinning-out at stretch points during forming at temperatures of 163-200°C (325-392°F).

"The KYDEX® sheet material is formulated for thermoforming applications, and we found it effective at maintaining a uniform wall thickness, confirmed by cross-section quality checks of (membrane) pressed parts. Although it's a rigid, heavy gauge sheet product, extensibility is sufficient to form a sharp 90 degree outside corner during miter-folding without heating of the sheet at the fold point," says Romano.

According to Mercogliano, the store's new look is harmonious with that of the mammal exhibit owing in part to the three-dimensional, organic shapes achieved by membrane pressing of the shelving. With the added durability of rounded corners and protective cladding, he anticipates the shelving will continue to look new longer than possible using conventional materials and manufacturing techniques.

The Smithsonian Institution's Kenneth E. Behring Hall of Mammals, 25,000 sq ft interactive hall, features 274 taxidermied mounts and mammal fossils telling the story of the processes by which mammals arose and continue to adapt.

East Coast Cabinets, Inc. is a wholesale manufacturer and sub-contractor for millwork, exhibit and display houses. 2250-A Sherman Ave., Pennsauken, NJ 08110. 856-488-9710. <http://www.eastcoastcabinetsinc.com>

**New Look
Expected to Keep
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Membrane Pressing and Miter-Folding Basics

Cutaway shows 19mm (0.750") MDF board that has been CNC routed with mammal skin patterns and membrane pressed with KYDEX® sheet, encapsulating all top and side surfaces of the substrate. The backside was then routed with a 90° miter without touching the sheet - that was coated with adhesive and folded using the sheet as a hinge, creating a seamless outside corner.

Membrane pressing uses an inflated bladder or "membrane" to physically press heated plastic sheet onto a routed wood or composite substrate or "core" that has been sprayed with adhesive. Core surfaces can be flat or machined to create three-dimensional contours and seamless edges with compound curves since the flexible membrane presses the plastic into recesses and onto all sides, encapsulating all top and side surfaces including rounded corners, sharp profiles, undercut edges and fine details - virtually any flat or three dimensional shape that can be routed into a substrate. After milling, all top and side surfaces of the substrate are sprayed with adhesive, placed on the bed of a membrane pressing machine, then slid into a chamber where the thermoplastic sheet is heated and drawn onto the substrate by a vacuum below the sheet as it is pressed onto the substrate by an inflated membrane from above. Once cooled, excess sheet extending beyond the bottom edge is trimmed.



The three-dimensional capabilities of membrane pressing offer greater design freedom than flat laminating, and can improve durability when specialized thermoplastic sheet products that resist impact, chemicals and fire are utilized. If desired, outside corners and sharp edges can be beveled or rounded to reduce the chance of damage and/or improve safety. When total encapsulation of the part is desired, the bottom surface of the wood substrate can be prelaminated and/or heat welded at its perimeter.



Miter-folding is an innovative method of mitering the edges of two or more sections of pre-laminated wood sheet at any angle, with no visible outside seam, giving a solid, "of-one-piece" appearance to the finished component. This is accomplished by laminating the substrate (normally MDF board) with thermoplastic sheet (normally 0.70mm [0.028"] thickness), then routing a V-groove (miter) across the backside of the wood—deep enough to penetrate the wood but without touching the sheet. Both mitered wood edges are then sprayed with adhesive and hinged on the sheet to close the groove, forming an outside corner that is hidden by the seamless sheet. In addition to eliminating outside seams, miter-folding can significantly improve part alignment and structural integrity, while reducing labor cost and protecting the fabricated component from damage.

Membrane pressing and miter folding of 19mm (0.750") MDF board with KYDEX® sheet produced high-strength, impact resistant, chemical resistant shelving that withstands high traffic environments and repeated cleaning with harsh cleansers, while complementing the museum store's design theme.

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