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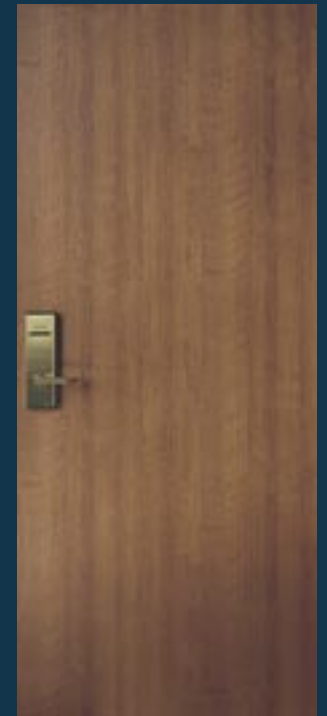
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Today's High Pressure Decorative Laminate Doors Combine The Best Of Both Worlds

WHITE PAPER

Today's high pressure decorative laminate (HPDL) doors offer a wide range of design options for endless creative possibilities, as well as performance features that comply with industry requirements for accessibility, fire safety, security and sustainability. This blending of form and function creates the best of both worlds for architects, contractors and building owners who demand product longevity that's aesthetically appealing. The following special report from architectural wood door manufacturer VT Industries Inc. examines the features and benefits of HPDL doors.



Introduction

Advances in manufacturing technology and materials used have resulted in a new generation of HPDL-faced architectural wood doors featuring hundreds of design options and performance features specially engineered to comply with industry requirements for accessibility, security and fire safety.ⁱ

Among the improvements found in today's HPDL wood doors are:ⁱ

- Laminate patterns that capture more depth, detail and contrast due to enhanced computer and printing technology.
- Smoother visual surface characteristics resulting from substrates that are more uniform.
- A stronger HPDL-to-wood bond from advanced adhesive and hot-press technology.
- New surface resin chemistry and additives that have led to low maintenance surface sheen or texture that gives the impression of depth and dimension to the laminate face material.
- Innovative manufacturing technology that applies the edge before the face protects the edge from damage and delamination.
- New core materials and construction methods enable manufacturers to meet positive pressure fire requirements for 20-minute, 45-minute, 60-minute and 90-minute interior doors.
- Door materials containing recycled or recovered fiber content, or made from certified lumber originating in forests that meet established standards for environmentally responsible forestry practices, comply with the design community's growing preference for "green" products.

Looks That Last

All components of a typical HPDL door have improved from a quality and cost perspective, compared to doors from earlier decades. This improvement, along with new construction of hotels, motels, hospitals and schools, has resulted in a growing demand for decorative laminate doors, which are available in a full range of colors, patterns, wood grains and custom laminates. Users rarely encounter the kind of chipping or delaminating edges as a result of the glue systems and ability to apply laminate edges before the face laminate to "lock in" the edge

strip. The edge-before-face design also conceals the seams for a more attractive appearance.ⁱⁱ

Basically, HPDL consists of multiple plies of phenolic resin-coated kraft papers covered with a high-grade decorative paper layer that is compressed under high pressure and heat (a minimum of 1,000 psi at 280-300 degrees F) for an extended period of time.ⁱⁱⁱ

The number of kraft/phenolic layers in each sheet of HPDL determines its thickness. Various thicknesses are available that meet NEMA requirements.

Surface textures are transferred from stainless steel plates to the top surface as the paper layers are bonded together during manufacturing. Once the pressure cycle is completed in a hydraulic press, the backside of the laminate sheet is sanded to provide better adhesion in fabrication and the edges are trimmed.^{iii, iv}

While most door designs are available with a standard matte finish that has moderate reflective qualities, others feature premium surface textures such as:^v

- Wood grain textures that have the feel of wood grain ticking and the look of hand-rubbed oil.
- Finely beaded textures that resist smudges and finger marks.

TABLE 1 NEMA TEST REQUIREMENTS FOR HPDL

TEST	NEMA REQUIREMENTS
Wear Resistance: Wear Value (cycles)	400 (minimum)
Dart Impact Resistance	300MM
Impact Resistance: (Inches dropped)	35
Dimensional Change: % MD, Max. % CD, Max.	0.6% 1.0%
Room Temp. Dimensional Stability % MD, Max. % CD, Max.	0.6% 1.0%
Resistance to Boiling Water	No Effect
Resistance to High Temperature	Slight Effect
Radiant Heat Resistance	100 seconds (minimum)
Stain Resistance	Unaffected by reagents 1-10; moderate 11-15
Light Resistance	Slight Effect
Cleanability	20

FACE MATERIAL PERFORMANCE

NEMA LD3 LATEST EDITION	STANDARDS	HPDL	LPDL (MELAMINE)
3.8 Ball Impact Resistance Scope: This test measures the ability of high pressure decorative laminate to resist fractures due to impact by a polished stainless steel ball, weighing 224 ± 3 grams.	50" minimum	58-66" (exceptional impact performance)	15"
3.13 Wear Resistance Scope: This test measures the ability of the surface of high pressure decorative laminate to resist abrasive wear-through of the decorative layer.	400 cycles minimum	700-1,000 cycles, solids, patterns or wood grains (exceptional wear performance)	400-500 cycles, solid colors; 125-150 cycles, patterns or wood grains
AWI 8th EDITION, Section 1300	Face Material	Recognized as quality standard	Not Recognized
WDMA I.S. 1-A QUALITY STANDARDS	Face Material	Must meet NEMA Standard LD 3, latest edition	Must meet LMA, latest edition, Voluntary Product Standards and Typical Physical Properties of Decorative Overlays

- Pebble textures with the look and feel of coarse-grained sand.
- Embossed finishes that recreate the feel of flat cut wood.
- Smooth, reflective surfaces that interact with color.
- Some laminates, textures and finishes require an upcharge and/or may not be available in door-sized sheets.

Performance standards for HPDL are established by the American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA) LD 3-2000 (see Table 1).^{iii, iv}

Bright, colorful doors not only provide a design aesthetic at the elementary and middle school level, they can be functional as well by defining areas.



At the college and university level, doors are often more traditional wood grains, with the most popular being Oak, light to mid-tone Maples and fruitwoods.

NEMA also sets the standard for low pressure laminate (Melamine), which is a single, thin sheet of decorative paper that is saturated and compressed under low pressure (approximately 600 psi at 392 degrees F) for 20 seconds. It is often used on the vertical surface of various kitchen, bath and furniture applications. A comparison of HPDL and Melamine is presented in Table 2.^{iv}

From Classroom to Boardroom

Laminate manufacturers offer hundreds of up-to-date design options, including solid colors, patterns, custom designs, and textures. These new design options are popular in education, health care, hospitality, day-care centers, entertainment, retail and office environments.^{vi}

Classroom and shared learning space design has taken on added importance as designers, parents, teachers and students become more aware of the impact of color and design on behavior and morale. At the elementary and middle school level, the use of bright, youthful colors is on the rise. Colorful doors not only provide a design aesthetic, they can be functional by distinguishing lower grades from upper level classrooms. At the college and university level, doors are often traditional wood grain laminates, such as maple, oak and fruitwoods.ⁱ

Improvements in the visual and physical texture of HPDL woodgrain designs have contributed to the increased acceptance of decorative laminate doors by designers, architects and specifiers during the past decade. Laminate wood grains are free of the gum pockets, pin knots or "natural" imperfections sometimes found on wood veneer doors. With natural wood veneer, doors will vary from one to another and can be difficult to match with interior trim and casework. The desire for consistency from door to door in the high-rise office building market has helped spur the use of decorative laminate by architects and designers.^v

Growing in popularity are designs that appear as solids from a distance, but actually have textural complexity, such as micro-textures or larger, heavier textures. Abstract designs that mimic the natural world with fibrous patterns, or create a brushed or hammered metallic effect, are being used in commercial office settings to create the warm feeling of wood. The aesthetics of these abstract designs are enhanced by premium surface textures to create a three-dimensional effect.^v

HPDL doors resist smudging and fingerprints often seen on wood doors in cafeterias or fast-food facilities where greasy handprints can cause embedded dirt that requires the door to be refinished or replaced. HPDL doors can be wiped down with general-purpose cleaners to remove smudges or fingerprints and are tolerant of disinfecting detergents used in health care facilities. Stains from pencil marks and inks, such as felt tipped pens, are removed using a solvent, such as denatured alcohol, fingernail polish remover, mineral spirits or paint thinners.ⁱⁱⁱ



In health care environments, decorative laminate doors are easier to clean and maintain and do not promote the growth of bacteria, microbes or fungus.

For tough jobs, such as removing paint graffiti from a door's surface, several cleaning products have been successfully tested under controlled conditions. Those products included:^{vii}

- Hair Spray (non-aerosol), which completely removed paint after sitting for 15 seconds, leaving no residue on the surface. (At Kent State University, maintenance personnel were able to clean off permanent marker graffiti from HPDL-faced dormitory doors by using ordinary hair spray and a dry cloth.ⁱ)
- Lacquer thinner worked well in removing the paint after sitting 60 seconds.
- Citrus based industrial cleaner (manufactured by 3M) completely removed paint after sitting for 15 seconds, leaving no residue on the surface.



Custom laminates such as this colorful design used in a pediatric clinic are visually appealing and can provide designers with a way to customize an interior space in a cost-effective manner.



Among the innovative aspects of decorative laminates is the ability for the designer to customize the design of the laminate, such as this interior auditorium door at a Hollywood movie theater complex.

- SoyPower® Graffiti Remover completely removed paint after 60 seconds, leaving an oily residue on the surface.

Water-based paints are removed with an ammoniated household detergent. In addition, laminate clad doors resist the growth of bacteria, microbes or fungus attributed to wood veneer doors.ⁱⁱⁱ

Laminate does not facilitate the growth of bacteria, microbes or fungi because of its melamine coating. Doors are available with laminated end rails for use in health care facilities or other applications where a smooth, impermeable finish is desired. Laminated end rails are available on both HPDL and wood veneer doors, meeting most negative pressure and positive pressure fire door requirements.^{viii}

Doors Illustrated

Laminate manufacturers can print any type of design including murals, logos, room numbers and other graphics for reproduction in a laminate form used to surface the face of the door. Custom HPDL doors, featuring images designed into the decorative paper, are gaining popularity in elementary schools and pediatric floors of hospitals to create a child-friendly atmosphere.ⁱ

Custom laminate technology is a noticeable improvement over earlier techniques that required manually piecing different colored papers together, which was time-consuming and created a dirt trap along the seams. The older method was also chip-prone, unlike the new custom process which incorporates all the colors and graphics into a single piece with no seams. Graphic imaging opens a world of design opportunity to architects. With graphic imaging, a full-color photographic image or original

artwork is scanned into a computer and transferred onto the decorative paper and turned into laminate surfacing material.ⁱⁱ

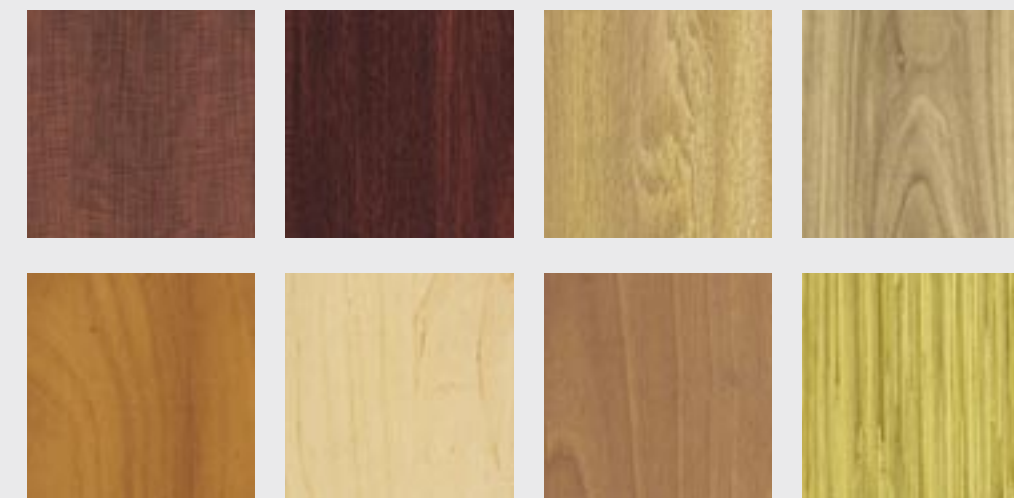
Decorative laminate doors provide a viable alternative to set-matched or blueprint-matched wood veneer doors, making them more cost effective and environmentally responsible.^{vi} Wood grains representing lighter-colored species such as oak remain a mainstay in health care facilities where they tend to promote a cheerful healing environment and fit in well with a wide range of interior treatments. Honey-colored mid-tones also are finding their way into new health care environments as maple, cherry and other fruitwood species gain popularity.ⁱ

Wood grain laminates provide the hospitality industry a uniform appearance and don't exhibit the visual inconsistencies of wood veneers.



A trend in recent years has been the expanded use of HPDL wood doors by major hospitality chains and in the restaurant and lounge industry. HPDL wood doors are being selected by the lodging industry for their visual appeal, lasting durability, ease of maintenance and uniformity of appearance across franchise operations.^{vii}

Moreover, as the world's supply of trees dwindles and attention is drawn to healthy workplaces, the design community finds that laminate provides the unique look of exotic wood species without depleting the global supply of these precious resources. Laminate



Decorative laminates allow designers to choose from a variety of wood species that some consider an improvement on nature.

Note: Some laminates, textures and finishes require an upcharge and/or may not be available in door-sized sheets.

TABLE 3

COST COMPARISON CHART HIGH PRESSURE DECORATIVE LAMINATE VS. 5-PLY WOOD VENEER

FACE MATERIAL	COST COMPARISON*
HPDL (3-ply construction)	0%
Red oak	+55%
Natural Birch	+70%
Mahogany	+81%
White Maple	+88%
Cherry	+91%
Anigre	+110%

*Cost comparison based on a 100-door project using 3-0 x 7-0 particle core doors, 20-minute fire rating, prepped for standard hardware, average field finished veneers, sold through distribution. Source: VT Industries

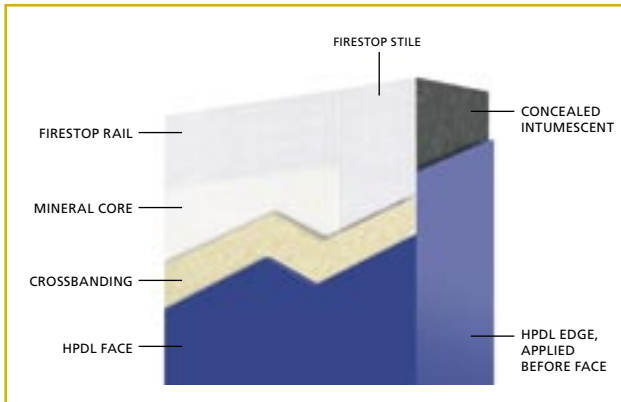
doors need little or none of the refurbishing and finishing wood veneer requires. HPDL doors arrive at the jobsite completely finished and ready to hang, saving installation time and expense.^{ix} Field finishing can add to the overall cost of wood veneer doors (see Table 3).

The Inside Story

Architectural HPDL wood doors can be engineered to comply with an assortment of national, industrial and local standards including:^x

- American Disabilities Act (ADA) accessibility standards designed to accommodate persons with a wide range of disabilities, including those with mobility impairments who use wheelchairs, canes, crutches, or walkers.
- STC (Sound Transmission Class) performance standards (American Society for Testing and Materials [ASTM] E90-90 and E 413-87). Typically, solid core wood doors with a particleboard, SLC core or SCL core achieve an STC rating in the lower

20s, which is sufficient to prevent loud speech or a television from becoming an annoyance. Under some conditions, it may be necessary for the installer to install perimeter gasketing and drop seals to bring STC ratings up to the mid 30s. Special construction material inside the door can provide even greater STC ratings and using acoustical lite kits, it is possible for STC doors to maintain an above average acoustical rating.



AN EXAMPLE OF CATEGORY A POSITIVE PRESSURE FIRE DOOR CONSTRUCTION.

- Security ratings are based on ASTM testing standards (F476-84 Standard Test Methods for Security of Swinging Door Assemblies) covering door assemblies of various materials and types of construction to deter unwanted intruders and frustrate the commission of “break-in” crimes. The door must be capable of sustaining an impact from a weighted ram pendulum system without damage to its stiles.
- A myriad of regional, state and local enforcement codes. All architectural wood doors must be engineered to meet specifications for fire ratings, which can vary from one jurisdiction to the next, placing the burden on the architect to specify door constructions that comply with the standard being enforced in their areas.^{ix} (Note: Wood door manufacturers do not accept responsibility for interpretations of local fire codes.ⁱ)
- HPDL interior wood fire doors are designed to meet fire-resistance ratings of 20- to 90-minute, depending on their location in the building.^{xi} Many code groups across the U.S. have adopted the International Building Code (IBC) which contains the requirement for doors to be tested under positive pressure instead of negative pressure.^{xiii} In order to meet this positive pressure requirement,

special core materials and innovative construction techniques have been developed that restrict the outflow of hot gasses and other combustibles from around the door in case of a fire. These materials can be concealed inside the edge of the door without distracting from its aesthetic appeal.^{xi}

What’s Ahead?

New commercial-oriented directions seen on the horizon for HPDL users include “fractured solids” patterns that appear as subdued solid colors from a distance, but showcase a complex textural complexity up close.^v

HPDL manufacturers are fusing organic and synthetic fibers and materials to create hybrid designs and patterns. Use of pearlescent ink that provides a translucent effect similar to frosted and etched glass is providing a subtle depth to the high pressure laminate design. Wood grain designs featuring subtle graining and color that is more complex, appearing more like an actual wood veneer versus a piece of plastic, also offer dimensional quality that appears visually tactile.^{ix}

In addition to HPDL wood grain patterns, some manufacturers offer a hybrid product that has a hardwood veneer on a phenolic backer laminate. These hybrid materials provide natural wood characteristics, but without the sanding and finishing required with wood veneer doors.^{xiii} Other trends envisioned by designers with decorative laminate manufacturers include:^{xiv}

- Personalizing and customizing spaces with exciting and exotic laminates.
- Adding luster and depth with special effect surface finishes.
- Producing realistic representational images of natural materials.
- Indulging in a flight of fanciful patterns and playful designs.

Wood door manufacturers are responding to the growing demand for environmentally responsible building designs and materials that help architects earn points toward “green” building certification under the LEED (Leadership in Energy & Environmental Design) Green Building Rating System™ and U.S. Army Corps of Engineers’ Sustainable Project

Rating Tool (SPiRiT). Criteria for achieving certification under these programs include use of Forest Stewardship Council (FSC) certified wood, use of recycled content and regional materials, and the use of low-emitting adhesives, sealants, paints, coatings and composite wood.^{xv, xvi}

As an alternative to using exotic wood veneers, HPDL designs are available that have the look and feel of a variety of different wood species. These wood grain designs can fool a skilled eye into believing it is looking at real wood veneer.^{xvii}

Manufacturers are also machining their doors for quick and hassle-free installation at the jobsite. Some manufacturers offer factory-installed glazing and pre-drilled pilot holes for hinges and faceplates, which reduces the chance of stiles being split during installation. Most manufacturers also offer the same product warranty on decorative laminate doors as wood veneer doors. Many offer lifetime-of-the-installation guarantees, and some include reasonable re-hanging costs.^{i, xviii}

Summary

- Today’s higher-fidelity wood grain reproduction print techniques and premium finishes have no connection to the “simulated wood grain” look from the 1970s.
- Premium surface textures provide visual, tactile and maintenance benefits, such as resisting scratching and finger marks that can mar veneer wood finishes. Surface textures also give HPDL designs a “three dimensional” depth perception while resisting scratching and smudging.
- HPDL doors deliver “exceptional” impact and wear performance according to NEMA LD3 latest edition standards.
- Architectural HPDL doors are engineered to comply with an assortment of national, industry and local standards including ADA Standards for accessible design, ASTM security ratings, STC acoustical ratings, and a myriad of regional, state and local enforcement codes.
- New core materials and construction techniques have been developed to meet positive pressure fire door requirements under the Uniform Building Code (UBC 7-2-1997).



Hundreds of HPDL design options are available, including these popular selections.

Note: Some laminates, textures and finishes require an upcharge and/or may not be available in door-sized sheets.

- New commercial-oriented directions include “fractured solids,” which appear as subdued solid colors from a distance but showcase a complex textural elegance up close and European-inspired retro designs.
- In all segments of the design world today, there is a robust move toward product decisions that call into question the use of scarce and lesser-tolerant materials.
- Factory machining prepares doors for quick and hassle-free installation at the jobsite.