

5

Exhibit Case Construction Materials

- 5:1 [Safe and Harmful Materials for Use in Exhibits](#)
- 5:2 [Testing Materials for Use in Exhibits](#)
- 5:3 [Hazardous Emissions from Wood Products](#)
- 5:4 [Using Plywood for Exhibit Case Construction](#)
- 5:5 [Using Composite Panels for Exhibit Case Construction](#)
- 5:6 [Barriers and Sealants for Wood Products](#)
- 5:7 [Using High Pressure Laminates in Exhibit Case Construction](#)
- 5:8 [Interior Paints for Exhibit Cases](#)
- 5:9 [Using Decorative Fabrics Inside Exhibit Cases](#)
- 5:10 [Adhesives for Use Inside Exhibit Cases](#)



Narrative Guidelines



Case Details & Illustrations



Figures and Tables



5 Technical Note



Exhibit Case Construction Materials

5:1 Safe and Harmful Materials for Use in Exhibits



The [stability of materials](#) used in close proximity to collection objects, including the materials used to build exhibit cases, is an important conservation consideration.

Are some construction materials safer to use in close proximity to museum collections?

Research and experience has shown that some materials are more acceptable for use in close proximity to museum collections. These materials are non-acidic, non-outgassing, and chemically and physically stable. The chart in this TechNote list materials implicated in the unnecessary deterioration of museum collections, and those considered to be more acceptable.

Some Materials To Avoid	Pollutants
Woods <ul style="list-style-type: none"> oak sweet chestnut Douglas fir yellow pine red mahogany (Khaya) teak western red cedar cork 	acetic and formic acids; organic peroxides
Wood-bonded products <ul style="list-style-type: none"> masonite chip board particle board interior plywoods bonded with urea formaldehyde C grade plywoods 	formic acid from adhesives; acetic and formic acids and peroxides from wood
Papers <ul style="list-style-type: none"> Unrefined wood pulp papers and cardboards 	organic acids, peroxide, sulfur
Plastics <ul style="list-style-type: none"> polyvinyl chloride polyvinylidene chloride bubble wrap cellulose nitrate cellulose acetate, cellulose diacetate, cellulose triacetate (most stable in group) 	hydrogen chloride and plasticizers hydrogen chloride and plasticizers polyvinyl chloride used in adhesive nitric acid variable—acetate group can evolve acetic acid



5:1 Safe and Harmful Materials for Use in Exhibits



Rubber (vulcanized natural or synthetic)	sulfur
Foams <ul style="list-style-type: none"> polyurethane low molecular weight polymer sponges polyesters (generic term; variable; may be under-cured) 	organic acids; acetates
Paints <ul style="list-style-type: none"> oil oil modified (alkyd, tung oil, tall oil, in mineral spirits, oleo-resinous) latex (styrene butadiene, polyvinyl acetates, vinyl acrylic emulsion with lithopone pigment) 	fatty acids, sulfur, hydrogen peroxide, aldehydes fatty acids, sulfur, hydrogen peroxide, aldehydes ammonia, fatty acids, sulfur, hydrogen sulfide
Waxes and Plasticene	fatty acids, sulfur
Varnishes <ul style="list-style-type: none"> polyurethanes oil based latex 	variable, formic acid, organic acids, fatty acids
Adhesives <ul style="list-style-type: none"> protein-based glues (animal) rubber-based or plasterized cellulose nitrate polyvinyl acetates (especially low molecular weight) urea formaldehyde adhesives 	sulfur sulfur nitric acid acetic acid formic acid
Fibers <ul style="list-style-type: none"> wool, animal fur, semi-tanned skins and leather nylon 6 and nylon 66 permanent press and crease -resistant fabrics flame-resistant fabrics pest proofing fabrics dyed with sulfur dyes 	sulfur sulfur formaldehyde formaldehyde formaldehyde sulfur

Selection of exhibit construction and [finishing materials](#) should be drawn from the following list which is taken from the current conservation literature.

Materials shown to be more appropriate for use in exhibits

Woods

- Well seasoned, air-dried spruce, mahogany, walnut, basswood, poplar, balsa
- Exterior grade [plywood](#) bonded with phenol formaldehyde or non-formaldehyde emitting glue
- High-density or medium-density [boards](#) using formaldehyde-free adhesive; e.g. Resincore I; Medite II; Medex



5:1 Safe and Harmful Materials for Use in Exhibits



- Paints (require aeration/thorough curing and isolation from direct contact with display objects)
- **Acrylic latex:** test each brand and color before use; aerate cases at least three to four weeks before object installation
 - Shellac: aerate case at three weeks before object installation
 - Two-part epoxy resins; 100% solid precisely mixed; aerate at least three weeks
- Plastics
- **Polyacrylonites:** e.g., Plexiglas, Lucite
 - Polyethylene: non-chemically polymerized polypropylene in sheet corrugated form
 - Polycarbonates
 - Polystyrenes: variable
 - Polyester: variable- e.g., Mylar D which is polyethylene terephthalate
 - Teflon (PTFE) tape
- Foams
- Polyethylene: e.g., Volara type A; gas expanded foams such as Plastazote
- Adhesives** (require aeration/thorough curing)
- Acrylic polymer solutions (e.g., Acryloid B-72)
 - Wheat starch pastes
 - Methyl cellulose
 - Polyvinyl acetate emulsions, neutral pH adhesive; may evolve acetates and acidic acids— aerate case thoroughly before object installation
 - Double sided archival tape; e.g. 3M 415
 - Hot-melt adhesives: e.g., Thermogrip 6330, Evo-Stik 7702
- Caulking** (requires aeration/thorough curing)
- Silicon-based sealants without ammonia, such as RTV (Room Temperature Vulcanized)
- Mechanical fastening methods
- stainless steel or monel alloy staples and pins; sleeve pin mounts with inert tubing
- Fabrics**
- Vegetable fiber cloths: cotton, linen; wash with hot water before use
 - Polyesters
 - Acrylics
- Papers
- Acid-free pH unbuffered (neutral) paper products (for use with photographs and protein-based materials such as silk, wool, semi-tanned skins, leathers)
 - Acid-free buffered (alkaline reserve) papers (for most other materials)



Products, Manufacturers, and Suppliers

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1. Plastics

Mylar D
Cloroplast

2. Foams

Volara
Plastazote

3. Adhesives

Acryloid B-72
3M 415 Tape
Thermogrip 6330
Evo-Stik 7702

The above products can be ordered through the following companies:

CONSERVATOR'S EMPORIUM
100 Standing Rock Circle
Reno, NV 89511
Telephone: 702-852-0404
Fax: 702-852-3737

GAYLORD BROS.
P.O. Box 4901
Syracuse, NY 13221-4901

UNIVERSITY PRODUCTS INC.
517 Main Street
P.O. Box 101
Holyoke, MA 01041-0101



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5:1 Safe and Harmful Materials for Use in Exhibits



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Padfield, D.E. and W. Hopwood. "Trouble in Store." *Science and Technology in the Service of Conservation. IIC Congress*, Washington DC (1982): 24-27.

Tennant, Norman H. and Thomas Baird. "The Deterioration of Mollusca Collections: Identification of Shell Efflorescence." *Studies In Conservation*, 30 (1985): 73-85.

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Exhibit Case Construction Materials

5:2 Testing Materials for Use in Exhibits



Unknown or potentially hazardous construction and finish **materials** must be tested before they are used in an exhibition within close proximity to display objects.

Can some products be eliminated without going through the trouble of testing?

Reviewing as much information as possible about its chemical and physical properties is the first step in evaluating a potential construction or finishing material. This information includes the manufacturer's product information such as the material safety data sheet. Talking with the manufacturer's technical department and other museum personnel who have used the product can prove very useful.

Any of the following factors may affect the stability of the material or product:

- Stability of parent components and additives varies greatly. There are classes of **unstable materials** to be avoided. In particular, avoid **urea formaldehyde**, sulfur or "sulfonated", chloride or chlorine, ammonia, formic or acetic acid.
- Additives dispersed throughout the parent materials, including foaming agents, co-polymers, plasticizers, and bulking agents that affect the handling characteristics.
- Surface finishes affecting the handling or safety characteristics include slipping agents, permanent press finishes, moth-proofing, and fire retardants.
- Stabilizers added to increase the useful life of a product degraded by ultraviolet radiation, heat, visible light, or inherent chemical instability.

How do I test materials selected through initial research?

A number of simple methods can be used to test a sample of the material. None are as scientific as chemical analysis using mass spectroscopy or other appropriate equipment. While the techniques listed below can be used as an indicator, results may not be entirely accurate or repeatable.

- Enclose the sample in a clean, dry glass vial with an all-glass or all-metal lid. Set the jar in the sun or another heated location. If a smell is noticeable when opening the jar after several days, it is likely that chemicals have outgassed from the material.



5:2 Testing Materials for Use in Exhibits



- A plastic material can be tested for the presence of chloride by placing a sample on the end of a copper wire and heating it in the flame of a gas burner. A green flame indicates chloride.
- The "Oddy" test identifies materials that are particularly inappropriate for use due to high amounts of outgassing. A material that passes the Oddy test may not, however, be stable over the long-term. Many products include stabilizers which may not be exhausted during the course of this test. Test results have been shown to be inconsistent.²

How is the Oddy test procedure carried out?

The following "Oddy" test¹ method is based on enclosing a sample of the material to be tested in a well-sealed container along with polished blanks of metal and a piece of pH-neutral paper. A moisture reservoir in the container maintains a high humidity and the container is heated; the heat and moisture accelerate reactions. The test blanks are visually inspected daily and any changes in appearance recorded. A determination of material suitability is made based on the speed and severity of any reaction.

The test requires two containers; glass containers sealed with PTFE tape or glass jars with all-metal screw lids can be used.

- Control container: Required for a comparison and to insure that a problem with the test preparation itself does not cause a false reaction. The control contains metal blanks of silver, copper and lead and pH-neutral paper, but not the material to be tested.
- Test container: Includes as much sample of the material to be tested as possible. Metal blanks of silver, copper and lead and pH-neutral paper are used as indicators of harmful volatile chemicals. Record the initial pH of the paper. Allow one half of each test blank to overlap the material being tested. This will test for problems caused by contact with the material as well as deterioration caused by chemical outgassing.

Place a small vial of water in each container and seal. Place both containers in an oven at approximately 140°F (60°C). Avoid opening the containers during the test period as this will dissipate any outgassing. Examine the blanks daily for signs of corrosion, pitting, tarnishing, or other change; record and date observations. The pH of the paper is measured at the end of the test.

The test should be run for a minimum of six weeks. The method is best at screening out particularly unstable products. Additives that improve the aging characteristics of a material may not be



5:2 Testing Materials for Use in Exhibits



exhausted during the test. Also, low levels of emissions over longer periods of time may cause damage not detected during the relatively short testing period.

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1. Metal Blanks

Silver- 99% foil 1 1/2" x 0.004" 5X0165 030
GM (30g for \$51.10)
Copper- foil 0.005" thick C11549-100GM
(100g for \$7.13)
VWR Scientific
501 31st Street Parkersburg, WV 26188
Telephone: 304-485-5123

Lead- foil 12" x 0.008" thick L27-11B
(lb. for \$21.70)
Fisher Scientific
7722 Fenton Street Silver Spring, MD 20910

2. Polishing Materials and Glassware

Precipitated carbonate
Denatured Ethyl Alcohol
Flasks/petri Dishes
Fisher Scientific
(see above)



5:2 Testing Materials for Use in Exhibits



- ¹The test is generally referred to as the Oddy test. The recommendations in this TechNote are based on the experience of Nancy Davis and on the following published resources:
Berndt, H. "Assessing the Detrimental Effects of Wood and Wood Products on the Environment Inside Display Cases." *AIC Preprints; Thirteenth Annual Meeting, Washington, DC* (1985): 22-23.
Blackshaw, S.M. and V.D. Daniels. "The Testing of Materials for Use in Storage and Display in Museums." *The Conservator* 23 (1979) 16-19.
Oddy, W.A. "An Unsuspected Danger in Display." *Museum Journal* (1973): 27-28.
- ²The NPS in cooperation with the University of Delaware is conducting research to develop a replacement test.

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Exhibit Case Construction Materials

5:3 Hazardous Emissions from Wood Products



Acidity and [outgassing](#) of formaldehyde make wood a problematic material from a conservation viewpoint.

Why is wood, used in exhibit construction, a conservation concern?

Acidity, naturally occurring in wood, is the primary conservation concern when using solid wood products. This acidity can migrate into collection objects that come in contact with the wood, and can release emissions thus creating an acidic environment. Studies have shown that hardwoods are higher in acidity; however; soft woods are more permeable, and therefore release volatile substances more readily.

- Tropical hardwoods are relatively impermeable and do not emit large quantities of acetic acid, making them [good choices for museum applications](#).

Maximum evolution of organic acids occurs when wood is rendered into sawdust. Knot holes, end grain and open-grained woods are also sites of accelerated emissions.

- Protect collection objects from redeposition of acidic deposits by containing dust generated during exhibit production.
- Exclude knots, seal end grain and avoid exposed wood joints inside an exhibit case. (Paraffin wax applied thickly is an effective end grain sealant)

Why are wood-bonded boards of concern?

Both acidity from the wood and chemical outgassing from adhesive used to produce wood boards pose dangers to collections. Formaldehyde adhesive systems are the major source of formaldehyde emissions from bonded boards, although some formaldehyde may result from thermal processing of the wood. Within sealed enclosures, concentrated levels of volatile formaldehyde and acid initiate or accelerate the deterioration of some artifacts.

Outgassing formaldehyde has been shown to:

- crosslink proteins and cellulose;



5:3 Hazardous Emissions from Wood Products



- cause color change in some pigments;
- corrode metals;
- cause crystal formation on glass.

Two types of formaldehyde-based adhesive systems, urea and phenol formaldehyde, are used to manufacture plywoods, particle boards, and medium-density fiberboard (MDF).

- Urea formaldehyde: This system outgases both volatile formaldehyde and residual ammonia used during the manufacturing process as a scavenger of formaldehyde. Most interior hardwood plywoods are made with urea formaldehyde. Wood composite boards—particleboard and medium-density fiberboard (MDF)—are made with the urea formaldehyde adhesive systems and are acidic (typical pH is below 7).
- Phenol formaldehyde: Although unreacted or free formaldehyde is always present in small amounts, once cured, phenol formaldehyde is stable. Plywood manufactured with phenol formaldehyde has extremely low formaldehyde emissions. Industry tests typically record emissions of 0.1 ppm from fresh panels; these emissions decrease over time (four to six months after manufacture) to 0.03 to 0.04 ppm.

What are the alternatives?

For obvious practical and financial reasons plywood and composite panels remain primary construction materials. Whenever wood products are used for exhibit case construction, use a solid wood board, [plywood](#) or [composite panel](#) that has minimal levels of acid and outgassing. Other materials that can be substituted for wood in the display chamber of an exhibit case are listed below. Due to cost restrictions, several of these [options](#) are usually reserved for critical situations.

- aluminum, steel or sheet metal;
- commercially available metal and paper honeycomb panels; some have similar strength and rigidity to wood products, and are machined in the same way. Visible areas are covered with a fabric lining, attached mechanically to avoid the introduction of volatile adhesive emissions;
- dry wall board; due to its porosity, sheet rock cannot be used in climate control cases.

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Exhibit Case Construction Materials

5:4 Using Plywood for Exhibit Case Construction



The [least problematic plywood](#) for use in exhibit cases are softwood plywood with an exterior adhesive system and hardwood plywood which meets the ANSI/HPVA HP-1-1994 standard.

What types of plywood are used to construct exhibit cases?

There are four basic types of plywood panels:

- Veneer core: several thin sheets of wood called veneers bound together with an [adhesive](#). The grains of the adjacent veneers are arranged at right angles with the face grain parallel to the panel length. After the adhesive is applied to the core veneers, it is cured in a hot press under high temperature and pressure.
- Particleboard core: chipped wood between face and back sheets of wood.
- Lumber core: face and back sheets of wood with a solid lumber core between.
- Medium-density core: face and back sheets of wood with a medium-density fiberboard (MDF) core.

Plywood can be made from either softwood or hardwood panels; both are used in museum exhibits.

- Softwood plywood: generally used for structural applications such as roof sheathing, floor sheathing and single floor systems. Because it must withstand temporary exposure to the elements, softwood plywood is often made with exterior grade phenol formaldehyde adhesive.
- Hardwood plywood: designed for interior applications such as furniture, wall paneling and cabinets. Since the exterior requirements for adhesion do not apply, and because a clearer adhesive is desirable, most interior plywood contain urea formaldehyde. Hardwood panels bonded with phenol formaldehyde to meet HUD (Housing and Urban Development) standards and state regulations can be recommended; however, they are not always available.



How do I select a conservation appropriate plywood?

Exterior softwood plywood are considered among the safest plywood because they are bonded with phenol-formaldehyde resin. Softwood plywood is generally made from pine, fir, spruce and often consists of the same species of wood throughout the board. Sitka spruce is the preferred wood due to its lower resin content; Douglas fir may be more readily obtained and is preferable to pine.

- The only softwood plywood considered suitable for exhibit case fabrication are those with exterior adhesive systems of phenol formaldehyde.

The outer veneers of hardwood plywood are often birch, oak, cherry, maple, etc. The veneer core can be made from particle board, MDF, or a hardwood lumber core. Plywood with solid wood core are hard to find and expensive; they usually must be specified from a softwood core and ordered ahead of time. They are marketed for cabinet construction and have therefore been used to construct exhibit cases. Birch is preferred due to its lower acid content. Oak is not used because of its high acidity.

- A phenol formaldehyde bonded hardwood with a hardwood veneer core should be requested when choosing hardwood plywood.

Approximately 25 years ago hardwood plywood emitted very high levels of formaldehyde. HUD (Housing and Urban Development) standards were created in response to health problems associated with use of hardwood plywood in residential construction. These interior hardwood plywood now have emissions of 0.13 to 0.14 ppm. To assure that you are purchasing this type of hardwood plywood with the lowest emission rate, check for the code ANSI/HPVA HP-1-1994 on the back. Only plywood panels with this code have passed federal and state regulations which allow a volatile emission rate of up to 0.3 ppm.

- Purchase plywood that are stamped as meeting ANSI/HPVA HP-1-1994 standards.

Although such a low-emitting product eliminates most of the formaldehyde, plywood remains a problem for case construction because the wooden components release acid emissions. When possible, use ventilated display case designs to assure a higher rate of air exchange and thus avoid the buildup of unwanted pollutants. If a case is to be tightly sealed, plywood must be isolated with a [barrier](#) film, a conservation appropriate sealant, or [plastic laminate](#).



5:4 Using Plywood for Exhibit Case Construction



For more information about plywood products contact:

Engineered Wood Association (APA)
P.O. Box 11700
Tacoma, WA 98411
Telephone: 206- 565-1524

The Hardwood Plywood and Veneer Manufacturers Association
P.O. Box 2789
1825 Michael Faraday Drive
Reston, VA 22090
Telephone: 703-435-2900

United States Forest Service
Department of Agriculture
Madison, WI
Telephone: 608-231-9592

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Exhibit Case Construction Materials

5:5 Using Composite Panels for Exhibit Case Construction



A number of particleboards made without [formaldehyde resins](#) can be used to build exhibit cases, as long as the surface is sealed to prevent acidic outgassing and migration.

What are composite panels?

Of the four major types of composition panels, only two are practical for [exhibit case construction](#).¹

- Particleboard: made from particles of waste wood mostly adhered by urea-formaldehyde resin; used for underlayment, cabinets, furniture and stairs.
- Medium-density fiberboard (MDF): composed of wood fibers mostly adhered by urea-formaldehyde resins; used for cabinets, furniture and moldings.

Most particleboard and MDF present conservation concerns because of their urea-formaldehyde resin content.

Are any composite boards acceptable for exhibit case construction?

There are voluntary standards for particleboards and MDFs. Particleboard standards ANSI A208.1-1993 allow up to a 0.20 ppm formaldehyde emission level for certain products. MDF standards ANSI A208.2-1994 allow up to a 0.30 ppm emission level. Several manufacturers produce specialized boards using either a phenol-formaldehyde resin or a polymeric diisocyanate adhesive system, both of which emit very little formaldehyde.

The following composite boards are rated as low emission products; others may also meet low emission levels.

- Particleboard: Resincore I (manufactured by Rodman Industries) is a homogeneous wood particleboard bonded with phenol formaldehyde resin. The manufacturer reports volatile formaldehyde emissions of approximately 0.04 ppm based on the ASTM large chamber test.
- Medium-density fiberboard: Medite II and Medex (manufactured by the Medite).



5:5 Using Composite Panels for Case Construction

Map



2

Corporation) use formaldehyde-free adhesive systems.

1. Medite II is an interior fiberboard made from mixed softwoods and formaldehyde-free polymeric methylene diisocyanate (pMDI). The manufacturer reports a formaldehyde emission level of less than 0.01 ppm. It has the same physical characteristics as other fiberboards and can be easily machined, cut and sanded.
2. Medex is a medium-density fiberboard originally designed for exterior uses such as road signs. It contains mixed softwoods bonded with isocyanates and small amounts of paraf-finic wax and mineral wax. It is heavier than plywood, 15 -20% stronger than Medite II, and has a smooth surface. Since it is an exterior fiberboard, it is more water repellent than Medite II. The manufacturer reports volatile emissions levels less than 0.01 ppm.

Are protective coating and laminates necessary for low-emitting composite panels?

Because particleboard and fiberboard contain wood chips and sawdust, the potential for airborne acidic emission is considerable. Any of these boards used to construct exhibits should be well-sealed on the interior and [end grain](#) surfaces or isolated through the use of [barrier films](#), sealant coatings or [laminates](#). Because the boards are absorbent, do not store specialized particleboard and MDF with products that can emit any significant amount of formaldehyde.

For more information about particleboard and MDF products contact:

The Engineered Wood Association (APA)
P.O. Box 11700
Tacoma, WA 98411
Telephone: 206- 565-1524

Composite Panel Association
18928 Premiere Court
Gaithersburg, Maryland 20879-1569
Telephone: 301-670-0604
Fax: 301-840-1252

USDA-FS Forest Products Laboratory
One Gifford Pinchot Drive
Madison, WI 53705-2398
Telephone: 608-231-9200
Fax: 608-231-9592



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1. Particleboard

Resincore I
Rodman Industries
2601 Cleveland Avenue
Marinette, Wisconsin 54143
Telephone: 715-735-9541

Medite II and Medex
Medite Corporation
P.O. Box 4040
Medford, Oregon 97501
Telephone: 541-773-2522 Fax: 541-779-9921

¹ Hardboard is made for siding, paneling and underlayment and is composed of wood fibers. Phenol-formaldehyde resins are most often employed. Oriented Strand Boards (OSB) have strands of wood directionally oriented and are similar to, but not the same as Waferboard which has randomly aligned strands. Phenol-formaldehyde and some isocyanate resins are employed.

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Exhibit Case Construction Materials

5:6 Barriers and Sealants for Wood Products



Volatile emissions from construction materials can be blocked from entering the display chamber by a layer of impermeable foil or composite film (e.g. aluminum/polyethylene), or by a number of coats of a conservation appropriate sealant.

When should I use a barrier film or sealant?

Reducing [emission levels](#) inside a case to the lowest possible level is particularly important when exhibit cases are sealed and if the display objects are especially vulnerable to chemical deterioration. Isolating the surfaces of problem materials is a practical and cost effective measure to [reduce emissions](#). Numerous advantages are gained from the application of barrier foils, films and sealants:

- blocking of volatile construction material [outgassing](#) from entering into the [display chamber](#);
- physical isolation of collections from the migration of acid from wood products used in construction;
- blocking of water vapor transmission through construction material for cases designed as microclimates;
- extending the useful life of a pollution absorbent.

What are barrier films and how are they used in exhibit case construction?

Barrier films are thin sheets of metal, and/or plastic, that are impermeable to moisture vapor and most gases. These films were originally designed to meet military specifications for the storage of equipment. Moisture permeability ratings are published, but specifications on gas permeability are more difficult to find in product literature. Barrier films have been used by some museums since 1980 as a way to lower emissions from wood products.¹

Most vapor barrier films used in exhibit cases are multi-layered, flexible sheets that include a film that limits water vapor transfer. This film is often aluminum, or in transparent films, polychlorotrifluoroethylene (PCTFE for example in Aclar). This layer is sandwiched between two layers of polyethylene with an outside surface layer that provides specific handling or application properties



5:6 Barriers and Sealants for Wood Products



such as strength, printability or heat-sealability. The outer layer also protects the laminate. **Barrier film** is relatively easy to work with as it can be heat-sealed to itself allowing case panels to be completely wrapped in the film. Points to consider when using a film barrier, such as Marvelseal 360 and Aclar, include:

- film can be sealed with a hot iron;
- Aclar requires higher seal temperatures than the aluminum foil films;
- seal dull sides together;
- joints in the film should be overlapped by at least 1/4 inch;
- the films can also be heat-sealed directly to wood and other materials;
- acrylic and polyvinyl acetate adhesives can be used to laminate most films to wooden surfaces;
- the film must remain puncture-free to provide an effective seal.

What coating systems can be used as a sealant inside an exhibit case?

Choosing a coating system that forms an impermeable layer to volatile contaminants is difficult, largely due to (1) the permeability of most dried paint films and coating, and (2) the tendency for films to develop micro-cracks from dimensional changes in wooden substrates.

Over the years museum exhibitors have tried numerous sealants without great success. Polyurethane resin coatings have been recommended in the past; however, the common type of oil-modified polyurethane contains alkyds. Research and testing performed at the Canadian Conservation Institute has shown that moisture borne (emulsion or latex) urethanes are a better choice. Also, two-part resin coatings such as 100% solid epoxy are relatively successful in providing a vapor barrier. Most paint systems, however, do not form effective barriers, even if the paint itself has relatively low emissions, such as acrylic latex paint.

To increase the effectiveness of coatings as vapor barriers, apply material liberally and in several applications and follow the manufacturer's directions. As a rule of thumb, coatings should be at least 1 mm. in thickness. This translates into approximately 3 coats applied with a roller or paint brush, or 6-8 coats of spray application. Sealing joints with caulking material prior to painting is recommended.



Products, Manufacturers, and Suppliers

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1. Barrier Films

Marvelseal 360 (aluminum foil) and
Marvelseal 1177 (transparent)
Ludlow Corp. Laminating and Coating Div.
4058 Highway 79
Homer, LA 71040
Telephone: 318-927-2531
Fax: 318-927-9825

FoilORap FR 2176 (aluminum foil); Foil-O
Rap FR 7750 (transparent); and Film-O-RAP
FR 3300 (flame resistant and transparent)
Bell Fiber Products
PO Box 1158
Columbus, GA 31993
Telephone: 404-323-7316

Nomex®Crate Liner (Dupont aramid fiber)
Masterpak
50 W. 57th Street 9th Floor
Manhattan, NY 11101
Telephone: 800-922-5522
Fax: 212-586-6961

Aluminum foil/plastic
Royco Packaging
3979 Mann Rd.
Huntingdon Valley PA 19006
Telephone: 215-322-8082
Fax: 215-322-9260
Polyester/aluminum sandwich
Distributor- Art Preservation Services
315 E. 89th St.
New York, New York 10128
Telephone: 212-722-6300
Fax: 212-427-6726

2. Coatings

Sancure 878
(aliphatic waterborne Urethane)
BF Goodrich Company
Performance Resins and Emulsions
Division
300 Whitney Street
Westminstre, MA 01453
Telephone: 978-537-4748
Fax: 978-537-8245



5:6 Barriers and Sealants for Wood Products

Map



4

Dexter Brothers
44 Rugg Rd.
Boston, MA 02134
Telephone: 617-332-3434

Aqua-Coat
(water-soluble polyurethane)
Sterling-Clark-Lurton Corp.
184 Commercial Street
Malden, MA 02148
Telephone: 781-322-0163

Polyglaze 1-146 Spray Grade;
1-175 Brush Grade;
(flat, semi-gloss or gloss finishes; clear or
pigmented water based aliphatic urethane)
Camger Chemical Systems, Inc.
364 Main St.
Norfolk, MA 02056
Telephone: 508-528-5787

Interprotect 1000 (Interlux 1000-1001)
(Clear epoxy coating, 100% solid)
Interlux
International Paint INC.
2270 Morris Avenue
Union, NJ 07083
Telephone: 908-686-1300
Fax: 908-686-8545
Distributor:
McClellan Brothers
122 North Langley Road
PO Box 819
Glen Burnie, MD 21061
Telephone: 301-761-9200

¹ Complied from a number of sources including articles by John Burke, Oakland Museum Conservation Center.

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5 Technical Note



Exhibit Case Construction Materials

5:7 Using High Pressure Laminates in Exhibit Case Construction



During the past two decades decorative laminates have had considerable use within cases. The major melamine resin brands of high pressure laminates, if carefully used, can be employed safely in museum exhibits .

What is a high pressure laminate?

High pressure laminates are rigid sheets made of a paper composite. A decorative top sheet is impregnated with melamine resin (an amino resin made from formaldehyde and melamine) and then laminated under high pressure to multiple sheets of Kraft paper embedded with phenol formaldehyde resin.¹ The surface texture or effects are made by impression with a textured paper or a metal sheet. Major manufacturers include Formica, Wilson Art, and International Paper.

Do the laminates outgas harmful chemicals?

The high pressures and heat used during manufacturing eliminate much of the solvent from the adhesive systems. There appears to be no significant outgassing of formaldehyde from the resins. When newly manufactured laminate sheets are cut, heated, or worked in some manner, some release has been recorded. One manufacturer recommends letting a laminate set from six months up to a year to dissipate any potential formaldehyde emission.

Wilson Art and Formica Corporation have tested their products with the Formaldehyde Test Method-2 1985 (also referred to as the large chamber test) and found emissions of between 0.01 and 0.04 ppm. These levels fall far below (up to 75 times) the maximum level for safety in the work place (current OSHA Standard is 0.75 ppm in 8 hours) and below the threshold for object damage.

Certain laminates include a fire retardant additive, for example, aluminum tri-hydrate(ATH). In general they are to be avoided in exhibit case construction because of possible salt formation and outgassing problems. In some instances salt crystals have formed on the back side of fire retardant laminates.



How are laminates used in exhibit construction?

High pressure laminates are used in museum cases as a decorative and/or protective layer over a substrate such as a wood product. Exhibit designers and fabricators use laminates for aesthetic reasons. If applied correctly, laminates can also provide the following conservation benefits:

- Act as an effective barrier against the outgassing from wood and wood products: The EPA considers these products to be encasing materials, indicating that they will function as a vapor barrier against volatile emissions from particleboard and other substrates.
- Assist in stabilizing a microclimate in sealed exhibit cases: Because the melamine layer is impermeable to water vapor, the laminate can reduce moisture interference from wood and wood products used to construct the case. The phenolic resins, however, swell with water; this can cause a laminate in a case maintained at a high relative humidity to warp.

There are a number of precautions to follow when using a laminate inside an exhibit case.

- Avoid the re-moldable laminates: Because they are under-cured compared to the general purpose laminate grade, these products can be heated and shaped. It is likely that re-molded laminates are less moisture resistant and more likely to outgas formaldehyde than the general purpose grades.
- Use adhesives carefully: The adhesives used to glue the laminates onto a substrate such as particleboard are a major potential source of volatile contaminants. These contact cements should be used outside of the exhibit area where adequate ventilation exists; use no more than the amount recommended by the manufacturer. Remove all adhesive residue from the laminate surface and allow at least three weeks curing time before objects are located inside the case.
- Make sure that there are no raw edges of a laminate exposed inside an exhibit case; all edges must be tightly fitted and gaps along seams filled with appropriate [caulk sealant](#) to prevent emissions.



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High Pressure Laminates

Formica Laminate
Formica Corporation
10155 Redding Rd.
Connecticut, OH 45241
Telephone: 513-786-3400
Web: www.formica.com

Nevamar and Micarta
International Paper
8339 Telegraph Rd.
Ardenton, MD 21113
Telephone: 410-519-2127
Fax: 410-551-0340

Wilson Art Laminate
Wilson Art
2400 Wilson Place
P.O. Box 6110,
Temple TX 76503-6110
Telephone: 817-778-2711

Pionite Decorative Laminate
Pioneer Industries
1 Pionite Rd.
Auburn, MA 04210
Telephone: 207-784-9111
Fax: 800 PIONITE

¹ Formica uses a water-based rather than a solvent-based phenolic resin.

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Exhibit Case Construction Materials

5:8 Interior Paints for Exhibit Cases



The selection of paints used in exhibit cases is an important conservation decision because of the high level of **emissions** produced by most commercial paints. Systems based on water-based acrylic resins with zero or low VOC **emission** rates are recommended.

Why are paints a conservation concern?

A paint system generally consists of a solution composed of pigments, a binding medium and a solvent (or vehicle). In the past, paints have been selected with little scrutiny as to their contents and possible effect upon materials being displayed within the case. Today, any solvent-based paint used in close proximity to exhibit objects is considered problematic due to the harmful effects of volatile organic compounds (VOCs) given off by these coatings. Objects are not safe unless a low (or zero) VOC product is chosen. Direct contact with any painted surfaces is not recommended due to the possible transfer of components and the **acidic nature** of many paint systems.

- VOCs are substances that contain carbon and evaporate readily.¹ VOCs that are harmful to objects include aromatic hydrocarbons, such as benzene and toluene, and chlorinated hydrocarbons, such as methylene chloride.² The interaction of sunlight with emitted VOCs can form ground level ozone.
- The measurement of the coating's VOC level is a good way to determine whether the paint is safe to use in an exhibit case. A low or zero VOC content is desirable, and is measured in "grams of VOCs per unit volume.
- The U.S. Environmental Protection Agency regulates levels of VOC emissions in paints.⁴ Paint labels display the "grams of VOCs per liter."⁵ A rule of thumb is the stronger the smell of paint fumes, or the higher the gloss level, the higher the VOC content.

Low VOC Paint Levels	Metric	English
Non-flat paint.....	0 - 150 g/l	0 - 1.25 lbs/gal
Flat paint.....	0 - 50 g/l	0 - 0.42 lbs/gal



What paints can be recommended for use inside exhibit cases?

There are some general considerations to follow in choosing a paint.

- Solvents and additives: Avoid paints with aromatic hydrocarbons, some of the most damaging VOCs. Research and inquire about other additives which may be present in paint such as mold retardants.
- Resin type: Oil and alkyd-based binders in paints are not appropriate for use inside an exhibit case. Latex paint is more breathable, has better color and mildew resistance, and expands and contracts with wood more easily than an alkyd paint.
- Barrier effectiveness: Neither alkyd nor latex paint creates an effective vapor barrier coating for wood products. Their film is permeable to wood offgassing and formaldehyde emissions. Use latex paint over a specifically formulated [barrier coating](#), foil or laminate.

Acrylic latex paints (emulsions) are dispersions of pigments in a liquid continuous phase of water and an acrylic resin, prepared by emulsion polymerization. Latex water-based paints with acrylic binders are essentially solvent free and are therefore among the safer paints for use within cases. Latex paints are variable, however, and may contain ammonia, sulfur or other undesirable chemicals. Selection and application of a paint should include the following considerations.

- 100% acrylic latex paint has proven successful in meeting restrictive conservation criteria.
- Paint loaded with calcium carbonate offers some benefits when acidic materials are a particular concern.
- Paint loaded with titanium dioxide will absorb UV light.
- Remove objects from the painting area during application.
- Never place objects inside the case until the paint is thoroughly dry to the touch and a curing time of at least three weeks has elapsed.
- Be aware that water-based acrylic latex paint can become tacky during periods of high humidity; isolate collection objects from painted surfaces.
- Although they do not provide a barrier to volatile emissions from the wood, shellac and other air-drying lacquers are acceptable clear coatings. Some plastics and resins or gasket and caulk products may react with the alcohol in shellac.

The commercial paints in the following table meet the "Green Seal" standard for VOC levels and prohibited ingredients.³



5:8 Interior Paints for Exhibit Cases



Zero or Low VOC Recommended Paints		
MANUFACTURER	PRODUCT NAME	VOC LEVEL G/L
Benjamin Moore	Pristine Flat	26
Benjamin Moore	Pristine® Eggshell	23
Benjamin Moore	Pristine Semi-Gloss	18
Con-Lux	Enviro-plex Flat White	0
Duran	Genesis™ Flat	0
Duran	Genesis™ Semi-Gloss	0
Duran	Genesis™ Gloss	0
ICI Dulux Paints	Lifemaster™ 2000 Eggshell	0
ICI Dulux Paints	Lifemaster™ 2000 Semi-Gloss	0
ICI Dulux Paints	Lifemaster™ 2000 Flat	0
PPG	Speedhide Wall Flat	19
PPG	Speedhide Enamel Eggshell	25
PPG	Speedhide Enamel Semi-Gloss	14
Sherwin Williams	ProMar 200 B3 I W200 Series Semi-Gloss	37
Sherwin Williams	HealthSpec™ B5 Series Flat	0
Sherwin Williams	ProMar 200 B30 W200 Series Flat	19
United Point Mfg.	Aladintone Satin	41
United Point Mfg.	Pointers Choice Eggshell	46
United Point Mfg.	Parade Flat	12
United Point Mfg.	Coverall Flat	14
Primer Paints		
Benjamin Moore	Fresh Start Exterior Primer	31
ICI Dulux Paints	Lifemaster 2000 Interior Primer	0
PPG	Speedhide Sealer	41
Sherwin Williams	PrepRite B28 W300	50
Sherwin Williams	PrepRite 200 B28 W200	26
Sherwin Williams	HealthSpec B11 W44	0
Sherwin Williams	PrepRite Anchor-Bond B51 W50	18
United Point Mfg.	Adhere-it (WB) Primer-Sealer	44
United Point Mfg.	Acrysheen Primer-Sealer	34
United Point Mfg.	Canyontone Water Base Primer-Sealer	39
VOC - Volatile Organic Compound. Rating is by G/L - grams per liter of product minus water. All VOC level information was provided by the manufacturers.		



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Manufacturers of Low-VOC Emitting Paints

Pristine Series

Benjamin Moore
800-826-2623
Distributor; CT Walls
Charles Town, WV
Telephone: 304-725-1461

Enviro-Plex Series

Con-Lux Coatings, Inc.
Box 847 Talmadge Road
Edison, NJ 08818

Genesis Series

Duron Paints and Wallcoverings
10406 Tucker Street
Beltsville, MD 20705
Telephone: 800-723-8766
Web: Duron.sales.com

Safecoat Paint (not tested)

Earth Friendly Products, AFM Enterprises
Alternative Energy Engineering, Inc.
P.O. Box 339
Redway, CA 95560

Lifemaster Series

ICI Dulux Paints
925 Euclid Avenue
Cleveland, OH 44145
Telephone: 800 984 5444
Distributor; 3711 MacCorkle Ave., SE
Charleston, WV 25304
Telephone: 304-925-4955

Speedhide Series

PPG
Telephone: 888 774 1010
Distributor: Duron Paints and Wallcoverings
5807 Highway 85
Frederick, MD
Telephone: 304-728-8722

ProMar and HealthSpec Series

Sherwin Williams
Telephone: 216 566 2151
Fax: 800-474-3794
Distributor; 10 Jefferson Crossing
Charles Town, WV 25414
Telephone: 304-728-8722



5:8 Interior Paints for Exhibit Cases



Aladintone, Pointers Choice, Parade, Coverall Series
United Paint Mfg. Co.
Telephone: 800-541-4383

Green Seal Inc.
1001 Connecticut Avenue, NW, Suite 827
Washington, D.C. 20036
Telephone: 202-872-6400
Fax: 202-872-4324
e-mail: karen.banks@greenseal.org

- 2. Organizations Focusing on Paint VOCs**
U.S. Environmental Protection Agency (EPA)
Research Triangle Park
Raleigh, North Carolina 27711 Telephone:
919-541-5408

- ¹ For specific VOCs, consult the U.S. Environmental Protection Agency (EPA) Code of Federal Regulations (CAR) Title 40, Part 60 Appendix A.
- ² Carbon dioxide, nitrogen oxides and sulfur dioxides are not VOCs but are also emitted into the atmosphere. Either alone or in association with VOCs, they contribute to a range of current or potential atmospheric pollution effects, like ozone depletion, the greenhouse effect, and acid rain.
- ³ Recommended VOC levels, Green Seal Inc. Green Seal Newsletter August-September, 1998 (www.greenseal.org)
- ⁴ Section 59.402 of the Federal Register. VOC contents are tested by the EPA's Reference Method 24.
- ⁵ The specific definition is "grams per liter excluding water or exempt compounds, thinned to the maximum thinning recommended by the manufacturer," Vol. 61, No. 171, September 1996, Proposed Rules of the Federal Register.

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Exhibit Case Construction Materials

5:9 Using Decorative Fabrics Inside Exhibit Cases



The dyes and finishes applied to many fabrics make them inappropriate for direct contact with collection materials. Only [certain fabrics](#) with a 100% pure fiber content and water stable dyes can be selected.

What are the principle conservation concerns when selecting fabrics for case interiors?

Experience has shown that many fabrics are [inappropriate](#) for use as case liners. Decorative textile fabrics used within exhibit cases for aesthetic or interpretive reasons must therefore meet [conservation criteria](#). The principle concerns are the fiber type, additives, dye stability and transfer, and surface characteristics of the finished fabric.

Fiber type:

- Wool is a sulfur-containing protein, which upon degradation, emits hydrogen sulfide gases which are corrosive to metals, especially silver.
- Cellulose acetate fibers can degrade to produce acetic acid.
- Polyvinyl chloride-containing fibers, part of the group of fibers called vinyls, produce volatile hydrogen chloride when exposed to heat and light.
- Volatile organic compounds (VOCs) are emitted by some fibers, like wood
- Adhesive and/or foam backings on hook and loop material (such as Velcro) can emit harmful VOCs into the environment of the case. Only hook and loop materials without these features should be employed.

Additives:

- Sizing additives are glutinous materials such as starch or acrylic acid derivatives (resins) added to fill the pores or surfaces of the yarn or threads in order to withstand the abrasive forces of the weaving or machining process. Sizing can react with display objects.
- Ammonia and mercerization treatments produce fabrics with very different characteristics. Residual chemicals can cause deterioration problems.
- Permanent press/fire retardant treatments use acidic chemicals, like urea formaldehyde, and a variety of other chemicals (disodium phosphate, etc.) which degrade readily and become volatile.



5:9 Using Decorative Fabrics Inside Exhibit Cases



- Carpets often include rubber, foams or adhesives which make them unsuitable for the enclosed environment of a case.

Dyes:

- Dyes can sometimes bleed or rub off onto materials which come into contact with them. This dye transfer can occur through dry abrasion of the surface or when the fabric is exposed to water or solvents. Very unstable dyes can become soluble during high humidity and leach into surrounding material.
- Direct dyes for cotton and linen using sodium chloride or sodium sulfate assists should be avoided.
- Choosing a light-fast dye prevents premature replacement of the material.

Surface characteristics:

- Delicate surfaces can be damaged by abrasive fabrics and knapps.
- The fabric can aid or inhibit the physical stability of objects; knots or imperfections in the knapp can prevent an object from resting securely on a surface. Velveteen and other smooth-knapped fabrics can help hold an object in place, for example when it is placed on a sloping surface.
- Carpets trap dust and insects and can provide an uneven and abrasive surface for artifacts.

How can textile materials be safely incorporated into a case?

Textile fabrics are extremely variable. It is especially important that a fabric used as a case lining be researched and tested, both for volatile outgassing and for damage that can occur from direct contact. In addition to the [Oddy test](#) examine dyes for water solubility by blotting a piece of the wetted fabric with white toweling, or by immersing sample in water for 15 minutes, then blotting. There are a few practical measures that make the use of fabric in a display case safer.

1. **Use the safest types of fabrics:** Unfinished cotton, linen, silk and synthetic fabrics are good choices.
 - Unbleached cotton, linen, silk should not contain any foreign matter or processing chemicals.
 - Synthetic materials have very low water absorbency or retention, and low abrasion qualities.
 - Polyester offers strength, abrasion resistance, and resistance to tearing.
 - Nylon (polyamides) have similar characteristics to polyester.
 - Acrylic, part of the group of fibers called vinyls or acrylonitrile, is chemically resistant and strong.



5:9 Using Decorative Fabrics Inside Exhibit Cases

Map



3

- 2. Isolate objects from direct contact:** Objects should only come into contact with stable materials. Use polyethylene or polyester sheeting, or other inert materials as a barrier between the object and decorative fabrics of uncertain stability.
- 3. Prepare the fabric for use:** Fabrics should be washed in a neutral detergent to remove excess dyes and finishes, and to preshrink fabrics; to remove all residual dye, wash until the water runs clear.
- 4. Avoid using adhesive:** Attach fabric mechanically; sewing is the best option. Rust-proof staples, tacks, pins, or archival-quality self-adhering tape can also be used.

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1. Fabrics Free of Surface Finishes

TestFabrics, Inc.
P.O. Box 26
415 Delaware Ave.
West Pittston, PA 18643
Tel: 717-603-0432
Fax: 570-603-0433
e-mail: testfabric@aol.com

Whaley's (Bradford)
Harris Court, Great Havton
Bradford West, Yorkshire BD7 4EQ
Telephone: 440-1274-576718
Fax: 44 0-1274 521309
e-mail: Whaleys@btinternet.com
Web: www.whaleys-bradford.ltd.uk



5:9 Using Decorative Fabrics Inside Exhibit Cases

Map



4

2. Polyester Felts and Knapped Fabrics

100% polyester felt with or without acrylic adhesive backing

Benchmark

P.O. Box 214

Rosemont, NJ 08556

Telephone: 609-397-1131

Fax: 609-397-1159

e-mail: dnchmark@voicenet.com

Prelude felted, Front Runner knapped fabrics

Melded Fabrics, Inc.

13926 Equitable Rd.

Cerritos, CA 90703

Telephone: 888-MELDEDS

Fax: 562-802-3227

e-mail: mfiusa1@aol.com

3. Hook and Loop Fastener Compatible Fabrics

Showtime Fabric or Gilford Fabric

(100%polyester; these fabrics are free of the low quality foam backing; available in different colors)

ExpoSystems

8701 Georgia Ave., St. 110

SilverSpring, MD 20910

Telephone: 301-587-3907

Fax: 301-587-7849

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Exhibit Case Construction Materials

5:10 Adhesives for Use Inside Exhibit Cases



Adhesives used to secure case liners, graphics and other elements to the case interior must meet [conservation standards](#) for low outgassing and stability, and must continue to function well over time.

Which adhesives should I avoid using inside a case?

Most adhesives emit large quantities of solvents and un-reacted monomer [volatile substances](#) during their drying or setting phase. Even after this initial period, lower levels of outgassing can continue indefinitely. In the past, a wide variety of glues and adhesive systems were used indiscriminately in exhibit assembly. Today a myriad of new and complex formulations are available on the adhesives market making the selection of a conservation-appropriate adhesive a difficult process.

Research has shown that some of the most damaging adhesives fall into the categories of "contact" and "pressure sensitive" adhesives. Rubber-based adhesives, either vulcanized or synthetic, age badly due to sulfur and chloride content. Traditional hide glues can be problematic due to their sulfur content. Two-part adhesive systems, such as epoxy and polyester types, also have a poor track record for stability.

Adhesive types to avoid within close proximity to exhibit objects include:

- **Rubber-based:** Avoid any adhesive that is based on or contains natural or synthetic rubber because of likely poor aging characteristics.
- **Animal glues:** This adhesive type contains residual sulfur and is therefore not a good choice for use in enclosed spaces.
- **Vinyl emulsions:** Emulsion-type adhesives in which a resin is dispersed in water, include polyvinyl acetate emulsions. These "white glues" do outgas, especially once the shelf life has expired.

Adhesives considered acceptable include:

- **Acrylics:** Acrylic adhesives are a stable class of adhesives that can be chosen for most



museum applications. Acrylics are used in many types of solvent adhesives, adhesive tapes, hot-melt adhesives, and stick formulations.

- **Hot melt:** Acrylic hot-melt adhesive sticks used in heat guns are approved for exhibit use; these are usually clear sticks. Opaque sticks with a yellow cast often contain waxes and other additives that make them a less desirable choice.

How can adhesives be used safely within the case?

Careful design of exhibits can actually lessen the need to use adhesives. Exhibit cases can be designed so that adhesives do not interface with the display chamber. When adhesives must be used inside the display chamber, joints should be sealed with a conservation-appropriate caulk. Alternatively, a laminate can be applied over seams. Unfamiliar adhesive systems require investigation and careful scrutiny; the key guidelines for selection are:

- Use mechanical fastening techniques. Whenever feasible, use a mechanical attachment method, such as staples, pins or construction overlap. In particular, attaching fabric case liners mechanically greatly reduces the amount of adhesive exposure within a case.
- Exclude adhesives from the case interior. Design the exhibit case and use construction techniques to limit the use of adhesives inside the case itself. Use conservation-appropriate laminates and caulks to create effective barriers at joints to prevent infiltration of volatile adhesive components.
- Use conservation-appropriate adhesive. Use adhesive systems which have a track record and include appropriate chemical components, such as acrylic resins and high-temperature, hot-melt adhesives.
- Aerate the adhesive. Allow sufficient time for the curing and setting of adhesives before objects are enclosed in the exhibit case. A minimum period of three weeks is recommended during which time the case doors should be open and bonnets left off.

Are adhesive tapes all right to use inside an exhibit case?

There are two types of tapes that have applications in case construction: adhesive transfer and double-sided. Adhesive transfer systems use paper backings to support the deposition of a layer of adhesive onto a surface. Double-sided film tapes have two surfaces of adhesive with a plastic carrier sandwiched between. The adhesive systems are usually based on rubber or acrylic adhesives. An acrylic adhesive should be chosen. The carrier films of pressure sensitive tapes are generally stable enough to use within a museum setting. An acrylic carrier is preferable to polyurethane.



If sufficient surface area is covered, such tapes can be used in a variety of case applications including adhering wood veneer and fabrics and boards. Some tapes are actually manufactured as replacements for mechanical fasteners.

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1. General Adhesive Source

Talas
568 Broadway
New York, NY 10012
Telephone: 212-219-0770
Fax: 212-219-0735
e-mail: talas@sprynet.com

Conservator's Emporium
100 Standing Rock Circle
Reno, NV 89511
Telephone: 702-852-0404
Fax 775-852-3737
e-mail: consemp@aol.com

Bostik
Boston Street
Middleton, MA 01949
Telephone: 508-774-7376

2. Adhesive Tapes

Scotch VHB (Very High Bond) Foam Tape 4910, and VHB Adhesive Transfer tape F9460PC (VHB) (Double coated and adhesive transfer tapes with acrylic adhesive; joining systems include low outgassing).
3M Industrial Tape and Specialties Division
3M Center, Building 220-7E-01
St. Paul, MN 55144-1000

3M Tapes 8671, 8672, 8681, 8663 (Scotch Polyurethane Protective Outdoor Grade; polyurethane with pressure-sensitive acrylic adhesive.)
3M Industries
(see above)



5:10 Adhesives for Use Inside Exhibit Cases

Map



4

Archival Filmoplast and 3M #415 Tapes
(A range of archival quality pressure sensitive tapes; some double-sided; range of carriers and adhesives)
Talas (see above)

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