

## Storage Furniture

Storage furniture is often overlooked, but the cabinets and drawers and shelves in your storage area play a vital role in protecting the collection from most sources of damage. Factors such as cost, purpose and type of collection need to be considered when choosing new storage furniture. You will need to select construction materials and decide between cabinets, drawers, shelves, screens or mobile or stationary racks. All can be purchased readymade or built specifically for your museum.

### FURNITURE MATERIALS

To ensure long-term preservation, all materials used in storage must be selected carefully. Poor quality materials can cause chemical and biological damage. Select inert construction materials that pose no hazard to the collection. In the long run, inert structural materials, adhesives, paints, finishes and laminates save money by preventing expensive conservation treatment and future storage upgrades.

Ideally, unknown materials should be tested for acids or other harmful components. Conservators have data on previously tested and acceptable construction materials and can assist in testing new materials. A simple test to help you select materials and a list of stable materials are described in chapter on **materials**. (in MS 203, more in MS 204)

Paints, adhesives and caulks require at least three weeks to cure. Do not place collections into new storage until the materials are fully cured. If you can detect an odor, allow the unit or room to air longer.

### Conserva-tips

1. Construction materials should be free of acids or harmful chemicals.
2. Test new or untested materials before using them.
3. Allow materials to cure.

### Metal Storage units

From a conservation perspective, metal storage furniture is best. Metal is strong and does not emit harmful vapors. Aluminum is preferred because of its strength, light weight and resistance to corrosion. Brass and stainless steel, while expensive for cabinets, are used for mounts. Steel is most commonly used for shelves and cabinets. In arid climates with RH below 32 percent, metal coating may be unnecessary. However, granting agencies that are familiar with preventive conservation typically ask that metal units be coated regardless of local climatic conditions.

### **Metal Coatings**

There are three common metal coatings found on museum storage furniture: paint, baked enamel and fused-polymer powder. Of these, the best is powder because it is applied using less solvent and thus is less likely to produce damaging fumes. (Although it does produce fumes. See Hawks, 2000.) While not as desirable as powder coatings, baked enamel and paint are commonly found on steel fixtures in museums. Powder coatings are applied by using an electrostatic charge to hold pigment in polymer particles to the metal surface. The steel substrate is given a static charge, and the dry powder is sprayed toward it. A uniform coating is developed and held in this manner until the metal is placed in a furnace to melt the pigment into a continuous coating. Powder coated furniture has become readily available, and you should consider powder coating even for homemade welded furniture. Powder coating facilities are found in many areas and can be located by contacting your local motorcycle repair shop. Baked enamel is considered an adequate coating and usually is found on older storage furniture. In this process, the metal is painted and then placed in an oven. Baking hardens the coating and drives off most solvent vapors. However, the resulting finish may emit harmful solvent fumes for many years. Metal paint is the least desirable option again because it can produce harmful gases for many years. These gases can be released as paint deteriorates or if it is exposed to solvents.

Testing is important. All coated storage furniture should be tested before it is used or purchased to determine whether it is releasing acidic fumes. Hit powder coated metal with a ball peen hammer. If it dents without cracking or flaking, it is a good coating. Swab baked enamel with various solvents to determine if it is stable. Contact a conservator for assistance.

### **Wood Storage Units**

From a conservation standpoint, wood products are not ideal. While wood offers some advantages, chiefly its ability to buffer humidity fluctuations, it also emits acids and organic compounds that harm many objects. If you use wood fixtures, you should consider replacing them. Failing that, wood fixtures can be refurbished with laminates to seal in harmful fumes.

The density and type of wood affects acid emissions. For example, while hardwoods tend to be more acidic, soft woods are more permeable, thus both can emit equal amounts of acid. Many tropical hardwoods are more inert. The most acid is emitted when wood is turned into sawdust, which is found in particleboard and fiberboard. These products are made of wood particles or fibers bound by three different adhesives: urea-formaldehyde, melamine-formaldehyde and phenol-formaldehyde. These wood

products are a chemical soup and potentially dangerous to any collection item. For example, the wood chips and urea-formaldehyde adhesive in commercial chipboard tarnishes metal within a few months. Formaldehyde released by adhesives damage proteins, cellulose, pigments, metal and glass. Resins and other chemicals in particleboard emit formic acid, phenols, hydrochloric acid and other acids, ammonia, hexamine and melamine.

Older wood cabinets may be less damaging than new ones because much of the acid contained in the wood has been emitted. However, tests of some oak cabinets show acid fumes being produced after 50 years. If you plan to continue using old wood fixtures, test them by placing an acid-detection (A-D) strip or a polished piece of lead on a shelf or in a drawer. If the strip turns green within two days, the wood is producing acid. Likewise, if the lead develops a white, powdery coating within three months, the wood is too acidic and the fixture should not be used. If the powdery coating takes a year or longer to develop, the fixture should not be used to store metal, textiles, photographs, paper or ethnographic material. Glass, ceramic, wood and non-carbonate stone are good candidates for temporary storage in these units.

### **Coatings and Laminates**

If wood is used, certain precautions must be taken. Protective coatings or laminates isolate wood surfaces and edges exposed to the storage cabinet interior. Sealing the wood reduces the rate at which acids and other chemicals are emitted. Laminates provide an excellent barrier; coatings are less effective. Stable laminates are aluminum foil, polyaluminum laminate (a metallicized plastic film commercially known as Marvelseal), and high-pressure laminates (commercially known as Formica and Micarta.) The most stable coatings are moisture-cure polyurethanes and some 100 percent solid, two-part epoxy coatings. All coatings should be applied in three layers for maximum effectiveness.

Avoid oil-modified paints and varnishes, one-component polyurethane varnishes (such as Varathane), any varnish containing oil and alkyd, epoxy ester, aluminum and silicone paint. All deteriorate to form acid fumes. Some coating materials, such as latex paints, remain tacky over time. Artifacts placed directly on these coatings will stick to the surface.

Isolate objects from wood surfaces with fabric coverings (washed cotton or linen), acid-free paper, acid-free cardboard, aluminum foil, polyethylene or polyester plastic barrier sheeting or white polyethylene foam sheeting (Nalgene, Ethafoam, Plastazote).

### **Conserva-tips**

If you use wood ...

1. Use the least acidic wood possible.
2. Avoid plywood and particleboard.
3. Use protective coatings or laminates to seal wood.
4. Place a barrier between objects and wood.

### **Gaskets**

Gaskets provide airtight seals that help keep dust out of storage units. If the gaskets are rubber, metal artifacts and photographic materials may be damaged by sulfur fumes. The preferred gasket material is silicone, which is inert. Silicone gaskets may be specified from cabinet suppliers. To test gasket materials, burn a small sample. Rubber produces black smoke and black ash. Silicone produces white smoke and white ash.

### **Adhesives**

Most adhesives emit vapors while drying or setting, and many continue to emit vapors during their useful lives. Contact and pressure sensitive adhesives are the most damaging. Since there is such a wide variety of adhesives available, we advise the following:

1. Avoid adhesives.
2. Do not use on cabinet interiors. Use laminates and caulking instead.
3. Use known adhesive systems with acceptable chemical components, such as acrylic and polyvinyl acetate. Work with a conservator if you are unsure.
4. Allow sufficient curing and setting time before placing collections in a cabinet. A minimum of three weeks is recommended.
5. Test all adhesives before using (See chapter on **materials**).

## **FURNITURE STYLES**

The choice of storage furniture styles is only slightly less important than the choice of construction material. Some furniture is adaptable to a wide variety of collections, while other furniture is designed for specific objects. Storage furniture protects collections from environmental fluctuations and dust. The proper furniture allows the greatest number of items to be stored in the most efficient manner.

Your storage area will use a combination of:

- Open shelving
- Flat drawers or trays
- Cabinets with drawers, trays, shelves, or rolled storage brackets

- Wardrobe storage
- Vertical storage screens
- Slotted storage shelves

### **Shelving**

Shelving is one of the most versatile ways to store your collection. There are a variety of styles available and each is best suited for a different type of collection. For instance, narrow shelving is good for smaller items, while deeper shelves are preferred for larger objects. Avoid storing artifacts behind others on the same shelf because of the potential for damage if a person reaches over the top of an object in front. Furthermore, you should not stack collection items unless they are boxed. Shelves are an excellent way to store boxes and sturdy boxes can be stacked. But, ideally, no higher than two or three boxes.

The simplest and most versatile storage furniture is open shelving. Open units allow maximum air circulation, but provide minimal protection from dust and moisture. They also allow maximum light penetration, which can be a problem for some artifacts but works extremely well for boxed storage. There should be minimal space between the tops of artifacts and the next shelf. However, there must be sufficient headroom to safely remove objects. Ideally, shelves fit only one artifact, one tray of artifacts or one box so that a person does not have to remove items from the front of a shelf to access items stored at the rear. Open shelves should have tight fitting dust covers that are closed with ties, buttons, Velcro or magnets at the sides, top and bottom.

The best shelving is made of powder-coated metal and has movable shelves. Baked enamel is a second choice, but painted shelving is not recommended. In some instances, wire shelves may be preferable to solid shelves. Many museums use wood shelves because wood is readily available and easy to use. However, wood produces acid fumes and if it is used to make shelving should be sealed.

Enclosed metal shelving offers greater support for particularly heavy artifacts and has the advantage of blocking light from ceiling fixtures. For collections of large, weighty artifacts that do not fit in cabinet storage (such as furniture, medium to large sculptures or scientific and musical instruments), enclosed metal shelves provide some protection from light and dust.

When using shelving:

- Bolt shelving to walls, ceilings and floors to make them as stable as possible.
- Add lips so artifacts don't roll or "walk" off the edge. Some museums attach

bungee cords to the front of shelves. Be aware that the rubber in bungee cords is not inert and may produce sulfur and acid fumes. Other museums add lips by inserting 3-inch-wide corrugated polycarbonate board behind the front uprights.

- Shelves should fit the collection; close together and narrow for small items, deeper shelves for large items.
- Avoid storing artifacts behind others on a shelf. Reaching over artifacts may cause damage.
- Don't stack collections. Each item should support only its own weight.
- Shelves are excellent for items stored in boxes. Sturdy boxes can be stacked.

Bulky items such as canoes and buffalo-hide robes often are stored on the tops of shelving units and cabinets. While top shelves protect objects from the danger of floor storage, there are some dangerous drawbacks. The top shelf is not protected from dust, water leaks or light. Cover items on the top shelf with clean muslin followed by polypropylene sheeting. The Science Museum of Minnesota builds a frame to support the drape over the object, which prevents the drape from resting on the object itself. The close proximity of ceiling light fixtures to the top shelf also can pose a serious threat. Objects too close to a light get heated unevenly and desiccated. They also are subjected to unnecessarily high light levels. Heavy items should be stored below eye level, ideally on the bottom shelf.

### **Head space**

Look at your shelving. Is there a lot of space between the top of your artifacts and the bottom of the shelf above them? This is called headroom or headspace. If there is too much room, you are losing valuable storage space. The Science Museum of Minnesota has become expert at dense storage without damaging artifacts by building small subsidiary shelves within larger steel shelving. This shelving has been refined over the years. At first it was made of acid-free cardboard. Then staff noticed that cardboard sagged over time. Next it was made from corrugated plastic sheeting – polyethylene, polycarbonate or polypropylene. Now it is made from a framework of PVC plumbing pipe and acid-free cardboard trays or metal baking trays.

### **Slotted Shelves / Art Bins**

Slotted shelves or art bins typically are used to store small to medium-sized framed artwork (art must be in good condition). This type of shelving usually is built by the museum and has vertical dividers every 10 to 12 inches. Dividers can be attached during construction. Alternatively, you can use tension rods placed vertically. The shelves must be deep enough to prevent artwork from protruding and high enough so that the height of the painting is fully protected. Commonly, the shelves are made of latex painted plywood or chipboard. These tend to sag. They also are acidic and must

be coated. Remember, some coatings such as latex paint remain somewhat soft and will stick to anything that rests on it for too long.

Although dividers are normally rigid panels, some museums have been creative in converting metal shelving into slotted shelves. At Wright County Historical Society, polyester clothesline is stretched through holes in the shelves to separate each slot. Another museum uses spring-loaded curtain rods positioned vertically between shelves to form the slots. The Montana Historical Society made its slotted shelves out of square, hollow metal rods welded together.

Each slot holds two framed works, which are stored vertically to put the full weight on the bottom of the frame. The art slides in and out of the slot. Because this can damage the bottoms of frames, use white polyethylene foam to pad the bottom of each slot.

Artwork stored this way needs to have screw eyes and picture wire removed from the back of the frame. The art is stored face to face and back to back. It is separated by acid-free cardboard or FoamCor cut larger than the framed piece.

### **Vertical Screens**

Vertical screens are used to store large, framed artwork (again it must be in good condition). These systems maximize storage space, allow quick and safe access to paintings, and afford easy visual review of a collection. Screen systems can be constructed in-house or purchased.

Screens are made from perforated metal or rigid wire mesh. Pegboard is acidic and not recommended. Hang artwork on S-hooks threaded through D-rings or eye-screws on the back of the frame. Do not hang a painting by the frame's wire. S-hooks could poke through the painting.

The mesh can be mounted on a wall or made into moveable panels. Condensation and temperature fluctuations occur on exterior walls and thus should not be used for wall screens. Interior walls usually are dry and have even temperatures, making them excellent choices for fixed-wall screens. Moveable panel screens that glide in overhead and floor tracks move smoothly and reduce vibrations that can damage paintings. Swinging panels, panels with only a top track, or panels on wheels are not recommended. Rolling screens with small wheels on the bottom vibrate enough to damage fragile paintings. Swinging panels (similar to a poster rack) are not recommended because, if misjudged, artwork could be crushed. Always be sure there is good clearance between the artwork and the next storage screen.

### **Covering Shelves**

Dust and light can damage items stored on shelves and shelves typically should be covered. Do not cover objects themselves or place them in bags because the weight and movement of covers and bags can cause damage as well. Instead, covers should be attached to the shelves themselves. Covers typically are made of clear polyethylene sheeting, cotton sheets or washed muslin, or Tyvek. Each has advantages and disadvantages. Muslin, for instances, is lighter, cheaper, provides light protection and can be washed, but it does not protect the collection from water. Muslin may need to be doubled or lined with blackout fabric to completely eliminate light. Because cloth draws water, cotton or muslin covers must never touch the floor. Ideally, they should end 6 inches above the floor. Clear polyethylene, on the other hand, is see-through and water resistant, but it attracts dust and does not filter light. Tyvek, one of my favorite cover materials, is less likely to form condensation than polyethylene, blocks light, allows fumes to pass though and provides a water barrier, but it carries a static charge and is not clear. For light and moisture protection, some museums cover shelving with tight muslin, and then drape polyethylene sheeting over the top.

The best covers adhere tightly to all sides of the shelving unit. Loose drapes do not protect against dust deposition. Covers can be attached with a variety of methods. Often, the method you choose depends on the skills of your staff or volunteers. Some museums use Velcro, which can be stapled and sticks to wood better than metal, while others use ties. Covers can open with tie-backs, roll up a rod or pull up like blinds. Drapes also can be designed like window shades with pulls that gather them up. Or they can have weights or metal rods in the bottom to help hold them down and flat to the shelf or to help roll them up from the bottom.

### **Drawers and Trays**

Drawers or trays are designed to store flat and fragile textiles, damaged paintings, works of art on paper (especially pastels, chalk and charcoal drawings, and gouache paintings), small artifacts and maps. Placing a rigid acid-free support under flat pieces in storage trays makes them easier to move.

There are many types of flat drawer storage. The most common are flat files used to store prints, drawings and maps. Also, cabinets with doors may contain a set of drawers or pullout shelves. Flat-drawer cabinets are manufactured in many sizes, some quite enormous. In addition to the storage of paper artifacts, flat drawer storage is frequently used to store textiles, particularly those that are delicate, weak, heavily embroidered or important. Drawers also are used for small objects such as coins, jewelry or tools. The drawers can be subdivided with small acid-free boxes.



The Vesterheim Museum in Decorah, Iowa, designed and built creative textile storage drawers. Large flags are stored in drawers made from welding aluminum L-channel and flat stock to form a thin drawer frame. The bottom of the drawers is a large sheet of acid-free FoamCor. The drawers are light, rigid and inert. For smaller flat textiles, metal baking sheets of different depths are used. Both types of drawers are stored in a Formica-lined wood cabinet. The drawers slide on metal C-channel. The Montana Historical Society created a similar economical storage solution for its ethnographic collection. For the same price as one commercial museum cabinet, Montana built five floor to ceiling metal drawer units. The drawers were made by a sheet-metal worker. The uprights were welded to C-channels. Silicone slides made the drawers open and shut smoothly. Plans for the Montana Historical Society cabinets are provided as a separate document. More on how to store items in trays and drawers will be included in the chapter on **mounts**. (in MS203)

If collections are in good shape, some stacking, interleaving with acid-free paper or cardstock, is allowed. Ideally, flat items are matted so that when they are stacked, the weight is on the mat, not the artwork or artifact. Place the most fragile pieces on the top and the sturdiest pieces on the bottom. However, ideally each item is stored on its own supporting tray, so it is easy to lift off items to get to a piece stored at the bottom without excessive handling of the other pieces.

Make sure the bottom of each drawer does not touch the collection stored in the drawer below it. Severe damage is caused by opening overfull drawers. The most commonly seen damage is wear on one side of photographs or documents that were stored in a file cabinet. Three-dimensional objects and costume accessories may require storage supports to retain their shape and keep them still when drawers open and close. These mounts may be designed to serve as exhibit supports as well. There will be in the chapter on **mounts**.

### **Cabinets**

Cabinets are versatile, provide excellent light and dust protection, buffer relative humidity and temperature fluctuations, and can be locked for extra security. Quality cabinets should have silicone gaskets to reduce dust and air penetration. Silicone, which is inert, is the only acceptable material. Rubber and polyurethane foam gaskets create acidic gases and polyurethane can deteriorate and create a messy dust. Again, powder-coated metal is the preferred material. Wood cabinets are acceptable, but should be lined in the same manner as open shelving. Custom designed cabinets may have drawers, trays, shelves or brackets. Commercial cabinets with vents allow airflow that dilutes fumes produced by the stored materials. Vented cabinets also should be filtered to prevent dust and gaseous pollutants from entering. Dust filters -- cotton works

well -- or pollutant filters can be purchased.

Trays can be constructed from the same material as the cabinet. Trays also can be fashioned from aluminum frames covered with stretched nylon or from commercial baking trays or racks. Stretched nylon allows increased airflow and ventilation, which is useful for hygroscopic materials, such as textiles or buckskin. One commercial cabinet manufacturer specializes in stretched fabric cabinetry. Cabinets with shelves can be outfitted for bracket storage of rolled textiles. Cabinet interiors have drawers that pull out revealing horizontal rolled textile storage. Make sure that drawers and trays move smoothly. Guides should be made of inert material such as polyethylene, polypropylene or Teflon.

### **Wardrobes**

Wardrobes are cabinets designed to store hanging costumes on padded hangers. The best designs incorporate a shelf or drawer at the top or bottom for accessories. If the surface is dark or rough, consider adding a lining made of smooth, light-colored fabric. This will make pest and other problems more visible. Hanging rods should be fitted with spacers to prevent overcrowding. Rods also should be high enough to prevent costumes from touching the bottom of the cabinet. Although wardrobes are an excellent space-saver for costume storage, they are not suitable for all garments. Please refer to the chapter on **Storage of Specific Collections**. (in MS 203)

### **Compact Storage**

Most commercial storage furniture can be installed on tracks to create what is known as compactor storage. This system compresses rows of storage units to conserve space. Rows can be opened manually or electrically. Vibration when moving storage units can be a problem, especially for wet biological specimens, hanging costumes, flaking paintings, glass and any other objects that would be harmed by movement. Items in compactor storage should be stored on mounts that absorb vibration and stabilize them. Manual compactor controls are preferred to electric because manual controls offer smoother movement. They are also less likely to malfunction in a disaster. Compactor storage is ideal for archival collections, but necessity has made it increasingly common in artifact collection storage areas.

### **Storage Enclosures**

Artifacts stored on or in furniture may need additional enclosures for their protection or handling ease. These include acid-free cardboard or corrugated plastic boxes with interior shelves (commercial or in-house manufacture) if necessary. Folders and mats protect photographs, paper and small flat textiles. Mylar encapsulation protects papers that are handled often. Wrappers protect books. Consult a conservation professional as

needed. For example, you may not want to encapsulate a highly acidic document without taking some special precautions.

The best acid-free materials should be pH-neutral and lignin-free. Do not use buffered acid-free papers unless you have a specific reason. Buffered papers are not pH-neutral. They damage colorants and protein materials such as color photographs and silk. There is more about choosing materials in the chapter on **materials**. (in MS203)