Defying Gravity with Magnetism

Gwen Spicer

The display of textiles presents many challenges; damage occurs very slowly and is often nearly imperceptible to the regular observer. Safe and responsible display involves not just the control and maintenance of the environment, but also the organization, planning, and cooperation of all personnel involved. There must be adequate time, space, and physical protection built into the display design to ensure safe handling and installation. The main consideration is to manage the mounting so as to equalize the artifact's weight among its supports, and thus prevent a change in shape. Formally, as summarized in *Mount-Making for Museum Objects* CCI: "Stress is the force applied to an object whereas strain is the change in shape of the object." Stresses and strains in isolated areas can quickly become permanent and irreversible, and slow changes in mounted artifacts often occur in surprising manners and places. These considerations are of paramount importance when designing a mount for any artifact.

Recently, magnets have become popular for the display of textiles and other organic materials at many institutions. A magnet mounting can be reversed quickly, eliminating the need for removing stitches or adhesives. Mounting with magnets has been found to be a beneficial and elegant technique.

History of Rare Earth Magnets

Magnets have become part of the palette of options to support artifacts for exhibitions. Conservators such as Maltby (1988) have found that the shape of moccasins was ideal for using magnets; many exhibitions incorporated such mounting techniques starting in the late 1980s.

However, it is the development of the neodymium rare earth magnets that has allowed their use in conservation to be extended to a wider variety of projects. During the 1970s and '80s rare earth magnets were developed to be the strongest magnets relative to their size, and were found to be highly resistant to losing their magnetic strength. By the 1990s their cost had dropped enough to encourage their increased use in conservation, where they have now replaced the bulky and difficult to hide ferrite magnets that were developed in the 1950s. They are strong, small magnets that can be more easily hidden as they are incorporated in mounting systems.

The permanence of rare earth magnets is due to the fact that their crystalline structure has high magnetic anisotropy along a preferred direction, making them resistant to magnetic fields in other directions. Manufacturers often guarantee them for twenty years. However, since they are quite brittle and vulnerable to corrosion, they are commonly plated or coated to minimize breaking and chipping. Two types of rare earth magnets are available, neodymium and samarium-cobalt. The neodymium magnet is the more common, less expensive option.

Since rare earth magnets can form a very strong attraction, care needs to be used to select an appropriate size, number, and distribution of magnets, and to prevent local crushing and deformation.

[Table 1] Table 1: Performance Properties for various magnet types

Magnet	*Date*	$B_r(T)$	$H_{ci}(kA/m)$	$(BH)_{max}(kJ/m3)$	$T_c(C)$
Neodymium $Nd_2Fe_{14}B$	1983	1.0–1.4	750–2000	200–440	310°–400°
Samarium-cobalt SmCo2	1969	0.8–1.1	600–2000	120–200	720°
Ferrite or Ceramic Sr-ferrite	1951	0.2–0.4	100–300	10–40	450°
Alnico	1935	0.6–1.4	275	10–88	700–860°

Performance characteristics of rare earth magnets are compared with the older Ferrite ceramic type in Table 1. In nontechnical terms, B_r represents the strength of the magnetic field; H_{ci} is the material's resistance to becoming demagnetized; $(BH)_{max}$ the density of magnetic energy; and T_c is the Curie temperature, the temperature at which the materials loses its magnetism. Neodymium magnets have the highest strength and density of magnetic field, making them the most useful choice in projects where size and placement is of utmost concern. These magnets come is a wide range of sizes, thicknesses, and shapes including, discs, rings, cylinders, rectangles, and spheres along with varieties that have holes or are rubber coated. Typically, the larger the size of a magnet, the greater is its strength, but variance in thickness rather than footprint also affects strength. The magnetic direction can also be selected within each shape depending on the application, through its thickness or axil. Manufactures have also created magnets with threaded holes to receive screws, ones with flanges or hooks can stimulate an even broader palette of mounting ideas. Working with this suite of options allows for wide flexibility in mounting designs.

Basic Concept (Two-Part Mount)

All designs that incorporate magnets involve a two-part system in which the magnets are used in tandem with a receiving magnetic metal. Magnets can be incorporated into the back support panel or into a surface mounting support. The artifact is then supported at the point at which the two parts are aligned. The receiving metal can be a full metal sheet, flashing, washers, or even screws that are selectively positioned within a panel to create one-half of the system. Alternatively, as used to mount oversized works of art on paper, the metal sheeting can be adhered to the artwork, and the magnets become part of the receiving framework. Mounting designs can be created as a single custom mount for a specific item or as an integral part of display and design for rotations in galleries, or collections. They can also be used for traveling exhibitions.

Typically, the magnets are embedded into a substrate that distributes the strength across the object's surface or the hanging mechanism. A wide variety of materials has been used for this purpose including; Plexiglas, layered ply-board or corrugated board, and in some cases these materials are covered with paper or fabric. All systems require a barrier between the magnet and the artifact, and Mylar or paper is most commonly used. In order to easily lift off the artifact, the use of Mylar sheet as a separator is a useful addition.

The spacing between the individual magnets depends on the specific strength and size of the magnet used. If spaced too closely, they become attractive to one another and can jump towards each other. The relationship between a group of magnets and the weight of the object seem to be more critical than the force of each individual magnet. Three issues need to be balanced: the attraction of one magnet to the other, (side-to-side movement), the number of layers between the magnet and metal (display fabric, board, batting, etc), as well as the bulk and strength of the artifact. The consideration of strength in selecting specific magnets is based on experimentation for each particular display need and situation.

Any specific application must be customized to the object. Conservators have noted concerns about slippage of the artifact, but this can be counteracted by including an angle in the mount or the use of nap-surfaced materials between the layers that are in contact with the object. As always, monitoring is necessary to make sure that the mounting system is performing as planned.

A Few Descriptions of Magnet Use:

Single Magnets in Pads/ Supports

An internal support is created with the magnet. Several of the designs used have embedded the magnet into an interior support board to distribute the pressure across the full underside of the artifact, such as the insole of a moccasin. The board is then covered with synthetic batting and fabric to create the internal structure. If a single magnet is used for a smaller artifact, one can either place the receiving magnetized metal as a local point (like with a fender washer) or use a larger one to provide full support.

Magnetic Strips in a Frame (Like a Window Mat)

Strips of mat boards with embedded magnets have been used to support small and mid-size artifacts on two or on all four sides/margins. The overall effect can be compared to that of a thin frame or window mat. This method has been used to support paper, textiles and other organics. The magnet strips can be covered with Japanese paper to match the artwork being mounted so as to visually disappear, or can otherwise be camouflaged with fabrics or sleeves that are incorporated into the artwork, such as for a Thangka. The support panel, often D-Lite board, can be surfaced with either a full sheet of metal or a strip of flashing to receive the magnetized mounting strips. The flashing can be adhered to the support panels with either hot glue or tape and then covered, depending upon the end application, with one-ply board or flannel, and a show fabric. This technique is especially useful in designing mounts for temporary exhibitions and rotations. In another variation, a two-part frame system can be constructed so that artifacts with a watermark or significant reverse can be safely mounted and used by visiting scholars. For a mount like this, the artifact is encapsulated and placed into a frame that is secured with magnets for ease of access.

Quilt Sleeves

A Plexiglas strip with embedded magnets has been used to mount large hanging textiles such as quilts. This strip is positioned into an upper sleeve that is attached to the textile and held against a metal support panel. In this case, the metal can be isolated to a section along the upper edge of the panel. The panel secures the textile while also giving it overall support, and can be positioned at an angle. This is a viable alternative to the use of Velcro systems for hanging textiles. Once the exhibition is over, the Plexiglas is removed from the sleeve and the artifact storage, without the bulky Velcro at one end. This can facilitate storage, especially if the quilt is to be rolled.

TRAVELING AND TEMPORARY EXHIBITIONS

For traveling exhibitions, such as the Wabanaki Textiles at the Maine State Museum, magnets were secured to the bottom side of DiBond support panels with a cooled hot melt glue (see figures 1 and 2). A top layer of Volara and show cover fabric was secured over the mount. Metal washers were secured into acid-free cardboard, Corroplast, or a padded support that acted like the anchor for each specific artifact. Conservators have also reported that magnets can also be hidden beneath digitally reproduced images to serve as a fairly invisible surface "cleat" during temporary exhibitions.

Image 1: Deck mount with imbedded magnets. Image 2: Artifacts secured to the finished mount with the magnets. Image 3: An example of an internal support with fender washer.

Beyond the Basic (Clever Disguises)

Small magnets can be easily hidden to act as a decorative elements in the artifact, like sequins and glass ornaments. They can also act as the fasteners on garments, if a metal strip is positioned within the mannequin form in the location of the opening. Or, a small magnet can be placed on the reverse side of the garment: one magnet disguised to look like a button, with a small receiving magnet on the other side of the artifact, separated with Mylar. Magnets can be used to create the effect of buttons in tufted upholstery, with the foundation layer containing attached fender washers that are positioned in the locations of the indentations. They can also be used for duel purposes, such push pins for a bulletin board so that they become a design element in the exhibit. Magnets can be painted, wrapped in paper or fabric to blend in, or made to look like either part of the object or the mount itself.

Other Applications/Tools

Magnets have been used in conservation as a treatment tool, most often as a clamp. Many conservators use magnets to align and hold a tear in-line, especially when an artifact's reverse cannot be reached. The strong hold of the magnets enables manipulations of materials from the obverse, and adhesive joints to be held when the orientation of the work is not horizontal and gravity cannot be employed. Low-strength or flexible magnets are helpful in humidification treatments where less pressure is required, and magnet clamps have also been used instead place of suction. Other conservators are able to extend the magnetic field, for use in securing stretched fabric, by embedding additional metal caps into the wooden stretcher. Magnets can also be used to hold stretched net layers while stitching encapsulation layers onto fragile artifacts, and are convenient when holding artifacts in place during photography or in-painting.

Risks

When used directly on items where the strength of the selected magnet was too strong, the soft surface of an object can be permanently indented. Such vulnerable materials include skins, felt, flocked or piled structures, and thick papers or textiles. Having a wide variety of strengths and sizes is critical for selecting the most suitable strength magnet. For example, when choosing magnets for a softer surface, the use of a larger number of weaker strength magnets might be safer than using fewer stronger magnets. Selecting thinner magnets can lower their strength in the specific location, or embedding the magnet into another support can further distribute its strength over a larger area or into the materials between the magnet and artifact. Some materials such as Volara, needle-punch polyester batting, and acid-free board have been used to reduce potential deformations. By having a full range of sizes and shapes on hand, one can experiment and focus on the solution that make the most sense for each individual project.

Magnets can pose some risks to the user. The force of one magnet becomes stronger when next to others; therefore their strength of attraction can result in pinched fingers. The use of a wooden tool with a hole can prevent harm when trying to separate one magnet from the other. Magnets can also easily jump out of partitioned boxes, so keeping them divided in lidded containers is recommended. Also, if they are used on an object with metal components, such as leggings with tinkler cones, the magnets can jump from their position of support onto the metal component, thus relinquishing their supporting role.

Magnetic fields can also harm electronics such as computers, televisions, and the magnetic strips on credit cards. They can be chipped and cannot be tooled. As can be seen by their Curie temperature, they lose all magnetic strength when in contact with high temperatures. When securing them with hot-melt glue to display decks, the glue needs to cool. This is because their Curie temperature (T_c , see Table 1), the temperature at which the materials loses its magnetism is quite low (310°–400° C). Hot melt glue can be used if it is allowed to cool slightly before extrusion onto a magnetic surface. In applications for which heat is necessary, samarium-cobalt magnets would be a better choice, since they have a T_c of 720°–800° C. These magnets are also more resistant to oxidation, but are more expensive.

Conclusion

The popularity of these small rare earth magnets can be seen when observing their recent availability as products for the home as well as their varied uses in conservation. Look closely and you will find these useful objects incorporated into many home supplies, such as stud finders, pin/screw finders and curtain tiebacks. Textile conservators and others who work with a wide range of artifacts are constantly trying to find simple, reversible, and non-damaging methods to manipulate and provide safe display for objects with flexible components. Rare-earth magnets open a whole new set of options to our ever-growing palette of ideas and solutions.

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Material Sources

Adams Magnetic Products
34 Industrial Way East
Eatontown, NJ 07724
800-747-7543
www.adamsmagnetic.com

Lee Valley
PO Box 1780
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