An Alternative to Velcro?
Upper Edge Hanging Methods Using Rare Earth Magnets

Introduction

Large textiles have been hung using Velcro since the 1970s, with little change of technique (Textile Museum; Smithsonian Institution 1977). The looped side of the Velcro is machine stitched to fabric, typically wide twill tape, and the fabric is then hand-stitched to the reverse side of the upper edge of a textile; the hooked side is attached to the wall or cleat. Some systems retain the cotton webbing with a sleeve, while others do not.

Over the years disadvantages of Velcro have come to light (Gates 1993; Gilberg 1994; Leath 1998; Gardner 2010). Concern with the use of Velcro began in the 1990s when discoloration of the product began to be noticed. Several conservators became concerned and suspected that product alterations were resulting in color change (Gates 1993). [Velcro was invented in 1941 by George de Mestral, a Swiss engineer; his patent expired in 1978 (Leath 1998).]

Furthrmore, the loop-side of the Velcro sewn to the webbing and then hand stitched is quite bulky, and this presents difficulty with storage, whether rolled or boxed. Moreover, due to the need of stitching this approach is not a solution for all textiles. This led conservators to investigate several methods using magents as alternatives, and these form the basis for this article.

Magnet system

The philosophy and design principles for hanging large textiles with magnets remains the same as for Velcro. A rule of thumb for Velcro is that it can support about 100 lbs per square inch. Finding a magnetic system that equals this is not straightforward. When using and selecting magnets of any type, there are three key components that are in play (Spicer 2013 & 2014).

1. The strength of the magnet
2. The ability of the ferromagnetic metal behind it to be magnetized
3. The gap between the magnet and the receiving metallic side

Each is significant in how the magnet behaves or is able to perform the task (Feynman 1964; Livingston 1996; Magnet Story 1998). Proper balance of these three considerations is necessary in designing a successful system for any particular situation.

Complications arrise from the wide variety of needs and requirements of each artifact. The system developed must be strong enough to support the artifact but not so strong as to create damage. Only by understanding the parts and their interactions can a system be created for a specific task. Each component is described below along with alternatives. The solutions provided here are to be adapted to fit the needs of the artifacts at hand (Spicer 2014).

The selected magnet strength is only reached if the ferromagnetic metal support used is sufficiently thick. For a steel plate, the minimum is 24-gauge steel before any coating such as galvanization or powder is applied. Recall that as the metal's thickness increases, the gauge decreases.

Magnetic solutions for mounting are used in two main categories, local spot fastener or a large area pressure. The local spot fastener is the easiest to use. A large area pressure fastener incorporates additional elements to provide more continuous pressure. Conservators have used both methods successfully. Below are examples of the successful use of each method, as well as ideas that have not been tested. They are divided into two groups; ones that use an attached sleeve and those without.

Use with a sleeve

The benefit of a sleeve when using a magnet is that there is no concern with compression of the artifact, since all of the system's elements are behind the artifact. As it is the sleeve that creates the gap between the magnet and the metal, cotton twill tape (TestFabrics tape 6) and a narrower type (Tape 5) or a thinner fabric tape can be used to reduce the gap.

The attached sleeve can be utilized either with a long metal strip inserted in the sleeve or with individual magnets fitted into pockets (Spicer 2010).

Large area pressure

Using a metal strip assists in keeping the upper section of the artifact both level and flat, preventing the scalloping effect that can occur with a point fastening method or the bending or flexing of the upper edge that frequently happens with Velcro. The upper edge can be easily raised and lowered as well.

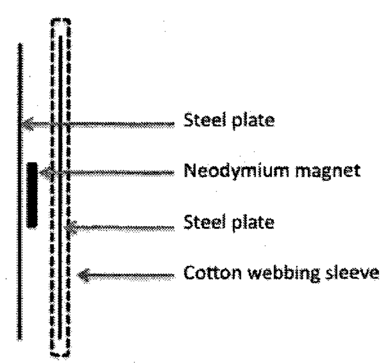
The steel sheet is sufficiently thin to greatly reduce the profile of the mounting system. If there are openings at various intervals along the sleeve, then shorter steel strips can be inserted locally. This is particularly useful for very wide textiles, or in tight or awkward locations.

A method used at the National Museum of the American Indian uses two 24-gauge steel plates, one plate attached to a honeycomb aluminum slant board covered with 200-weight Polyester Polarfleece (Polartec), and the other 24 gauge plate (1" wide strip) within a sleeve stitched to the reverse side of the artifact (Heald 2012).

Figure 1.

Two 22 gauge steel plates, one attached to the mount and the other fit inside a sleeve.

The magnets are positioned on the uncovered plate first.



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Magnets are placed onto the slant board and the artifact with the sleeve is positioned onto them (Fig. 1). Magnets used were N42 grade and were ½" and ¾" disc that were either 1/8" or 1/16" thick. The selection of the actual size would be determined by the weight of the artifact.

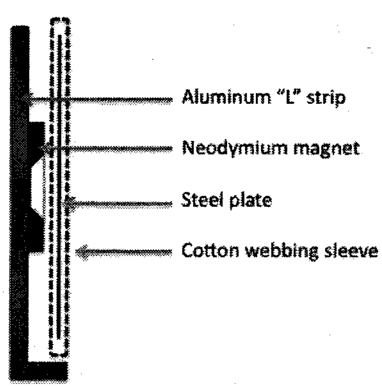
The slant board is positioned between 5 degrees (very steep) and 45 degrees (not so steep) off the vertical angle, depending on the condition of the textile. The nap of the fleece covering helps to support the weight of the textile and allows for lower gauss strength magnets.

Unlike paper artifacts, textiles can be quite heavy, creating a concern with downward pull of the artifact or shear stress of the system. One solution to this problem is to attach the magnets (Grade N42, measuring ¾" dia. X 1/8", with counter sunk holes) at 6" intervals along an aluminum strip with a small lower lip (L-shaped in cross-section.)

A 22-gauge steel plate is held into a stitched sleeve along the upper edge of the artifact (Wood 2013; Spicer 2013). In this solution the lower lip actually holds the weight of the artifact, but it is the magnets that ensure that the steel piece is held back and onto the aluminum horizontal element. (Fig. 2). The secured magnets can be adjusted closer or further away from the aluminum, depending on the specific situation.

Figure 2.

2 3/4" disc N42 Neodymium magnet with countersink hole is screwed to a L-shaped aluminum bar. The magnets are spaced about 6" apart. The lower lip holds the 22 gauge steel that is secured in the sleeve and attached to the textile. The magnets keep the steel sheet back against the support.



Local spot fasteners

Individual magnet cups can be used as the ferromagnetic material and have several advantages, such as variations in spacing (Fig. 3). The cups also provide a fastening fixture to secure the magnet.

However, some planning is necessary. The cups greatly increase the strength of an individual magnet beacause the sides of the cups focus the magnetic field force more densely. The strength of a magnet can easily be beyond the adhesive strength of any glue used for fastening (Wood 2012). Magnet cups are best used if embedded into the mount or wall in order to create a smooth surface (Figs. 3a and b).Cups can be used with magnets installed or empty (Figs. 3b and 3c).

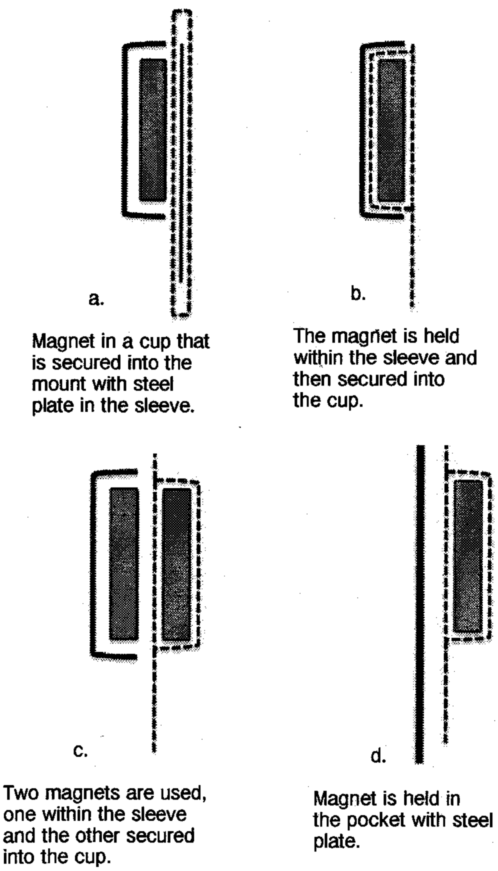


Figure 3. To keep the face of the textile smooth when magnets are secured into pockets, empty magnetic cups can be used. The face of the textile remains smooth, whereas when two magnets are used the second magnet protrudes to the front. Only options a. and b. allow the textile to be flat.

The use of a webbing sleeve allows for this variation as small pockets can be stitched into the webbing layers to hold the magnets. Several stitch patterns can be used (Fig. 4). A zigzag-stitch pattern that extends from the upper to lower edges of the webbing is an option (Spicer 2014). If cups are to be used with the magnet in the sleeve, care is needed to insure that a magnet does not fall out of its assigned pocket.

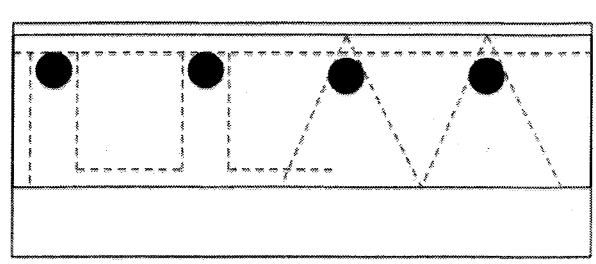


Figure 4. Several sewing patterns can be used to hold the magnets. Here are two, one a simple box pattern and the other a zigzag. Each create repeating pockets between the layers to hold magnet discs. The openings of the pockets need to be along the lower edge.

Whatever the pattern, the opening needs to be along the lower edge. Cups embedded into the wall support with the magnets placed into pockets creates a smooth surface at the face of the webbing, where the artifact would be.

Once the magnet is inside the cup, it is difficult to remove. A notch can be cut into the sidewall of the cup before use to allow for prying out the magnet with a tool.

Use without a sleeve

For many textiles or other textile-like artifacts, sewing a sleeve is not possible or not desired and compression of the artifact becomes a consideration. Balancing the various parts of a magnetic system needs to be considered and appropriate adjustments made.

One way to manipulate the system is to adjust the field force of the magnet by choosing magnets of different thicknesses. Thin magnets have tighter field forces allowing them to be placed closer together (Jordan 2011), and more magnets can be used across an area. They provide the same total pull force as would fewer thicker magnets that would have a stronger force in one spot.

A range of sizes might be used to support one artifact depending on the material and construction. Manipulating the actual size and shape of a given magnet is necessary in order to find equivalent pull forces. When selecting the grade of magnets, note that the higher the grade, the more brittle the magnet. Magnet N52, for example, desirable because of its strength, easily breaks when less than 1/8" thick (Spicer 2014).

Choice of barrier material is also important. Using barrier materials that have a nap can assist with the strength of the system by creating grab between the artifact's surface and the magnet. Mylar may have an opposite effect, unless there has been some roughening of the surface.

Large area pressure

Large area pressure can be achieved over the surface of the artifact in several ways. Flexible magnets are the most obvious large area approach to supporting fine and lightweight artifacts. These ferric bonded magnets are weak, but they provide gentle pressure evenly dispersed over the entire surface (Heer 2012; Migdail 2012).

One can increase the strength somewhat by using both the thicker flexible magnets and a heavier gauge of support metal (Table 1). Suppliers of flexible magnets sell a convenient foil tape. However, a thicker ferromagnetic material does improve the strength of even weak ferric magnet (Spicer and Owens 2013 & Spicer 2014).

Table 1

Gauge / Flexible Magnet Thickness	.06	.25
.001 Foil tape	6.5 oz	4.33oz
.01	2lbs	2 lbs
.025 (24 guage)	1.25 lbs	2.16 lbs

Embedding magnets into a stiff material like mat board is another approach (Holbrow and Taira 2011). Block-shape magnets are ideal for this method. The magnets are spaced apart, just outside the magnetic field force along the center of a wider width of mat board. The magnet and the mat board are selected to be the same thickness. Japanese paper placed as the lower layer provides a thin gap with some texture (F ig. 5). At the Asian Art Museum they create borders that surround a vertically-mounted textile. A similar style of magnet embedded mat board strip is used to mount Thangkas for display.

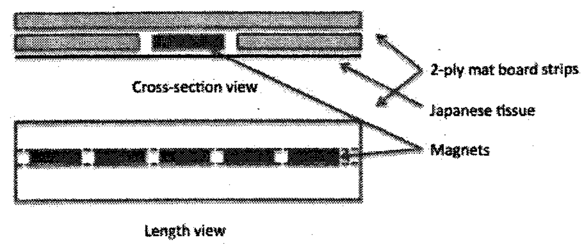


Figure 5. The block-shaped magnets are embedded into strips of 2 ply mat board. Three sizes of mat board strips are cut, one for the top layer and two for the center layer. The center layer is composed of two longer strips with a row of alternating magnet and mat board. The layers are secured with PVA.

A similar method was used to support a large flag at the National Museum of Taiwan, displayed at a 45-degree angle (Ku and Chen 2013). Placing two magnets into 8" long sections of board-sandwich that were butted against each other, allowed them to smooth out the flag and make adjustments during mounting, started in the center (Fig. 6). This is especially useful for large textiles. Holes for the disc-shape magnets were cut with a drill bit. They were positioned evenly both along the board section and the adjacent one.

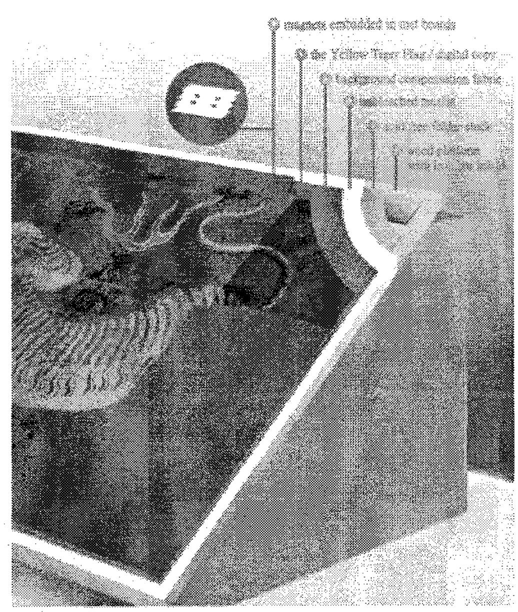


figure 6. Detail of the flag's mount (Ku and Chen 2013). Holes for the embeded disc magnets are cut out with a drill. The thin 1/16" magnets are doubled to increase the pull force and protected from breakage in the mat board.

The top surface of both of these solutions can be easily disguised to blend with the artifact, either covered with fabric, or a digitally printed photograph.

Local spot fasteners

Individual magnets have been used to display a Tapa Cloth. This system used a steel strip that was powder coated and attached to the wall with screws, (gauge is not known). N42 Neodymium (1" x 1/16") disc magnets were used on the surface of the Tapa cloth (Peranteau 2012). The 1/16" thick magnets allowed the individual magnet to be placed fairly closed to one another. The number of magnets needed was assisted by earlier research that found Tapa weighted 140 grams per sq. meter (Dean-Jones, n.d.). One advantage of Tapa compared to most textiles is that it is inherently a stiffer material that is less likely to scallop along the upper edge. This is a consideration when spacing the magnets horizontally. Pigmented Japanese paper was used to cover the magnets.

Conclusion

The replacement of Velcro with magnets is not straightforward, however the method offers many benefits.

One of the critical problems is the issue of shear stress, which dictates that the weight of the artifacts being mounted needs to be carefully considered when adapting the systems. Two solutions described here, increasing the angle of a mount and the use of a lower lip of the aluminum member, are both useful.

In this article I have described a few systems that have been used successfully to mount textiles along their upper edges (Table 2). Information has been provided so that that they can be duplicated and adapted to other situations. The systems described provide several options to select from, with and without a stitched sleeve.

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Table 2

		Magnetic properties					**Ferromagnetic material**		**Gap**		
authors	**artifact**	**grade**	**size**	**gauss (g)***	**pull force (lb)**	**polar direction**	**gauge**	**coating**	**sleeve / none**	**gap layers ■ magnet ● mount**	**angle of mount**
Heald 2012	Navajo blaket	N42	1/2" x 1/16" disc	1,601	3.1	axial	24	powder-coated	S	■● Polarfleece, sleeve, artifact	5°- 45°
Wood 2012	quilt, weaving	N42	3/4" x 1/8" disc	2,087	9.76	axial	22	powder-coated	S	■● sleeve, artifact	vertical
Holbrow and Tiara 2011	thangka	N40	3/8" x 3" x 1/8" block	2,436	14.82	diaxial	26	galvanized	N	■ 2 ply board artifact,display fabric ●	vertical
Holbrow and Tiara 2011	paper	N40	3/4" x 3/8" x 1/16" block	1,480	3.67	axial	26	galvanized	N	■ 2 ply board, artifact,display fabric ●	vertical
Ku and Chen 2013	flag	N35	1" x 1/8" disc	1,467	10.5	axial	19 (1.2mm)	galvanized	N	■ 2 ply board, artifact,display fabric, muslin, folderstock ●	45°
Peranteau 2012	tapa	N42	1" x 1/16"	816	6.8	axial	?	powder-coated	N	■ paper, artifact Mylar ●	vertical

* based on direct contact with a steel plate

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