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This note describes a method to construct mounts for three objects in a travelling exhibit using rare earth magnets. The objects were made of textile and leather and included an original beaded fire bag, reproduction leather mittens and reproduction leg garters. The mounts for the mittens and leg garters were successful but the mount for the fire bag failed in one context.

La présente note décrit une méthode de fabrication de supports de fixation magnétiques à l'aide d'aimants à base de terres rares, pour trois objets dans le cadre d'une exposition itinérante. On trouve, parmi les objets en tissu et en cuir, un sac à feu original orné de perles, ainsi que deux reproductions : des moufles en cuir et des jarretières. L'efficacité des supports de fixation magnétiques des moufles et des jarretières a été démontrée, mais celle du sac à feu s'est révélée déficiente dans un contexte particulier.

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INTRODUCTION

The travelling exhibit *Beyond Fiddles and Sashes: Showcasing Parks Canada's Métis Collections* required that all objects be secured to their mounts and display cases for the duration of the exhibit, including for transit. A special solution was sought for three textile and leather objects: an original beaded fire bag, reproduction leather mittens and reproduction leg garters. These soft and pliable objects could not be safely secured with the same nylon monofilament or rigid clips used for metals and ceramics. Inspired by recollection of Maltby's use of rare earth magnets to mount moccasins,[1] development of suitable mounts was undertaken after further research using more recent sources.

THE DESIGN PROCESS

A magnetic system was considered for mounting since the objects were in good condition and the materials were strong with no significant areas of weakness. The design of the mounts was adapted from those described in two different posts on Spicer's blog, *Inside the Conservator's Studio*.[2,3] Magnetic contact points that hold each artifact in position are created by pairing rare earth magnets embedded in the mount bases with receiving metals that are attracted to the magnets placed within or attached to the artifacts. The technique was considered suitable in this case because the objects could house one part of the magnetic system.

To plan the mounts, each object was measured and patterns drawn on paper to both the external dimensions and the internal or backing dimensions.

The design process included the construction of a trial mount from scrap materials for each object. The magnetic contact point in the mounts is a magnetic system having three components: the magnet, the receiving metal and the space in between which Spicer refers to as "the gap."[4] The mock-ups allowed experimentation to determine the qualities of each part of the magnetic system and the locations of magnetic contact points needed for the minimum strength required to hold the objects in place. Round, N35 grade neodymium rare earth magnets were used in three sizes (diameter x thickness): 6 mm x 2.5 mm (1/4 in. x 1/10 in.), 12 mm x 3 mm (1/2 in. x 1/8 in.) and 18 mm x 3 mm (3/4 in. x 1/8 in.). The receiving metals were ferromagnetic components that were chosen based on availability in the lab. They were zinc-plated washers in two diameters, and rectangular 18 gauge galvanized strap ties, 3 cm x 23 cm (1 1/4 in. x 9 in.). The latter types of hardware are manufactured with perforations that do not affect their attraction to magnets but could limit options for magnet placement.

Many factors affect the strength of the attraction between the magnet and the receiving metal. Those considered in the mount designs were: the size of the magnet, the size and gauge (or thickness) of the receiving metal, and the gap and gap materials, including their effect on the flushness of the contact. Receiving metals larger than the corresponding magnets were used to increase the size of the area of attraction so that exact matching of the contact points would not be necessary, thereby simplifying object placement. The grade of the magnets, which in part reflects the strength of attraction, was not considered because N35 was the only grade available for use.

Considering the above factors and the characteristics of the objects, the number and size of magnets were chosen for each object. The magnetic pull force at any contact point needed to be strong enough to penetrate the object and gap materials. In addition to the objects, the gap materials in these instances were the padding and display fabric layers. The size and flexibility of the three objects to be mounted required the use of multiple contact points because each magnet secures only a small surface area. Unsecured areas could lift and potentially cause detachment from the magnets. Using the minimum strength required to hold the object in place reduced the chance of leaving a residual surface impression on the object when taken off the mount.

Testing the ability of the magnetic systems to secure the objects was done by placing each in its mount and gently shaking the mount. When good contact appeared to be established, the mount was carefully lifted on an increasing angle to confirm magnet strength. The sizes and locations of the magnets and receiving metals were marked on the paper patterns.

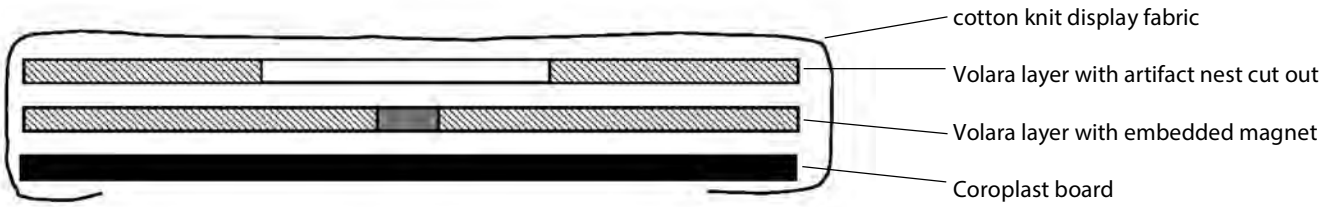

Figure 1. Cross-section of layers making up the mount base. Illustration: Amanda Harding, © Parks Canada.

MAKING THE MAGNET MOUNT BASES

Each mount base was designed to fit into the bottom of the corresponding exhibit case. **Figure 1** illustrates the layers of the mount. The bases are made of Coroplast with Volara foam adhered to the top with 3M #415 double-sided tape. The uppermost layers of Volara foam were nested to conform to the object shapes using the pattern of the external dimensions. Multiple layers were used to accommodate different depths in corresponding parts of the object. For example, the thumb and fur trim on the mittens were at a greater depth than the rest of the mitten. Recesses were cut into a Volara layer to fit the magnets as marked on the pattern (**Figure 2**). By comparison, Spicer's version of mount bases for a travelling exhibit used DiBond board instead of Coroplast, and 25 mm (1 in.) Ethafoam was used for artifacts requiring a recess of greater depth. Spicer's mount bases were not installed in the exhibit case during travel.[2]

High heat can cause rare earth magnets to lose strength, so the magnets were adhered with hot melt glue that was first allowed to cool to the touch. Standard grade N rare earth magnets will begin to lose strength at 80°C and will completely lose magnetism at 310ºC.[5]

Figure 2. Mount base showing rare earth magnets embedded in Volara layer and nested layers of Volara to accommodate the thickness of the objects. Photo: Amanda Harding, © Parks Canada.

The top surfaces of the mounts were covered in a cotton knit display fabric to coordinate with the exhibit design. The fabric was secured to the underside of the Coroplast with double-sided tape. The mount corners were finished by sewing. On mounts where a more defined perimeter for the object nest was preferred, all the mount layers were sewn through along the nest edges using a strong needle and thread in a matching colour.

The placement of magnetic contact points for the beaded fire bag was more challenging than for the other objects. The bag is particularly heavy because of a large quantity of glass bead ornamentation. The bag consists of a pouch with beaded designs sewn on fabric (the designs are different on front and back) and a panel of solid beadwork made on a loom edged with yarn tassels attached to short lengths of strung beads (**Figure 3**). Because magnetic attraction did not penetrate the beadwork well, magnets were aligned with spaces between the beaded areas on the back of the pouch and between tassel stems; therefore, artifact placement needed to be exact. The mount fabric provided some "tooth" to secure the fabric and leather objects, but was ineffective in this way for the smooth beads of the fire bag.

MAKING THE RECEIVING METAL LAYERS

Preparation of the receiving metal layers was different for each type of object.

Fire Bag

To fully secure the fire bag it was necessary to have magnet contact points both in the pouch and behind the solid beading below the pouch. A receiving metal layer was designed to fit inside the pouch. It consisted of two 18 mm (3/4 in.) diameter by 1.2 mm (3/64 in.) thick washers sewn onto a piece of stiff, paper-like Tyvek (the type used for envelopes) covered with a layer of 3 mm (1/8 in.) thick Volara. The Tyvek alone was too flimsy to easily slide into the pouch. The Tyvek and Volara layers were covered in a dark grey synthetic knit fabric. To accommodate contact points for the beaded panel and tassels, the row of beads forming the tassel stems was secured to 36 mm (1 1/2 in.) wide white cotton twill tape using four evenly spaced rows of running stitches and Gütermann Skala ultrafine polyester thread. The twill tape had been cut to a length double the width of the tassel row plus 1 cm. The twill

Figure 3. Beaded fire bag and accessories mounted in exhibit case. Accessories in top row: 3 smoking pipe bowls and a spark cap. Photo: Amanda Harding, © Parks Canada.

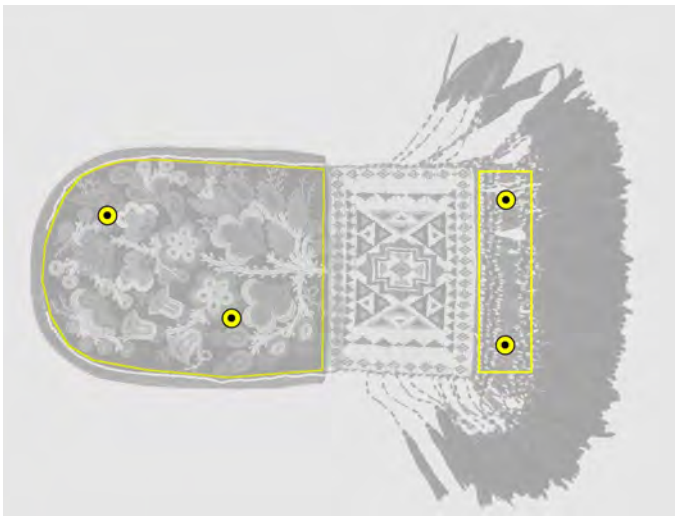

Figure 4. Fire bag, verso. The yellow rings with black centres indicate the location of the washers that correspond with the magnets in the base. The yellow outlines indicate the location of the receiving metal layers: layer inserted in pouch on left and twill tape sewn on the back on the right. The verso of the bag is placed face down in the mount. Photo: Amanda Harding, © Parks Canada.

tape was centred on the tassel row so that each end extended beyond the width of the tassel row at either end. Near each end of the row behind the beads, 18 mm (3/4 in.) diameter by 1.2 mm (3/64 in.) thick zinc-plated washers were sewn to the twill tape. The location of the washers is illustrated in **Figure 4**. The extended ends of twill tape were folded over to cover the washers and met at centre back with a 0.5 cm overlap. The centre seam and top and bottom edges of twill tape were hand sewn closed. The mount base (**Figure 3**) housed two 12 mm (1/2 in.) diameter magnet contact points under the pouch and two others under the beaded tassel stems.

Reproduction Leather Mittens

The mittens have openings in which the receiving metal layer can be placed. Pieces of 3 mm (1/8 in.) Volara were cut to the shape of the mitten interiors. A galvanized strap tie, 30 mm x 23 cm (1 1/4 in. x 9 in.), was attached to each piece of Volara using 3M #415 double-sided tape. The sharp edges of the strap ties were covered with self-adhesive Volara rabbet tape (**Figure 5**). It was desired to have a slightly stuffed appearance for the mittens, so polyester batting was placed over the strap tie (**Figure 6**). The Volara layer and batting were covered with soft, fabric-like Tyvek and were machine-stitched closed (**Figure 7**). The design was modeled after internal supports made for gloves by Spicer, where Nomex was used as the base material and steel L-brackets were used as the receiving metals. In that case, both sides of the Nomex were covered with Volara only.[3]

The mount base included two magnet contact points for each mitten: a 12 mm (1/2 in.) diameter magnet for the hand area and an 18 mm (3/4 in.) diameter magnet for the cuff (**Figure 2**).

Reproduction Leg Garters

The leg garters are flat textiles with beading on the front and with the edges bound by a red-coloured fabric strip. Pieces of stiff Tyvek were cut to fit slightly inside the perimeter of the back of the leg garters. For each one, 18 mm (3/4 in.) diameter by 1.2 mm (3/64 in.) thick zinc-plated washers were sewn at both ends of the Tyvek pieces to form the receiving metal. The Tyvek pieces were then encased in red cotton fabric sewn closed by hand, and stitched to the back of each leg garter using red cotton thread (**Figure 8**). The mount base for each leg garter housed two 6 mm (1/4 in.) magnet contact points (**Figure 2**). **Figure 9** shows the mittens and garters on the mount base in the same exhibit case.

INSTALLATION AND SHIPPING

A few additional measures were taken to protect the objects while in transit. Lids made of 4 ply acid-free mat board were constructed to cover each object case. Muslin pillows stuffed with polyester batting filled the space between the objects and the lids to prevent movement of the ties and tassels, which were not secured, and to minimize the potential risk of failure of the mounting system. It was expected that more extreme movements would be experienced during transit than during normal display conditions and the mounts had not been tested for vertical movement in reaction to bumps. The cases were securely packed in shipping crates that were custom designed for the exhibit.

An instruction manual for the exhibit included procedures intended to further reduce the risks of damage to the objects from physical forces and handling. At the exhibit venues, the cases were to be placed directly into glass-covered exhibit tables after the tables were positioned and the casters locked

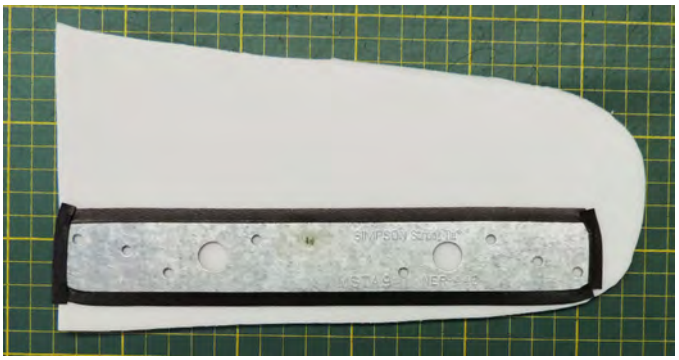

Figure 5. Components for mitten insert showing galvanized strap tie, edges covered with black self-adhesive Volara rabbet tape, adhered to Volara. Photo: Amanda Harding, © Parks Canada.

Figure 7. Mitten insert padded with polyester batting and covered with soft Tyvek. Photo: Amanda Harding, © Parks Canada.

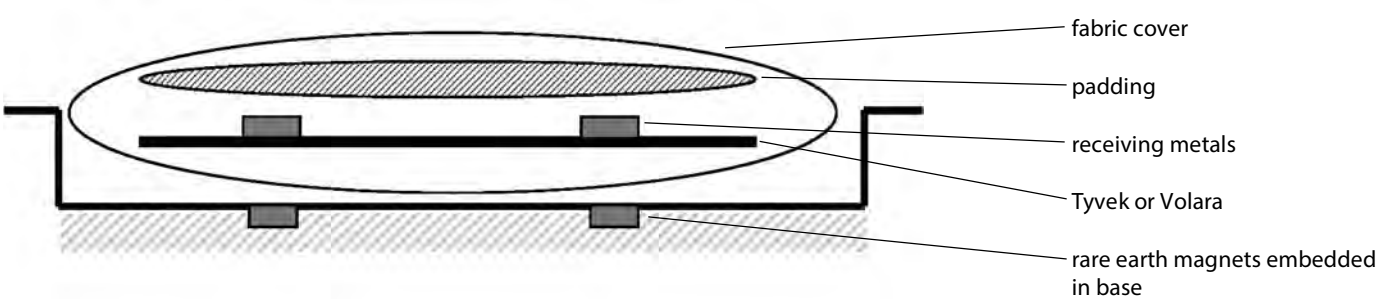

Figure 6. Cross-section of the mitten insert showing the receiving metal and corresponding magnet contact points in the mount base. Illustration: Amanda Harding, © Parks Canada.

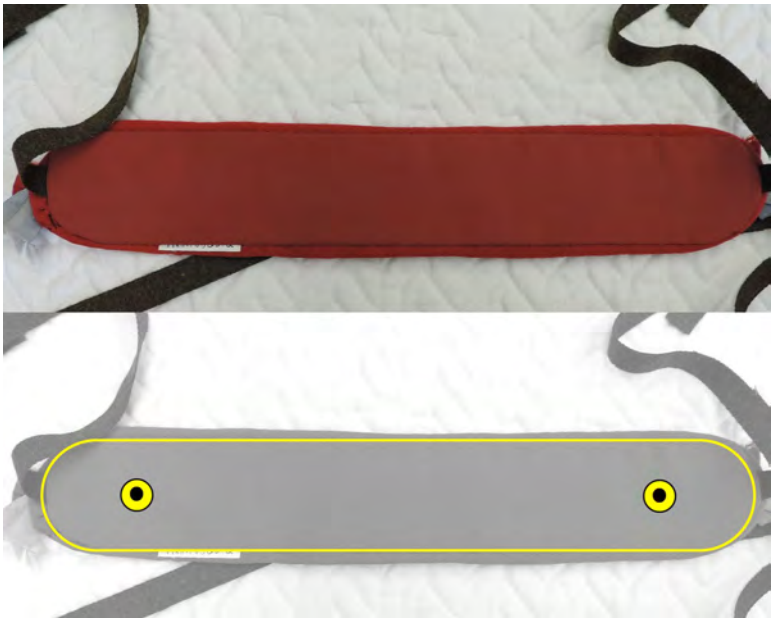

Figure 8. Top: Back of leg garter with receiving metal layer covered in red fabric. Bottom: The yellow rings with black centres indicate the location of the washers that correspond with the magnets in the base. The yellow outline indicates the location of the receiving metal layer attached to the back. Photo: Amanda Harding, © Parks Canada.

into place. For take down, the object cases were to be removed prior to moving the tables. Other than a small amount of manipulation of tassels and ties (as instructed), the exhibit could be set up and taken down without handling and arranging the objects.

When the exhibit finished travelling, the receiving metal layers would be removed with the assistance of a conservator. The magnets could be removed from the mounts and repurposed.

RESULTS

In spring of 2015, the exhibit *Beyond Fiddles and Sashes: Showcasing Parks Canada's Métis Collections* travelled successfully by ground transportation from Winnipeg, Manitoba to Gatineau, Quebec. The cases and mounts remained stable with the objects in place despite some damage and marks on the outside of the shipping crates which indicated that the crates had been impacted during the journey.

While at the exhibit venue it was necessary to move the exhibit tables containing the cases with the objects. Although the tables were on casters suitable for moving, it appeared that one of the tables experienced an abrupt movement. As a result, the fire

Figure 9. Mittens and garters mounted on fabric-covered base fitted inside exhibit case. Photo: Amanda Harding, © Parks Canada.

Figure 10. Location and position of beaded fire bag after impact to the exhibit table. Photo: Michael Eisen, © Parks Canada.

bag detached completely from the mount, slid to one end of the case and the beaded panel folded over on top of the pouch (**Figure 10**). The case containing the mittens and leg garters was in the same exhibit table and it was unaffected. Conservators at the site repositioned the fire bag and it stayed in place for the remainder of the exhibit.

The exhibit subsequently travelled to La Prairie, Quebec in winter 2015, Ottawa, Ontario in spring 2016, and Fort Langley, British Columbia in summer 2016 without incident.

CONCLUSION

The use of rare earth magnetic mounting systems developed for these textile and leather objects was, on the whole, successful for the travelling exhibit *Beyond Fiddles and Sashes: Showcasing Parks Canada's Métis Collections*. This method would be considered for future travelling exhibits because it can safely secure objects during display and transit, it is aesthetically pleasing, it reduces the need for handling the objects at every stage of the exhibit, and it is simple to construct.

The release of the fire bag from its mount was a notable exception and can be considered a partial failure of the magnetic system. Further experimentation and testing are needed to determine if the magnetic system can be improved for artifacts of this type, objects that are not only very heavy, but that are relatively thick, creating a larger gap between the magnet and the receiving metal layer than is typical, or that have solid panels of beaded ornamentation which limit magnet placement. Thus, a re-think of the guideline to use the minimum strength of magnet required to hold the artifact in place may be advisable in these situations. Alternatively, other mounting methods may need to be explored.

MATERIALS

3M #415 double-sided tape (polyester film with acrylic adhesive): archival and stationery suppliers

Coroplast fluted polypropylene board: art and archival suppliers

Cotton twill tape (various widths available): fabric stores and archival suppliers

Fabric: fabric stores

Gütermann Skala ultrafine polyester thread: Oshman Brothers, 136 Eldridge Street, New York, New York 10002-3782, USA; Tel.: 212-226-7448; <www.oshmanbrothers.com>

Polyester batting: fabric stores

Rare earth magnets: Lee Valley Tools; Tel.: 1-800-267-8787; <www.leevalley.com>

Strap tie by Simpson Strong-Tie (galvanized steel with pre-drilled holes): hardware stores

Tyvek expandable envelopes (stiff, paper-like – Type 10): Uline Canada, 60 Hereford Street, Brampton, Ontario L6Y 0N3, Canada; Tel.: 1-800-295-5510; <www.uline.ca>

Tyvek nonwoven spunbonded olefin fabric (soft, fabric-like – Type 14): Carr McLean, 461 Horner Avenue, Toronto, Ontario M8W 4X2, Canada; Tel.: 1-800-268-2123; <www.carrmclean.ca>

Volara closed cell polyethylene foam: Carr McLean, 461 Horner Avenue, Toronto, Ontario M8W 4X2, Canada; Tel.: 1-800-268-2123; <www.carrmclean.ca>

Volara foam rabbet tape (closed cell polyethylene foam with acrylic adhesive): Carr McLean, 461 Horner Avenue, Toronto, Ontario M8W 4X2, Canada; Tel.: 1-800-268-2123; <www.carrmclean.ca>

Washers, zinc-plated steel (various diameters): hardware stores

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