

Safe Handling of Magnets in the Conservation and Display of Works of Art

INTRODUCTION

Strong permanent magnets have proven to be a practical, reversible, and sustainable tool. They are becoming ubiquitous in the art world, used not only for presenting, displaying, and exhibiting works of art, but also as a tool used during conservation treatments. A growing body of literature addresses the use of magnets for conservation treatment, display, stabilization, and storage of cultural heritage objects; see the box “Literature on Magnet Use by Cultural Heritage Institutions.”

Research on the subject is still limited, but the need for investigations about the influence of the magnetic field exerted on art materials stems from the fact that certain materials (e.g., pigments) containing ferro- and paramagnetic elements react in a significant manner when in the vicinity of strong permanent magnets (Szozda 2020). Unquestionably all materials are susceptible to magnetic influence; since magnets emit a permanent magnetic field undetectable by human senses, research on human safety is of concern (Simon 2013).

Defining Safe Magnetic Exposure

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) distinguishes two types of exposures to magnetic fields:

- › Static amplitude (referred to as “static” by the ICNIRP), where neither the field changes nor is there movement between the magnet and the person touching the magnet.
- › Dynamic amplitude (referred to as “time varying” by the ICNIRP), which can be generated by the relative motion with respect to the static magnet (e.g., a hand moving toward a magnet to pick it up will experience magnetic field amplitude which varies with time). The limits are as follows and are applicable for any short exposure, even below one second.

Table 1: Magnetic Field Exposure Definitions (ICNIRP). (See p. 30 for more on Tesla.)

	Static Limit (Teslas)	Dynamic Limit (Teslas)
Working with Magnets	2 for head and trunk; 8 for limbs	0.2
General Public	0.4	0.04

It is believed that a static magnetic field is not as dangerous as a moving (dynamic) field because most matter inside humans is non-magnetic. A changing or moving magnetic field can induce voltage in nerves that can have negative impacts. Voltage can interfere with the nervous system and in extreme cases even cause heating inside the flesh. Therefore, the safe levels of time-varying exposure are much smaller than for static fields. Neodymium magnets, commonly used in conservation, can exceed these limits. For example, grade N42 is 1.45 T (VAC 2015, Arnold Magnetic Technologies 2021).

Health Effects of Magnetic Fields

Although magnets can exceed the permissible levels recommended by the ICNIRP, the small magnets used in conservation are not strong enough to cause severe magnetically-induced symptoms, such as damage to internal organs, vertigo, and nausea.

However, people with electronic medical devices like pacemakers and other medical implants such as surgical clips and contraceptive implants (which in some cases are manufactured with ferromagnetic materials) are at risk. These individuals should refrain

from working with strong magnets unless they receive medical advice to the contrary. It should also be noted that biological effects on sensitive tissue (e.g., pregnancy) are unknown, so it is best to avoid strong magnetic fields.

Literature on Magnet Use by Cultural Heritage Institutions

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PRACTICAL USE OF MAGNETS: GUIDELINES

Physical Contact:

- › Physical contact with magnets should be limited because the magnetic field surrounding the magnet penetrates the skin, flesh, bones, and blood.

Handling:

- › Keep in mind a magnet in motion emanates an alternating field that can be more dangerous to human bodies than a stationary magnet, so only move magnets when necessary.

- › Take care when handling more than one magnet because they can unexpectedly move toward each other and may result in damage to art, pinched skin, and/or damaged magnets.
- › When handling is necessary, avoid the poles as well as any corners and edges, as this is where the magnetic field is strongest.
- › For flat, coin-shaped magnets, it is impossible to avoid either the poles or the edges when handling magnets directly. New technical solutions to shield the magnetic poles are much needed (Szozda 2022).
- › Gloves provide improved protection from physical damage to the skin caused by magnets colliding with each other. Nitrile and cotton gloves do not protect the hands from the effects of the magnetic field, which penetrates all non-magnetic materials. Thick leather gloves would provide marginally better protection simply by increasing the distance between the skin and magnet. Significantly improved protection can only be achieved with gloves made of a thick magnetic material.

Individual Sensitivities:

- › The strength of a magnetic field decays quickly with increased distance. For a member of the public viewing a work of art mounted with magnets, the field should usually be low enough to be safe. However, this depends strongly on the frame to which the magnets are adhered as it will distribute the field differently.
- › Consider practical solutions to protect people with medical devices sensitive to magnetic fields (ICNIRP 2009), such as setting a minimum viewing distance for items displayed using magnets or including a warning about the magnetic field if it exceeds the ICNIRP limits.

Conclusion

Undeniably, magnets are an indispensable and a very practical tool for conservators and museums. The scope of the topic of safe handling of magnets in conservation and exposition of art is complex, extensive, and needs more research, but following the general rules and recommendations outlined above can guarantee the safety of artworks and employees.

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