Temporary Display and Transit of Photographs and Works on Paper: Using Design of Experiments (DoE) for the Evaluation and Optimization of Framing Methods and Choice of Materials

Ana Martins and Lee Ann Daffner
David Booth Conservation Center, The Museum of Modern Art, New York, NY, USA

A Design of Experiment (DoE) approach was used to lay out the experimental plan and to evaluate the influence of all the variables of interest at the end of the experiment.

How did the frames perform?
How well does the enhanced frame protect from Relative Humidity (%RH) extremes and fluctuations?

A combination of buffering and sealing is fundamental to maintain a very stable RH inside the frame and minimize the short term (daily) and long term (seasonal) fluctuations. However, even the fully enhanced frame cannot protect the object from extreme seasonal fluctuation (it is difficult to fully seal the frame package; Plexiglas for example is known to be porous).

Conclusion
Impact on the museum’s policies

• Framing works on paper in a passepartout increases the costs significantly but offers undeniable protection – it should continue to be requested for outgoing loans.
• Building a perfectly sealed is difficult or prohibitive. The slow diffusion of moisture will occur if displayed in extreme conditions for extended periods. The passepartout should however perform adequately in conditions within the Biziot guidelines (40%-%RH-60% with fluctuations of no more than ±10% RH per 24 hours).
• Sealing the passepartout with tape is labor intensive and protects essentially from long term exposure in more extreme conditions. Adding just a sheet a Marvelseal adds little to the cost of materials and labor but offers great protection against short term RH fluctuation. The new policy is to systematically add a sheet of Marvelseal to all frames.
• The removal of metal tape is very labor intensive and often precudes reusing the frame materials. The use of tape is easier to remove and performs similarly and is now considered a suitable alternative.

How to test the impact / benefit of adding buffering material + vapor barrier + sealing tape?

A full factorial design was performed on a series of metrics derived from the RH and temperature values to evaluate the impact of buffering and sealing the frame:

For most works on paper, a range of 50%-%RH is desirable. Adding Artsorb is needed to effectively reduce the seasonal fluctuation (as long as the frame is sealed against moisture diffusion by adding at least a sheet a Marvelseal).

Sealing with tape further improves the performance of the frame. No significance difference is observed between the 2 tapes but Artsorb is easier to remove when the frames need to be disassembled.

Whether Artsorb is present or not, adding just a sheet of Marvelseal helps keeping the amplitude of daily %RH fluctuation within a 5%RH maximum range. Adding the tape seems to have little impact, probably because the diffusion through the edges of the frame is much slower than from the back.

MoMA now has a standard frame: with and without Mat and Window Mat: with and without Marvelseal or Marvelseal and Linenco Frames or Marvelseal and Permacel JLar tape (vapor barrier) + Lineco and Marvelseal. The new policy is to use a standard frame designed to stabilize works during transit or display in unknown or less controlled environments.


In 2015, MoMA sent more than 500 objects from their collection on exhibition tours and outgoing loans. At least 23 of the objects were works on paper. The general policy at MoMA is to use a passepartout for the display of works in unknown or less controlled environments and for works travelling overseas.