

Updating The Metropolitan Museum of Art's Oddy Test Protocol: Reducing costs and waste with a stainless steel coupon hanger

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Abstract:

The Met developed a reusable stainless steel holder to replace the Shapeways 3D-printed nylon holders for hanging metal coupons inside the jar. The steel holders are washable, reusable, and have the same initial price point as the nylon holders. Oddy testing conducted by the Met produced only very minor differences in the results between jars with nylon holders compared to stainless steel when the same sample material was tested. No differences were observed with the copper and lead coupons. A slight difference in sensitivity was observed with the silver coupon, however, given the advantages of the steel holder, the difference was not considered significant enough to hamper its use. Furthermore, carryover testing of stainless steel holders confirmed that a history of use in jars with temporary or unsuitable materials has not affected the overall results of subsequent tests when the same steel holder was used after washing.

Background:

The Met's current Oddy testing protocol, which was issued in early 2019 (20190226_OT)¹, instructs limited reusability for the plastic components of the test. Plastic materials are often capable of absorbing chemicals from their surroundings and can then release those chemicals over time. To minimize the impact of the plastic Oddy fixtures on the test results, lids are reused up to 3 times after being on jars with a temporary result and not reused after being on a jar with an unsuitable result; nylon holders and Viton® o-rings are not reused after being in a jar with either temporary or unsuitable results. Because of these reusability practices, testers must continuously repurchase these components.

In an effort reduce plastic waste and lower the cost of running the test, the Met developed a washable and reusable stainless steel coupon holder (Figure 1). Because the steel is not porous, even those used with unsuitable materials can be washed and reused. The holders are water-jet cut from a thin sheet of stainless steel by Asterisk Inc. Water-jet cutting allows the steel to remain corrosion resistant.²



Figure 1: Stainless steel coupon holder with attached copper, silver, and lead coupons.

¹ The protocol is available on the AIC Wiki's Oddy Test Protocols page: https://www.conservation-wiki.com/w/images/9/94/20190226_OT_1_MMA_Oddy_Protocol.pdf

² Laser cutting of stainless steel significantly reduces corrosion resistance.

Summary of test results:

Testing Standard Materials:

The Met periodically tests a set of 3 materials that reliably produce permanent, temporary, and unsuitable Oddy test results. The permanent standard is Obomodulan 500, manufactured by OBO-werke and sourced through McCausey Specialty Products. The temporary standard is a gummed paper tape produced by Klug Conservation, sold through Talas as Heritage Gummed Paper Tape. The unsuitable standard is Wool Flannel 527 from TestFabrics, Inc.

The 3 standard materials were tested two times using stainless steel holders, and the results

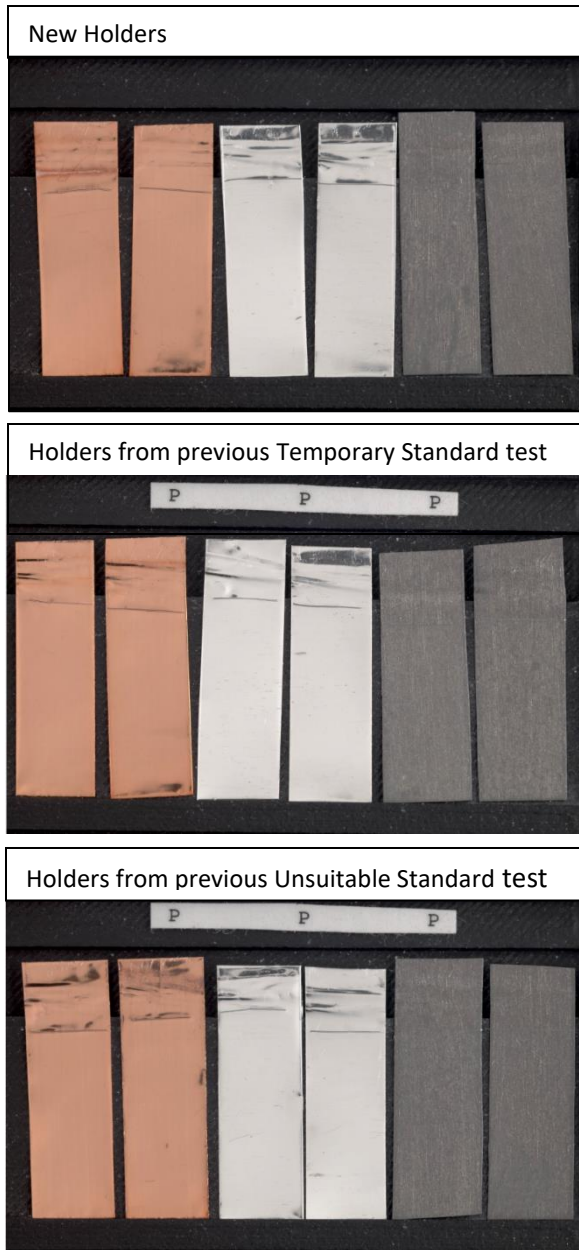


Figure 2: Oddy coupons from control jars with new steel holders (top), with steel holders from a previous temporary standard test (middle), and with steel holders from a previous unsuitable standard test (bottom).

were compared to tests of the same materials evaluated with nylon holders. The permanent and unsuitable standards produced no observable difference between tests with different holders. When comparing steel and nylon holder tests of the temporary standard, only the silver coupons exhibited a slight difference. Of the total 14 temporary standard tests with nylon holders that the Met has conducted since 2019, a faint yellow tarnish was observed on 79% of the silvers. No yellow tarnish was observed on any silvers from steel holder tests of the same material. While this difference did not affect the overall rating of those jars, the silver coupons were different. The holder-dependent differences in tarnish level was investigated further and is discussed below.

Carry-over testing:

Stainless steel holders previously used in jars with the temporary and unsuitable standards were washed with plastic Oddy components on a hot water only cycle using a Lancer 815 LX Dishwasher and dried in a 60°C oven. Those holders were used in control jars without sample material and compared to control jars with new stainless steel holders. No differences were observed (Figure 2).

Testing non-standard materials with a broad range of temporary and unsuitable results:

Sample materials with a range of corrosion types on all 3 metals from temporary to unsuitable were selected for re-testing with one nylon holder jar and one stainless steel holder jar for each material. The goal was to confirm that the stainless steel holders would not affect any of the types of corrosion commonly seen in MMA tests. Amongst the tests,

copper results included varying amounts of red and rainbow tarnish, slight haze, and heavy haze. The silver results included slight yellow tarnish, rainbow tarnish, purple tarnish, white haze, and orange haze. The lead results included darkening, blue tarnish, yellow/green compacted corrosion, white compacted corrosion, and crystal growth. The types and amounts of tarnish observed in all but one test were the same regardless of holder type.

The test that produced a slightly different result when the nylon or steel holders were used was a vinyl flooring tile (Expona Commercial 5056). The silver coupon on the nylon holder produced slightly more yellow tarnish than the coupon on the stainless steel (Figure 3), though both exhibited yellow tarnish. In this case, the slight differences in tarnish amount did not affect how the coupons were rated. In addition, the silvers from a different vinyl floor tile (MRGE ERIE DI001) both had the same degree of faint yellow tarnish with both holder materials (Figure 4). Figures 6-19 in Appendix I show a range of silver corrosion types and levels produced by the same materials with both nylon and steel holders. While more work is needed to establish the silver coupon's sensitivity dependence on the holder type, silver corroding chemicals in concentrations near the permanent/temporary rating border established with nylon holders are usually detectable in tests with steel holders. Based on this result and the tests with standard materials mentioned above, it is likely, however, that the silver coupon is slightly less sensitive to sulfides when using the stainless steel holder. The difference does not appear to be significant enough to warrant the continued use of nylon holders given the cost and reusability benefits provided by the steel holders. Nylon holders will remain available from Shapeways for those using the Oddy test to evaluate materials intended for use with silver collections, where the sensitivity of the silver coupon is paramount.

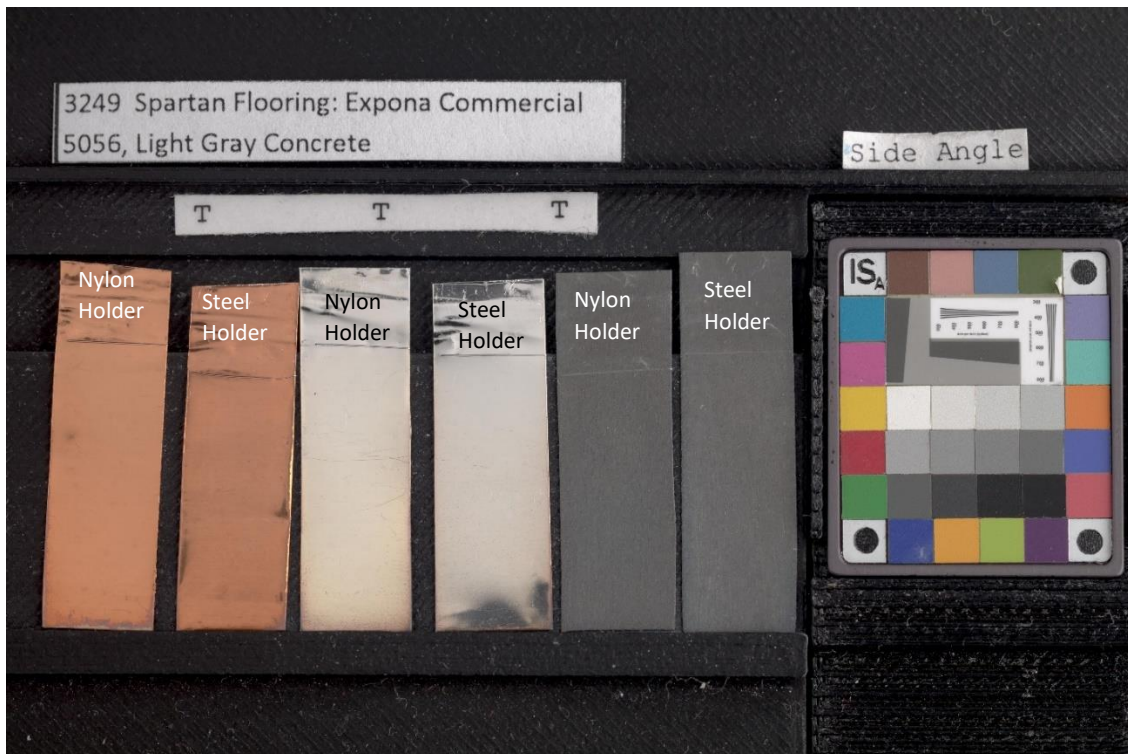


Figure 3: Coupons from Oddy test of Expona Commercial vinyl flooring. In each pair of coupons, those from the jar with the nylon holder are on the left, and the steel holder are on the right. The left silver coupon has slightly more yellow tarnish on the bottom half compared to the one on the right.



Figure 4: Coupons from Oddy test of MRGE Erie DI001 vinyl flooring. In each pair of coupons, those from the jar with the nylon holder are on the left, and the steel holder are on the right. No significant differences were observed between coupons from different jars.

Ordering and preparing:

The holders are ordered from Peter Hotkowski at Asterisk Incorporated.³ They are a custom-shape design water jet cut from 0.5 mm 316 stainless steel and cost approximately ~\$5 per holder (~\$15/part). Each “Met Oddy part” contains 3 holders that must be separated using fine wire cutters and bent into a triangular prism shape (Figure 5). The initial cost is equivalent to purchasing Shapeways nylon holders, which cost ~\$5 per holder.

The holders contain burrs from the cutting process. These can be filed with a fine file, though it is not necessary to do so. The images in Figure 5 are of

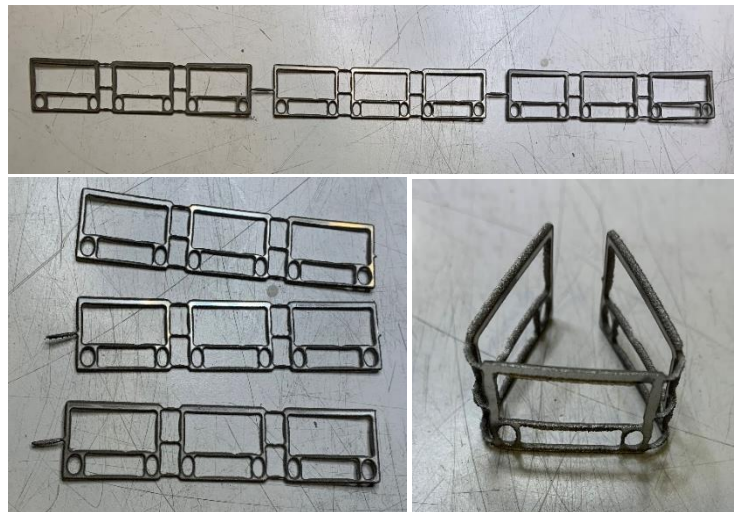


Figure 5: Stainless steel holders as a flat, 3-piece “Met Oddy part” (top), separated into holder sections (lower left), and tabs removed followed by bending over rounded tool like a screwdriver shaft into triangle configuration (lower right).

³ Order ‘Met Oddy part’ in 0.5mm 316 stainless steel from Peter Hotkowski of Asterisk Incorporated, 50-3 River Street, Old Saybrook CT 0647, 860-388-3811, peteh@asteriskinc.com. Forwarding the Figure 5 in your request may expedite the process.

unfiled holders, which is the condition used in the tests reported herein.

Before using the stainless steel holders for the first time, wash them with a 1% solution of Micro-90 Lab Cleaner in tap water, rinse thoroughly with hot tap water followed by de-ionized water, and let dry completely. Once the individual holders are clean and separated from their 3-piece chain, they must be bent into a triangle configuration. This can be done by hand without heating or the use of pliers, though it is best to bend each joint over a curved edge or tool, like a small screwdriver shaft, to avoid crimping the hinge. Attach the metal coupons to the bottom of the holder by hanging them over the thin edge and crimping the coupon's fold closed. Insert the holder with the coupons into the mouth of the test jar so that the top of the holder is level with the top of the jar.

After testing is complete and the metal coupons have been removed, the holders must be washed again before further use. Follow the same washing procedure described for new holders. Used holders should remain in the triangle configuration – repeated un-bending and re-bending of the holder will cause unnecessary wear and breakage of the hinges. Allow to dry completely before use.

Contact Us:

If you are using the Met's protocol, we appreciate any input or questions you may have regarding instruction clarity, ease of use, or general experience. To discuss the Met's Oddy protocol or the switch to steel holders, please contact Eric Breitung (eric.breitung@metmuseum.org) or Alayna Bone (alayna.bone@metmuseum.org).

Appendix I – Additional Oddy Testing Images

Test set 1: Two jars of each standard material and controls with stainless steel holders (right column) compared to recent nylon holder tests of those materials (left column).



Figure 6: Control coupons from jars with nylon holders (left) and control coupons from jars with steel holders (right).



Figure 7: Coupons from jars with nylon holders and the permanent standard (left) and coupons from jars with steel holders and the permanent standard (right).



Figure 8: Coupons from jars with nylon holders and the temporary standard (left) and coupons from jars with steel holders and the temporary standard (right). Very slight yellow tarnish is visible around the edges of the nylon holder silvers, whereas the steel holder silvers were marked “T” for slight white haze which is not caused by tarnishing.

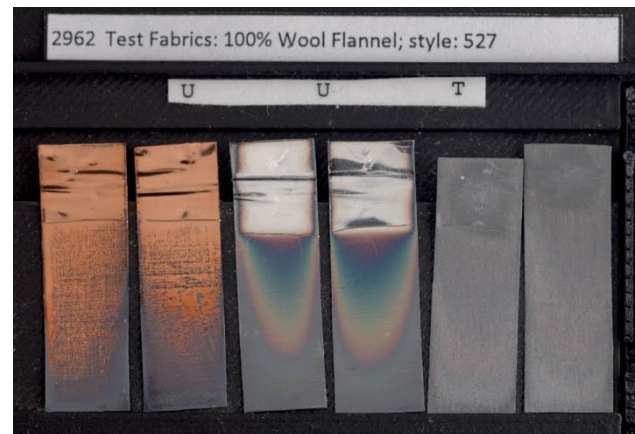
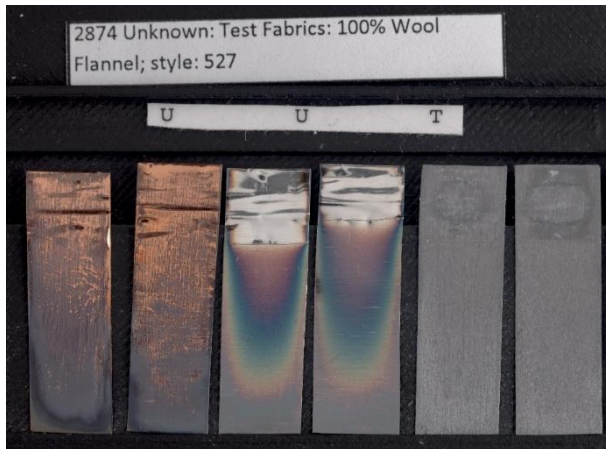


Figure 9: Coupons from jars with nylon holders and the permanent standard (left) and coupons from jars with steel holders and the permanent standard (right).

Test set 2: Three jars for each material tested, two with nylon holders and one with a steel holder. This set includes three random materials that had not been previously tested.

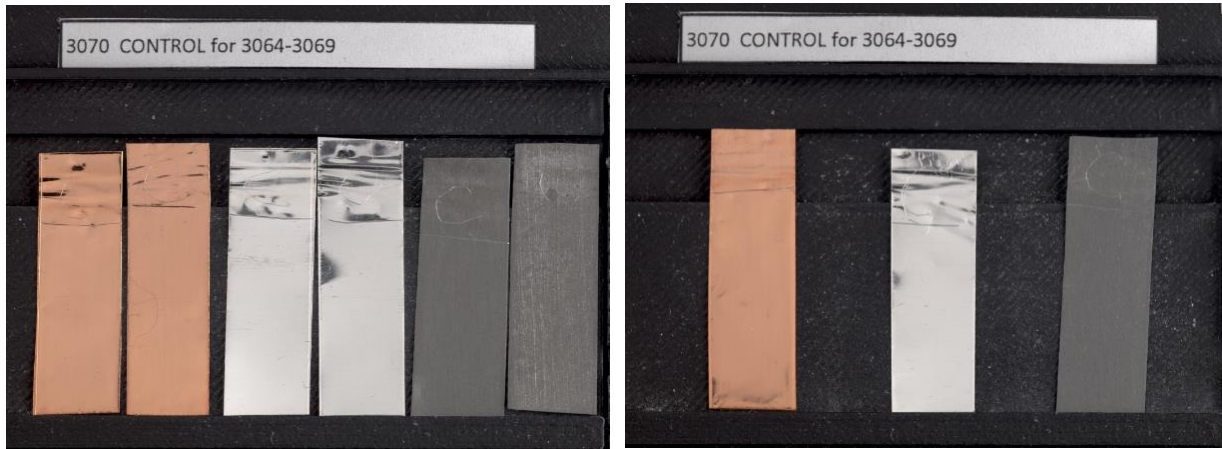


Figure 10: Coupons from a control test in jars with nylon holders (left) and with a steel holder (right).

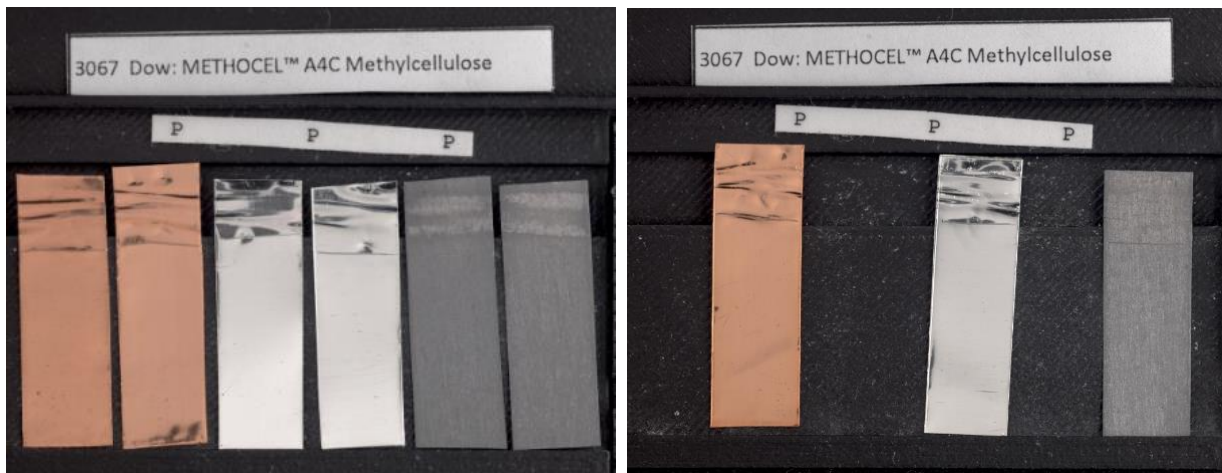


Figure 11: Coupons from a test of Methocel™ A4C Methylcellulose in jars with nylon holders (left) and in the jar with a steel holder (right).



Figure 12: Coupons from a test of Dowsil™ 795 in jars with nylon holders (left) and in the jar with a steel holder (right).

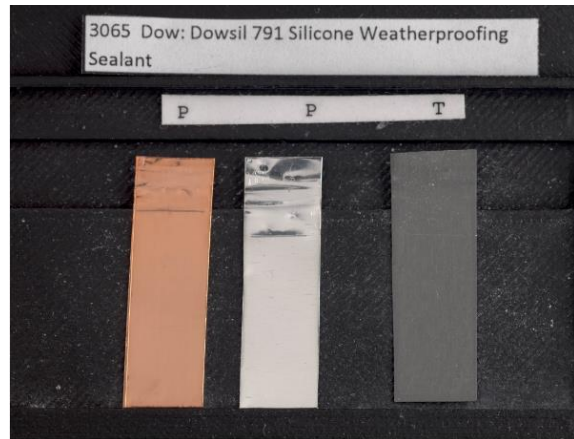
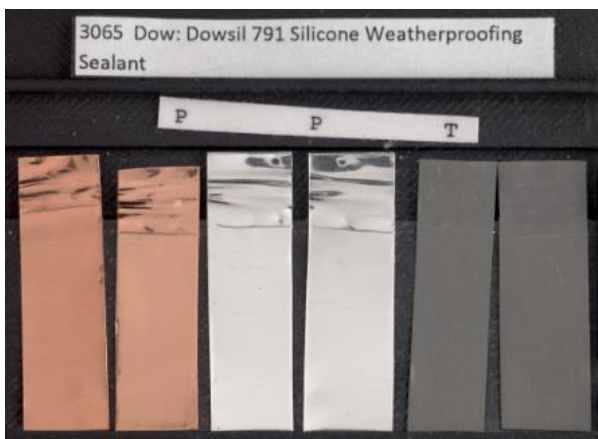


Figure 13: Coupons from a test of Dowsil™ 791 in jars with nylon holders (left) and in the jar with a steel holder (right).

Test set 3: Two jars for each material tested, one with a nylon holder and one with a steel holder. Materials were selected based on results from prior testing that showed a range of temporary to unsuitable results for each metal type. The coupons from Figures 3 and 4 belong to this test set. For each metal type in the images, the left coupon was hanging from the nylon holder and the right coupon was hanging from the steel holder as indicated in Figure 14.



Figure 14: Coupons from a control test. In each pair of coupons, those from the jar with the nylon holder are on the left, and the steel holder are on the right.

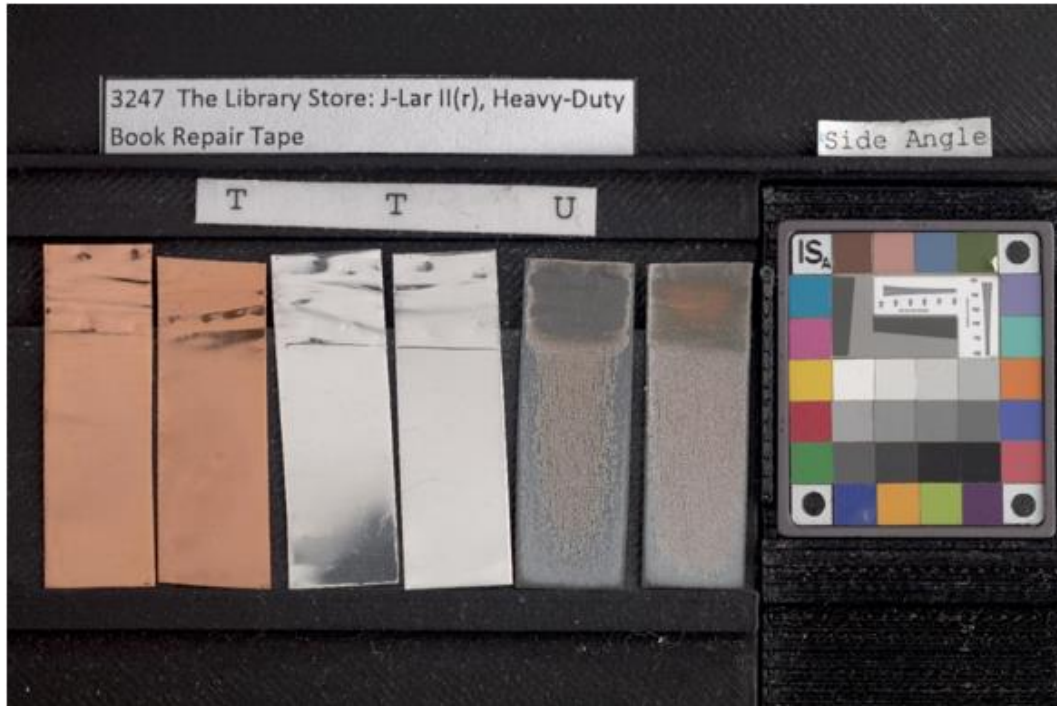


Figure 15: Coupons from a test of J-Lar II® book repair tape. For each metal type, the coupons from the jar with the nylon holder are on the left, and the steel holder are on the right. The silver coupons were rated Temporary for a white haze.

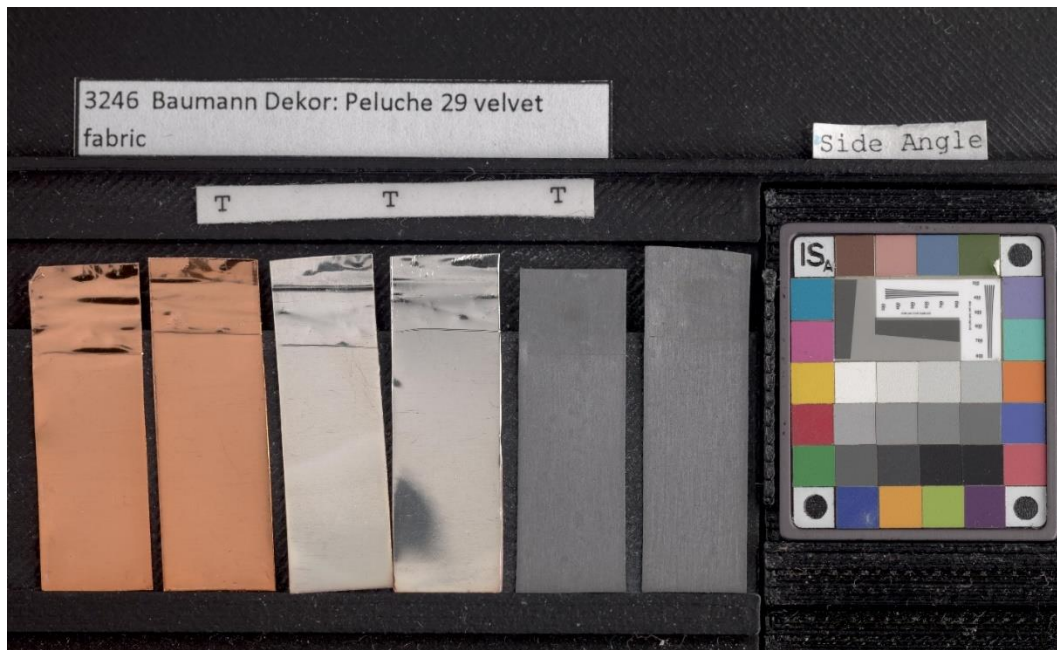


Figure 16: Coupons from a test of Baumann Dekor Peluche 29 velvet. For each metal type, the coupons from the jar with the nylon holder are on the left, and the steel holder are on the right. The silver coupons were rated T for orange haze overall and yellow tarnish at the edges.

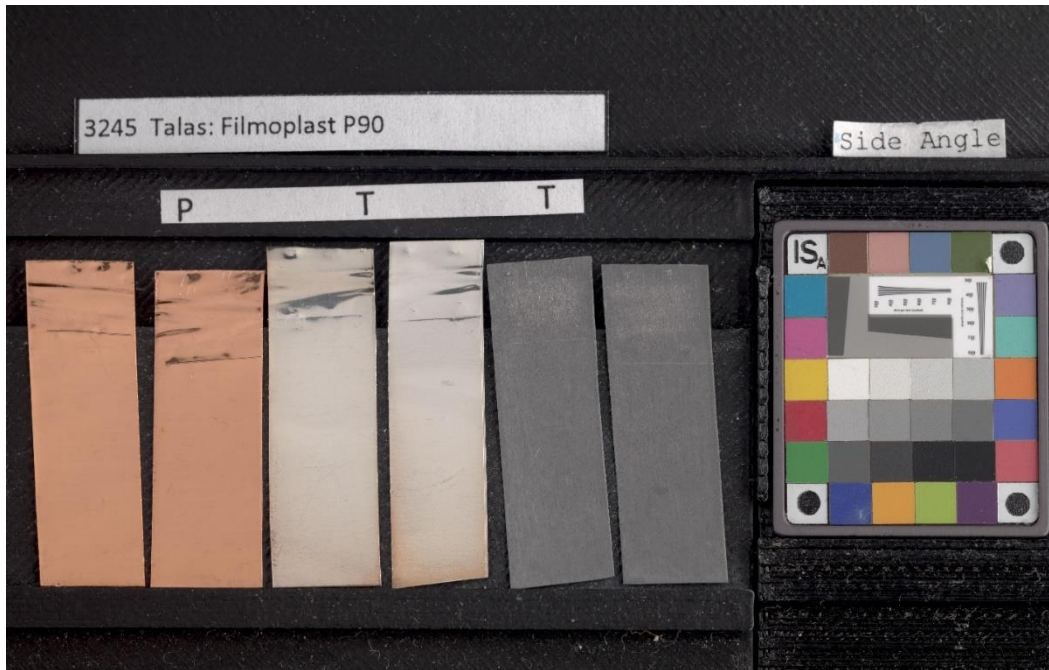


Figure 17: Coupons from a test of Filmoplast P90. For each metal type, the coupons from the jar with the nylon holder are on the left, and the steel holder are on the right. The silver coupons were rated Temporary for white haze and yellow tarnish overall.



Figure 18: Coupons from a control test. For each metal type, the coupons from the jar with the nylon holder are on the left, and the steel holder are on the right. The silver coupons were rated T for slight yellow tarnish at the edges.



Figure 19: Coupons from a test of Paradise Packaging Company Mushroom Packaging. For each metal type, the coupons from the jar with the nylon holder are on the left, and the steel holder are on the right. The silver coupons were rated Unsuitable for extreme rainbow and purple tarnish overall.