

Third Interim Narrative Report  
for IMLS LG 06-07-0067

DP3 Project: Digital Print Preservation Portal  
(PART II) – Evaluations of the Effects of Housing,  
Handling, and Flood on Modern Digital Prints

**For the Period November 1, 2008 to April 30, 2009**

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## INTRODUCTION TO THE PROJECT

This is the third interim report on the Institute for Museum and Library Services Project LG 06-07-0067 titled “The DP3 Project: Digital Print Preservation Portal (PART II)—Evaluations of the Effects of Housing, Handling, and Flood on Modern Digital Prints.” This is a major research and development project dealing with the preservation of digitally printed materials: inkjet, dye diffusion thermal transfer or “dye sub,” and color electrophotographic. This project is intended to help all conservators, curators, archivists, librarians, and collection managers better understand and care for these objects in their collections.

The project involves research into several key elements of preservation for digital prints in libraries, archives, and museums. The research focuses on the potential harmful effects of mixing traditional and digital print collections, the effects of housing and display materials on digital prints, the effects of handling, and minimizing the risk of damage due to flood. The ultimate goal of the project is to create a set of science-based recommendations to help cultural heritage institutions make collection care decisions and to publish this information on IPI’s The DP3 Project: Digital Print Preservation Portal website.

The project has three stages:

**Preparatory** – In this stage, which was primarily confined to the first two quarters of the project, experimental equipment necessary to the project and outlined in the original project proposal were purchased, installed, and calibrated at IPI. Any necessary training was also concluded during this time. Additionally, a large number of materials had to be collected to create the test sample population. These samples were made at IPI or other departments at RIT, or, when unavoidable, obtained from sources outside of IPI and RIT.

**Experimental** – In this stage, which is ongoing from the second quarter of the first year through the third quarter of the second year, experimental work will be performed in order to understand the behavior of these materials over time. As mentioned above, a variety of print characteristics and vulnerabilities are being explored. This experimental phase can be divided into four separate categories:

*Chemical Interactions* – Chemical interactions between traditionally printed materials (chromogenic photographs and offset lithographic prints) and digital prints (inkjet, dye sub, and electrophotographic) will be examined. Also, interactions between digital prints (inkjet, dye sub, and electrophotographic) and common enclosures used in institutions (such as cotton paper, mat board, and polyester films) will be examined. Results will be

used to determine whether digital and traditional prints can be stored together or need segregation and, further, to determine whether enclosures currently used for traditional materials are equally suitable for digital prints.

*Physical Interactions* – Physical interactions between prints in stacks or prints in contact with enclosures and framing materials (for example, ferrotyping, bonding, and colorant transfer) will be explored with the goal of providing suggestions to prevent these forms of damage.

*Physical Handling* – The sensitivity of digital prints to surface abrasion and emulsion/surface cracking (brittleness) will be examined with the goal of providing guidelines for handling.

*Flood/Disaster Sensitivity* – Samples of various digital print processes will be exposed to water immersion and evaluated for survivability. This will be done in order to help institutions include care for digital prints in their disaster plans.

**Reporting** – In this stage, information regarding the properties under investigation will be posted on IPI's DP3 website, and interim reports will be transmitted to IMLS at requested intervals. The final results at the end of the project will be reported and made available to IMLS and to the public, and will be specifically marketed to the archives, libraries, and museums that need the information.

## ORIGINAL PROJECT SCHEDULE OF COMPLETION

The following table shows a simplified version of the project's schedule of completion as outlined in the grant proposal. The black areas indicate the aspects of work completed.

	Year 1				Year 2			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Purchase and install experimental equipment								
Create/collect samples								
Perform chemical interaction tests								
Perform physical interaction tests								
Perform flood experiments								
Perform abrasion and brittleness tests								
Update DP3 website with project results								
Reporting/dissemination								

**PREPARATORY STAGE**

The preparatory stage of the project is finished. All equipment purchased for the project has been installed.

**EXPERIMENTAL STAGE***Chemical Interaction Tests*

There are two separate lines of inquiry in the chemical interaction tests. The first examines the potential for chemical interactions between digital and traditional prints. The method used focuses specifically on whether digital prints may harm traditional photos when they are stored together. The test requires separately examining the effects of digital print papers and colorants for reactivity. The tests using the print papers alone are finished. The tests using the colorants are almost complete. Two trials are finished and a third is currently in incubation. Preliminary analysis suggests that most digital print colorants are inert with respect to traditional photographic images. All testing should be complete by the end of June. An abstract of the work has been submitted to the Society of Imaging Science and Technology (IS&T) NIP25: 25th International Conference on Digital Printing Technologies in Louisville, KY September 20-24, 2009.

The second line of inquiry is into whether there may be potentially harmful interactions between digital prints and common enclosures (such as envelope papers or plastic sleeves) during long-term storage. These tests are currently in the preparation stage. The accelerated aging of these materials is expected to begin in June. This is slightly behind schedule; however, IPI believes that the project will still be completed on time.

*Physical Interactions between Digital Prints and Common Enclosure and Framing Materials*

The blocking and ferrotyping tests using the print paper alone was completed during the last reporting period. In review, all types of digital print papers are less prone than traditional color photographic print paper to stick to enclosures, glass in frames, or to themselves in stacks. Most types of prints (including those on plain paper, dye sublimation, and inkjet on mineral-coated papers) did not block at all.

The next step has been to perform the tests using printed samples to determine if the printed colorants are prone to blocking, ferrotyping, and image transfer. This phase of the experiment is more than halfway complete and should be finished by the end of May. Analysis of the results should be completed by the end of June. An abstract of this work also has been submitted to the IS&T NIP25: 25th International Conference on Digital Printing Technologies.

*Abrasion Testing*

Two related questions are being addressed with regard to abrasion and digital prints. The first is how sensitive are digital prints to abrasion by common enclosure materials (such as envelope papers or plastics sleeves) or by other digital prints when stored together in stacks? The second is how sensitive to abrasion are the different digital print types compared to each other?

For the first question, fifteen different print types were tested in triplicate against three different enclosure types (polyester sheet, interleaving tissue, and envelope paper) and the reverse sides of the same print type (as in stacks). Five different measurements were made on each sample (gloss, optical density, colorimetry, average grey level, and visual). A total of 144 samples with a total of 720 measurements were made to determine the abrasion sensitivity of digital prints to common enclosure materials or against their reverse sides in stacks. It was determined that, with respect to colorant damage, the polyester film was least damaging, and interleaving tissue, envelope paper, and print back were all equally more abrasive. With respect to surface gloss damage, the polyester and envelope paper were equally the least damaging, with interleaving tissue being next in abrasiveness and print back as the absolute worst. It is concluded that the best approach is to file digital prints in polyester sheeting or use polyester film interleaving. The worst approach is to stack prints without any protection, as this will most likely cause damage to both the colored areas and surface gloss. The results of this portion of the abrasion testing are scheduled to be presented at the annual meeting of the American Institute for Conservation of Historic and Artistic Works Book and Paper Group, May 19-22 in Los Angeles.

For the second question, the tests to rank the relative sensitivities of all the digital printing technologies have all been performed; however, the analysis of the data has not been completed. This should be completed by the end of June. The results from all the abrasions tests will then be submitted for publication in the American Institute for Conservation of Historic and Artistic Works *Book and Paper Group Annual*.

*Brittleness of Digitally Printed Materials*

Most of the brittleness tests have been completed. The digital print samples are also being tested at both 50% and 10% RH to determine if low humidity exacerbates brittleness as it does with photographic images. Both printed and unprinted samples are being tested to determine if colorant has a mitigating or exaggerating effect on brittleness. The results have shown that the materials display various degrees of sensitivity and that there are various types of effects (micro and macro cracking as well as buckling) and levels of severity (minor to complete tears). An abstract of the work has been submitted to the IS&T NIP25: 25th International Conference on Digital Printing Technologies.

*Flood Sensitivity Testing*

Since the last interim report to IMLS on this project, flood sensitivity testing work has focused on further improving the methodology. The last of that preliminary work has been completed and a new method, a new target set, and a new set of metrics have been established.

During the preliminary testing some digital prints were nearly unaffected by flood (only slight curl), and others were completely destroyed with neither image nor text readable. There was, however, some difficulty in characterizing the intermediate levels of damage which range from slight aesthetic loss to compromised, but not fully degraded, readability.

From the preliminary tests, a new set of assessment criteria was created that will allow for a more descriptive evaluation of the various intermediate levels of damage the materials may develop during flood events. These include the qualitative metrics of color bleed, gloss changes, bronzing, planar deformation (cockle and curl), emulsion delamination, text readability, and water spots as well as the quantitative colorimetric measurement of Delta E – a total measure of color change including image loss and hue change for both the image and white areas of the prints.

Work on evaluating a large set of 30 different digital print types has begun. This is the final experiment and will result in clearly establishing the risks to digitally printed materials in flood events or other severe water disasters. This work is expected to be completed by July.

**REPORTING STAGE**

IPI intends to post all of the project results on the DP3 website, as stated in the original grant proposal, during the final quarter of the project. The DP3 website (DP3Project.org) is now up with basic information about the project as well as resources to aid collection caretakers.

As stated above, IPI has submitted several technical papers to professional societies for inclusion in conferences and/or journals. IPI has also submitted a presentation to the annual Research Forum of the Society of American Archivists in Austin, TX, to provide a general overview of all the research that IPI has performed on this topic to date. IPI will be informed by June 15 as to whether that presentation is accepted.

IPI has also launched the project's *DP3 Newsletter*, which will be used to keep subscribers up to date on the status of the experimental work, the development of the website, and the dates and locations of IPI presentations on digital print preservation. So far, there are 180 subscribers to the newsletter. The first issue went out in March.

## CONCLUSIONS

At this point in the project, the following observations can be made:

- The IMLS-funded work for IPI's DP3 Project is proceeding according to schedule.
- Almost all experimental work is complete with the exception of work examining the effects of common enclosures on digital prints. That work is still expected to be completed on time. Currently the large amount of data generated by the project is being analyzed so that it can be distilled into clear recommendations to collection-care professionals on how to care for digitally printed materials. The final results of the project will be posted to the DP3 website during the last quarter of the project.
- IPI is sharing this information with other relevant organizations through its submission of papers for publication and presentations at conferences such as the American Institute for Conservation of Historic and Artistic Works Book and Paper Group Conference next May, the Society of American Archivists annual meeting in August, and the Society for Imaging Science and Technology NIP 25 Non-Impact Printing conference in September.