

Second 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 May 1, 2008 to October 31, 2008**

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## INTRODUCTION TO THE PROJECT

This is the second 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.

There are three stages to the project:

- 1) **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.
- 2) **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 further categorized into three separate areas:
  - a. *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.

*b. 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.

*c. 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.

*d. 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.

- 3) **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 during the first year.

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

**1. PREPATORY STAGE**

With the exception of the installation of a low-humidity chamber, the preparatory stage of the project is finished. IPI has received and is working on installation of the low-humidity chamber. Note that receipt of the unit took longer than the manufacturer’s original estimate provided to IPI during the drafting of the project’s proposal. This was in part due to the fact that the project required a custom-configured test chamber as opposed to a standard “in-stock” configuration. Installation, calibration, and training will need to

be performed in order to make that equipment ready for experimental use. Installation of all other equipment was performed prior to the first interim report in May 2008.

## **2. EXPERIMENTAL STAGE**

### ***Performance of Chemical Interaction Tests***

The first round of testing traditional photographic prints in storage with digital print materials has been completed. In this stage the paper substrates typically used in the creation of digital prints were artificially aged in contact with special detectors used as standard surrogates for traditional photographic prints. This test showed whether the paper substrates on which digital prints are made would cause fading or staining of traditional prints stored in close proximity.

The first set of test results showed that certain types of digital print substrates were inert with traditional photographs; these included dye sub papers, offset press papers, and digital press papers. On the other hand, some examples of electrophotographic and inkjet papers were very reactive. IPI has since repeated the experiment two more times to reduce experimental noise and ensure that any recommendations will be accurate. As was stated in the previous interim report, IPI believes that it will be fruitful in a future research project to determine if these effects can be mitigated by reduced-temperature storage.

The second stage of testing traditional prints in storage with digitally printed materials is continuing. In this stage the colorants (inks and toners) used in the creation of digital prints are being artificially aged in contact with the same special detectors described above. This test will show whether the colorants in digital prints (as opposed to just the paper support) can cause fading or staining of traditional prints stored in close proximity. IPI will perform three test trials to ensure accurate results. The first trial has been completed and the second is under way. The first trial indicates that some colorants used to create digital prints may be reactive with traditional photographic images if stored in direct contact or even in close proximity.

### ***Performance of Abrasion Testing***

After a series of preliminary tests aimed at improving existing abrasion test methods so that they are relevant to digitally printed materials, IPI has finalized its method. IPI will use a Sutherland rub tester with a two-pound weight and with a total of 100 rub cycles for each test.

Prior to the preliminary testing it had been assumed, based on experience with traditionally printed materials and some anecdotal evidence, that the primary damage to prints would be loss of surface gloss and/or colorant in the high-density areas of the print. Initial testing has shown that some print materials experienced smearing of their colorants from printed areas into non-printed areas, causing darks streaks. While certainly

aesthetically displeasing, this also has the potential to obliterate text or destroy fine detail in images.

Because there are now three metrics for the abrasion test (gloss change, colorant loss, and colorant smear) IPI conducted a psychophysical study of the decay manifestations to determine which metric was most important to users. The tests discovered that the smearing of colorant was the most objectionable form of abrasion. Because of this IPI will include measurements of colorant smear throughout future abrasion tests.

IPI is now continuing the abrasion testing by expanding the number of print types and the types of materials used to initiate abrasion. The enclosure types currently being used to abrade the print samples are polyester film, envelope paper, and interleave tissue. IPI is also continuing to test the effects of abrasion for prints in stacks.

### ***Physical Interactions Between Digital Prints and Common Enclosure and Framing Materials***

The testing of digital prints for physical interactions with common enclosure and framing materials has begun. In practice this is often seen when photographic prints bond to glass in frames (an effect known as *blocking*) or when toner on a photocopy adheres to PVC plastic in a binder. Additionally, the inks in some digital prints have exhibited a tendency to migrate from the image to adjacent surfaces, including the backs of other prints in stacks.

The first trials in these experiments examined the effect using unprinted sheets. This isolated the substrate's interaction with adjacent materials. A second set of trials will begin later this year that will examine the effect with printed materials. The reason for testing the materials both ways is that sometimes it is the white area of a print that sticks and in other cases it may be the colorant applied during printing that sticks or transfers to an adjacent material. To date, most digital print papers have not shown blocking with the exception of a few that use the same type of surface coating as traditional photographs to hold the image in place. IPI is about two-thirds through the total list of papers it intends to test for the project. Detailed descriptions of the effects for all the tested papers will appear in the final report.

### ***Brittleness of Digitally Printed Materials***

The testing of digitally print materials for cracking and brittleness has not yet begun. This phase of testing should begin before the end of 2008.

### ***Flood Sensitivity Testing***

The testing of digital prints when exposed to flood has begun. The first experiments include a variety of test target types. So far it appears that some print types are nearly unaffected by total water immersion while others are completely destroyed. It

has also been determined that individual printing technologies or colorants alone cannot be used to predict a print material's sensitivity to flood. The type of printing paper used has a strong influence on the ability of a print to withstand total water immersion.

A larger sample set consisting of a greater variety of digital printing technologies and printing papers will be tested during the next six months in order to provide guidance to institutions regarding the sensitivities of these materials to flood.

### **3. REPORTING STAGE**

IPI intends to post all of the project results on the DP3 website as stated in the original grant proposal. Currently, the DP3 website is in draft stage. IPI also intends to submit technical papers to professional societies for inclusion in conferences and/or journals.

In June 2008, in Marly, Switzerland, IPI presented early results of the abrasion work to the ISO TC-42 Working Group 5. This committee is responsible for the publication of standards related to the physical properties and permanence of imaging materials. A project leader has now been assigned to develop a standardized method for measuring abrasion resistance of digitally printed materials. The work at IPI will provide significant assistance in the development of a new ISO standard.

IPI presented a technical paper on digital print abrasion test methodology to the Society for Imaging Science and Technology's Non-Impact Printing (NIP) conference in Pittsburgh in September 2008. The paper focused on IPI's efforts to finalize a methodology that was particularly suited to the sensitivities of digital prints. The paper was well received by the audience.

Finally, IPI has submitted a technical paper on the risk of abrasion of digitally printed materials by common enclosure materials to the AIC Book and Paper Group for their annual conference in Los Angeles held from May 19-22, 2009.

### **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.
- Testing of 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 are all fully under way with the exception of print brittleness testing which is expected to begin before the end of 2008.
- IPI is sharing this information with other relevant organizations through its presentation of a paper on abrasion methodologies to Society for Imaging Science and Technology's NIP 24 conference, sharing of those methodologies with the

ISO TC42 Committee to initiate work on a new abrasion standard, and submission of an abstract on the final abrasion testing results to AIC's Book and Paper Group Conference next May.