

1-1-2009

A Sample Book Of Late 20th And Early 21st Century Expired Silver Gelatin Photographic Papers

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A SAMPLE BOOK OF LATE 20TH AND EARLY 21ST CENTURY
EXPIRED SILVER GELATIN PHOTOGRAPHIC PAPERS

by

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An applied thesis project
presented to Ryerson University
and
George Eastman House International Museum of Photography and Film

in partial fulfillment of the
requirements for the degree of

Master of Arts
in the Program of
Photographic Preservation and Collections Management

Toronto, Ontario, Canada, &
Rochester, New York, USA, 2009
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Author's Declaration

I hereby declare that I am the sole author of this thesis project.

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A SAMPLE BOOK OF LATE 20TH AND EARLY 21ST CENTURY EXPIRED SILVER GELATIN PHOTOGRAPHIC PAPERS

Master of Arts, 2009

Joanne Rycaj Guillemette

Photographic Preservation and Collections Management

Ryerson University, Toronto, Ontario in coordination with George Eastman House International
Museum of Photography and Film, Rochester, New York

Abstract

In this applied thesis project, a sample booklet of various expired silver gelatin papers is created. Specific information on the use of expired photographic papers by contemporary photographers is discussed as well as insights from collection caretakers (collection managers/archivists/conservators) on the possible implications that printing with expired silver gelatin papers may have for the long-term preservation of photographic works.

The major contribution of this thesis is to create and gain a better understanding of tools that can be used in the characterisation and identification of expired silver gelatin papers. It is also to demonstrate that a tactile tool such as the sample booklet can assist in identifying various deterioration events. I feel that it is important to have a hands-on source that can be used independently or collectively with other sources such as web-based visual identification tools. The booklet will be useful as an educational tool for students, collection care takers, as well as professionals in the photographic field.

Acknowledgements

This applied thesis project would not have been possible without the support of many people. I am grateful to the following collection caretakers for their willingness to participate in interviews by telephone, in-person, or by answering a questionnaire via e-mail; Jennifer Gilliland (The Ottawa Art Gallery), Janet Kepkiewicz (Library and Archives Canada – Gatineau Preservation Centre), Shannon Perry (Library and Archives Canada), Greg Hill (Canadian Conservation Institute (CCI)). I would especially like to send my appreciation to Alison Rossiter for “Lament”-ing about silver halide photography, and to David Plowden for being so kind to share his decades of stockpiled information. With their use of expired or outdated silver gelatin papers, these two photographers unveiled what may prove to be a new approach to the long-term preservation of photographs.

To Doug Munson and Oleg Baburin from Chicago Albumen Works for helping to produce the final negative used to print the photographic paper samples and Nancy Binnie, CCI, for allowing me the use of a Chroma Meter.

I need to thank Tania Passafiume (Library and Archives Canada – Gatineau Preservation Centre) for asking me if I was available to do some sample printing for a project. Your request was the beginning of my thesis idea. I would also like to thank her along with Greg Hill (CCI) for being advisors during the course of my research.

I am deeply indebted to my thesis supervisor, Dr. Christopher Evans, for his support, understanding and patience. I am appreciative of his guidance (or guiding light) through the dark forest that is my writing where people would have otherwise gotten lost reading it. Thank you to Mike Robinson who was my third set of eyes. I would also like to thank Alison Nordström and Marta Braun (thesis committee) for allowing me to change my thesis topic and to Jamie Allen for being so supportive. Thank you to Dana Pandolfi, Mary Murphy, Lisa Hennessey and Kaitlyn Muller.

As always, to my family for their unconditional support in all my endeavours and especially to Robert for hanging in through thick and thin.

À tous et à toutes, je vous en suis très reconnaissante.

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1. Introduction

Over the past decade, silver gelatin paper is nearing its disappearance due to the increasing popularity of digital output media. With the decline in the popularity of silver gelatin paper as a printing medium, various photographic research and conservation institutes are currently salvaging the last of the discontinued paper stock from various manufacturers and collecting it to conduct further research. The long-term storage of these papers by galleries/museums/archives has generated a need for a better understanding of the papers' chemical composition and behaviour when in storage. This need for additional knowledge relating to retention of various paper types of silver gelatin paper is the basis of my thesis. In particular, as these stockpiled papers age, it is important to record a reference point of the paper characteristics obtained at an early stage in their long-term storage. Such a reference point will serve as a "benchmark" to which collected papers can be compared later.

The continued use of expired silver gelatin paper by contemporary photographers creates an additional justification for this current research project. The use of expired papers by artists along with the collection and storage of such works by institutions generates a need for tactile tools (i.e., print samples), models and techniques to inform collection caretakers of the possible variants in the deterioration of expired silver gelatin papers and their identification.

This applied thesis project therefore aims to assist in the identification of photographic materials. Specifically, this thesis researched and produced a sample print set using late 20th century and early 21st century black-and-white silver gelatin papers that have expired. The print sample set will be used as a photographic paper identification tool for educational and research purposes. This thesis intends to describe and better the understanding of the visual differences between various photographic papers and assist in the ease of identifying different paper types.

A research project by Tania Passafiume, Library and Archives Canada, Gatineau Preservation Centre, (LAC - GPC) on surface characteristics of papers¹ was a precursor to the production of the accompanying sample booklet to this thesis. An invitation by Ms. Passafiume (LAC – GPC) and Greg Hill, Canadian Conservation Institute (CCI) to assist in the printing of photographic samples from a stockpile of papers (Klaus Hendriks) from CCI's collection, formerly the conservation Laboratories of the National Archives led to the development of this thesis. This applied thesis project led to the coordination and the production of an exposure modulator, that will, in the future, be used for multiple productions of sample booklets of 20th and 21st century silver gelatin paper. For the purpose of this thesis, the exposure modulator was used to produce the final sample set that accompanies this applied project (Figure 1).

Briefly, the approach to this research consists of a comparison between a newly produced expired paper sample set, printed with a suitable image, and previously manufactured paper sample sets (i.e., “standard” print outcomes provided by the manufacturers to indicate the expected print qualities of their products). The research also includes the identification of the various distinguishing surface qualities of the different paper types (demonstrating a range of textures, sheen, base tints and paper weight) as well as the production of a sample booklet with the expired photographic papers to use as a visual and tactile resource.

Contemporary artists' application of expired materials may have implications for the preservation of photographic works of arts. For this reason, researching contemporary photographers who are currently using expired papers in their artistic practice was necessary. For this project, two artists who consciously make use of expired or outdated paper as an art

¹ T. Passafiume, “A Silver Gelatin DOP Sample Book and a Characteristic Catalogue of the Edward Weston Collection at the George Eastman House” (Advanced Residency Program in Photographic Conservation, Rochester, NY, 2001.

material, are introduced their points of view, concerns, etc. regarding their personal use of the materials are presented.

The primary goal of this work is to generate a final product which will serve as education and research tools both to students and professionals in fields such as photographic preservation, collections management, archive, and conservation in addition to assist or private collectors and dealers.

2. Literature Review

As analogue photography is being rapidly replaced by digital technology, concerns relating to the “loss of crucial information about past artistic, commercial, and experimental photographic processes and technologies”² have prompted collaborations between photographic conservation and research institutes to discuss the development of an “advanced methodology to identify photographs as a prerequisite for further development of treatment and preventive treatment.”³

Photographic conservation and research institutes provide the majority of sources material relating to this research project. The most useful resources pertaining to silver gelatin research found are the projects on characterization of black and white silver gelatin prints through the Advanced Residency Program in Photograph Conservation hosted by the George Eastman House (GEH) and the Image Permanence Institute (IPI), both located in Rochester, NY. The particular focus of this program enables valuable research such as the identification of fraudulent facsimiles and authentication of vintage prints, and various researches on print condition, which describe particular, visible deterioration features of silver gelatin prints. Relevant and informative projects on imaging systems and tools to help with the description of surface characteristics are also available. More specifically, Tania Passafiume’s “A Silver Gelatin DOP Sample Book and A Characteristic Catalogue of the Edward Weston Collection at the George Eastman House”⁴ is at the forefront of this project’s sample booklet research. This study is the starting point of the production of the sample booklet component of the current

² The Getty Conservation Institute, “Research on the Conservation of Photographs” The Getty, <http://www.getty.edu/conservation/science/photocon/index.html>. (July 30, 2009).

³ The Getty Conservation Institute, “Research on the Conservation of Photographs” The Getty, <http://www.getty.edu/conservation/science/photocon/index.html>. (July 30, 2009).

⁴ T. Passafiume, “A Silver Gelatin DOP Sample Book and a Characteristic Catalogue of the Edward Weston Collection at the George Eastman House” (Advanced Residency Program in Photographic Conservation, Rochester, NY, 2001).

research project, with the support and approval of Ms. Passafiume. This study offers a greater understanding of the purpose of a characteristic identification tool.

Original manufacturers' sample booklets are accessible in the collections of the George Eastman House (GEH) libraries and the Image Permanence Institute (IPI) library. GEH's earliest sample booklet dates from before World War I (c.1910) to the most recent early 2000. IPI's earliest samples date from the 1940s through to circa early 2000. Other resources on sample booklets are available on Paul Messier's website (<http://paulmessier.com/>). Messier currently houses a collection of sample books consisting of 138 unique books (2619 total paper samples). In addition, his paper collection consists of over 4900 catalogued papers⁵. Other resources on paper samples include IPI's Digital Sample Book (<http://www.digitalsamplebook.com>) originally created for the purpose of inkjet prints but is now being expanded to include pre-photographic, silver gelatin and colour prints⁶, among others, and its newer counterpart is obtainable under the alias of Graphics Atlas (<http://www.graphicsatlas.org/>).⁷ These tools permit researchers to "visually explore and compare"⁸ various types of prints. Another of IPI's current projects will eventually assist photographic professionals in the identification of digital prints⁹ (<http://www.dp3project.org/>). This digital print resource is currently under development, while the former two are available for use, although the content is incomplete. Emily Welch's unpublished thesis research "Photographic Paper Sample Books: A Reference Collection at the George Eastman House" can

⁵ Paul Messier, e-mail message to author, July 6, 2009

⁶ Image Permanence Institute, "Digital Sample Book", IPI, http://www.imagepermanenceinstitute.org/shtml_sub/pr_dsbook.asp. (July24, 2009)

⁷ Image Permanence Institute, "Graphic Atlas", IPI, <http://www.graphicsatlas.org/>. (July24, 2009)

⁸ Image Permanence Institute, "Digital Sample Book", IPI, http://www.imagepermanenceinstitute.org/shtml_sub/pr_dsbook.asp. (July24, 2009)

⁹ Image Permanence Institute, "DP3 : Digital Print Preservation Portal", IPI, <http://www.dp3project.org/>. (July24, 2009)

be accessed as an online reference resource “Notes – on Photographs” which catalogues, evaluates and describes photographic paper sample books from the GEH collection.¹⁰

Most of the information pertaining to artists and photographers who use expired or outdated photographic papers originate from magazine articles found on the internet, as well as gallery and museum websites. Otherwise, personal interviews and direct correspondence are the most effective means of collecting data since not all photographers and artists feel it necessary to distribute openly this type of information. The photographers interviewed were very candid about their working practices. In further research, interviewing (through series of questionnaires) museum/archive professionals who deal directly with photographs through acquisitions, care or conservation of the items allows for clarification on the care of collections and long-term preservation.

Other resources, which have been useful for information on preservation standards and preventive care of collections, are books such as Bertrand Lavédrine’s “A Guide to the Preventive Conservation of Photograph Collections” and “(re)Connaître et conserver les photographies anciennes” which address archival processing and conservation recommendations respectively.

An interesting resource regarding the use of expired silver gelatin papers, what materials photographers are stockpiling, fogging, and other relevant information was accessed through a series of website forums geared to analogue photography such as the Analog Photography Users Group (APUG) (<http://www.apug.org/forums/home.php>), Photo.net: A Community of Photographers (<http://photo.net/community/>), and Large Format Photography (<http://www.largeformatphotography.info/forum/>).

¹⁰ E. Welch, “Photographic Paper Sample Books: A Reference Collection at George Eastman House” (MA thesis, Ryerson University, 2008), iii.

3. Methodology

Producing the prints that comprise the sample booklet took place in the dark room of the Photography Conservation Labs of the Gatineau Preservation Centre (GPC) of Library and Archives Canada (LAC) (Ottawa) during a five-week period (Dec.2008-Jan.2009). The final printing with the finalised exposure modulator took place over a one-week period during the summer of 2009.

3.1 Processes

3.1.1 Paper Selection and General Processing

The selection of approximately 30 different papers types (full boxes) out of the stockpile of over 50 boxes of paper stored in the darkroom at CCI ensures a large variety of paper types. The use of full boxes enables the production of a larger quantity of sample books if necessary.

The first step is to process the initially selected papers without exposure to assess the quality of the white or base tint. This requires directly fixing the paper samples (Appendix 1). After processing the papers, a selection of 15 paper types are collected for the purposes of the project. Next, a table listing the different types of papers along with their manufacturer's base tint, surface texture, and surface sheen was produced (Appendix 2). All sample boxes were numbered (on the top and the sides of each lid) and these matched the numbers on the chart. This made it an easier system to follow in the darkroom. Appendix 3 lists printing outcomes observed with test strips and printing of the preliminary sample prints of the various expired papers and indicates whether a particular paper type was used in the final sample book.

3.1.2 Darkroom Processing

Initially, tests were done to check for light leaks from the enlarger as well as safelight safeness (Appendix 4). All trays and measuring cylinders were cleaned to minimize the risk of

chemical contamination. Chemicals (Kodak) such as developer, stop bath, fixer and wash aid were mixed according to manufacturers' instructions on the packages (Appendix 1).

Preliminary printing tests were done with stockpiled packages of chemicals in the GPC darkroom. These chemicals were found to be unusable. New chemicals were purchased from Henry's (<http://www.henrys.com/webapp/wcs/stores/henrys/index.jsp>) and mixed as per instructions on supplied the packages.

Each paper was processed according to the instruction sheet that was supplied from the manufacturer. If the instruction paper was missing, processing information was taken from "The Compact Photo-Lab – Index – The Cumulative Formulary of Standard Recommended Photographic Procedures" manual or from the paper manufacturer's technical documents accessed on their websites. Each paper had options for various types of developers. For the purpose of this project, Dektol was used as the universal developer for each paper type.

3.2 Printing Methods

3.2.1 Enlarger used for Printing, UV Box and other equipment

A Durst Laborator 1840 enlarger was used for the project. The enlarger head with lens was set at a height to light the entire paper surface contained within the contact frame (holds 8 1/2" x 11"). The lens was cleaned and any dust was removed.

For the printing of graded paper, the filters were removed and white light was used. This is sufficient since the printing method was not enlarging but contact printing. The CLS Durst Enlarger colour head with filters was not removed or replaced with the condenser. The colour filters were used for multi-graded paper. A UV Box (8 bulbs 11"x14"/610mm, 20 watts) was used to expose the printing-out-paper (POP) and UV goggles were worn for eye protection. The contact print frame or Kodak Register Printing Frame model 2 (11 1/2"x13 1/2" window opening)

was cleaned with a mixture of denatured alcohol and water and with a one ply anti-static delicate surface wipe (Kimtech Kimwipes).

3.2.2 Negative used for Printing

The original selected negative was an 8"x10" (20.3 x 25.4 cm) sheet with six grey scales but when tested, the results did not produce successful density maximums and minimums as the digital outputs were not dense enough to produce a minimum. The purpose of the 6-scale setup was to produce multiple samples at the same time. This multiple set-up was part of the configuration of the exposure modulator used in the final printing of the samples (see below).

As a second approach, a Kodak No.2 21 step tablet grey scale was selected for printing. One edge of it was taped to a strip of black board in order to create a final sample that would enable half the paper not to be exposed to light (i.e., to create a white area) as well facilitate the handling of the negative thereby reducing the risk of fingerprints. This sample format was not the final sample but used as a preliminary sample for optimization of the printing parameters.

3.2.3 The Printing Process: Optimization of Printing Parameters

Sets of print test strips were prepared with the goal of optimizing the exposure of the papers used in printing the images for the sample book. The 21-step tablet grey scale negative (see above) was placed emulsion side up in order to have contact with the emulsion side of the paper. Each paper selected to print was cut from 8" x 10" (20.3 x 25.4 centimetres) into 3 smaller sections of approximately 8" x 3.33" (20.3 x 8.5 cm); this would be the size of the preliminary prints. To produce test strips, an 8"x3.33" section was further cut into strips of approximately 8"x1" (20.3 x 2.54 cm).

An 8"x1" test strip was placed on top of the negative (emulsion to emulsion). Exposure tests were done in consecutive intervals of 2 seconds. Once a contrast close to that desired was

achieved, a supplementary test was done in consecutive exposure intervals of 1 second to attain the desired exposure time. The exposure was completed with the use of a black piece of cardboard to mask sections of the exposed paper thereby producing exposure steps.

3.2.4 Processing of Prints

The processing of the test strips and preliminary prints was performed either according to the instruction sheets included with the papers, from “The Compact Photo-Lab – Index – The Cumulative Formulary of Standard Recommended Photographic Procedures”¹¹ manual or taken from the technical documents found on the paper manufacturer’s website¹² (Appendix 5).

Drying of the test strips and prints was accomplished by hanging the prints with a clip on the hanging bars in a negative dryer. The negative dryer was not turned on.

3.3 Final decision on prints

The key decision criterion to include the final prints in the sample book was that the prints achieved a variable range in grey scale (achieving density maximums and minimums). If the test prints did not achieve any tonal range (e.g. black only) it was decided that prints on these papers and with these exposures would not be selected for inclusion in the sample book. The purpose of the selection was to ensure that all samples demonstrated a good tonal range as well as a white and black maximum. If there were issues such as mottling, greyish whites, or yellowing, the prints were included in the booklet as examples of various types of deterioration (most were found to be types of fogging) that one may encounter when dealing with acquisitions and/or preservation of prints in a collection. However, the decision was made to include an extra

¹¹ Ernest M. Pittaro, editor, *The Compact Photo-Lab – Index – The Cumulative Formulary of Standard Recommended Photographic Procedures* (London: The Fountain Press, 1979).

¹² Kodak, “Support Information – Technical Publications”, Kodak, <http://www.kodak.com/global/en/professional/support/databanks/filmDatabankPapers.jhtml?pq-path=13700/14472/14476>. (June 25, 2009)

sample of white-only prints for those papers that did produce a tonal range, but did not achieve a maximum white. This decision was taken to ensure all samples included a white, black and grey scale range for a more precise visual representation of the paper characteristics.

3.4 Final production of sample book

The final sample book was prepared following the initial printing parameters established with the test strips and final exposure times of the preliminary samples (i.e., optimized exposure and processing for a given type of paper). A new exposure modulator (negative) was produced to create the final sample book prints. This was produced with the assistance of Doug Munson and Oleg Baburin from Chicago Albumen Works (<http://www.albumenworks.com/>). A 4"x5" negative with an image of an eye (sitter: Kaitlyn Muller), taken on Ilford FP4+ film with a Sinar medium format camera (Schneider-Krenznach Copal No.0 Symmar-S 5.6/150 lens) was sent to Doug Munson at Chicago Albumen Works. A negative with a density range of ~ 1.2 was produced. This negative includes a 21-step tablet on the right hand side, both a blank and black section of equal widths to the left of the step tablet, and the image of the eye (approx. 2"x1") above the solid sections. The addition of a United States Air Force (USAF) resolution target under the eye image, both in the black and clear sections serves as a resolution target that tests sharpness of focus.¹³ This collection of images was repeated six times (3 across, 2 high) on an 8"x10" (20.3 x 25.4 centimetres) sheet of Kodak T-Max 100 film in order to produce multiple samples at one time. The image of the eye was scanned on a Creo iQsmart 3 flat bed scanner, the final image of the negative was assembled in Adobe PhotoshopCS4 (TIFF file – 3048ppi)

¹³ Doug Munson, e-mail message to author, August 4, 2009.

and the TIFF file was outputted to the film using a Kodak Saturn LVT high resolution film recorder.¹⁴ Two sheets were acquired (Figure 1).

3.5 Sample book

Each sheet in the sample book includes an accompanying transparency placed in front of it. 3M brand transparency film for inkjet printers was used. The transparency film was tested using the Beilstein burn test. The results proved negative for chlorine, which means the plastic is not a polyvinyl chloride, a harmful plastic to photographs (Appendix 4). The 3M website identifies their use of type 1 plastics as materials used to produce the specific transparencies in question.

(http://solutions.3m.com/3MContentRetrievalAPI/BlobServlet?locale=en_US&lmd=1151611854000&assetId=1114298029794&assetType=MMM_Image&blobAttribute=ImageFile)

Type 1 plastic according to the Society of Plastics Industry

(<http://www.plasticsindustry.org/AboutPlastics/videodetail.cfm?ItemNumber=1416>) is a polyethylene terephthalate (PET) material that is considered non-harmful plastic to photographs. However, the transparency does have a coating, which, in principle, could be harmful. After trying a method suggested in the CCI Notes for the Beilstein Test of introducing “fumes at the air intake for the flame”, allowing a more sensitive method to detect chlorinated materials, and no evidence of chlorination was observed.¹⁵ It is therefore plausible to assume that the transparencies are not harmful to the photographic materials.

Information about the kind of paper, its manufacturer characteristics along with general characteristics and L*a*b* values is printed in black on one-half of the transparency to overlap

¹⁴ Doug Munson, e-mail message to author, August 4, 2009.

¹⁵ Canadian Conservation Institute, “The Beilstein Test: Screening Organic and Polymeric Materials for the Presence of Chlorine, with Examples of Products Tested”, CCI Notes 17/1, p.2

on the white section of the print, making it easy to read the information. The general characteristics are noted on the control sample, as for the manufacturers' characteristics are found on the print sample of the booklet. The sample book is secured together in the top right corner with an aluminum screw post or Chicago post "used as a binding mechanism for pages"¹⁶. The Kodak Studio Proof F print sample has been omitted. The use of such paper requires a negative with a density range of ~ 1.80 according to information from the Chicago Albumen Works website regarding negatives used for printing-out papers. The paper also needs prolonged exposures of several hours, which was not feasible in the current darkroom arrangements.

¹⁶ Talas, "Fasteners & Hardware – Posts, Grommets and Rivets", Talas, http://apps.webcreate.com/ecom/catalog/product_specific.cfm?ClientID=15&ProductID=24024. (July 24 2009)

4. Paper Comparisons

4.1 Comparison of surface characteristics of Prints made with Expired Paper to Manufacturers' Sample Books

The comparison of the newly produced paper samples to the manufacturers samples was to ensure identifiability of the actual paper types noted on the packages. Since all the boxes were previously opened, verifying the papers through comparison with the manufacturer samples ensured accuracy of the materials used. The paper types were easily identified through the comparison. The preliminary samples prepared on expired papers were compared with both the George Eastman House (GEH, Rochester, New York) paper sample booklet collection and the Image Permanence Institute (IPI, Rochester, New York). The sample books in each collection are from the paper manufacturers and consist of prints made under standard conditions on fresh paper most likely printed within the year of paper production. The comparison is based on visual observations of the manufacturer's assigned characteristics; these were noted for both the sample book produced for this research project as well as the manufacturers' sample books. The characteristics include base tint, surface sheen, surface texture, weight as well as visible deterioration (Table 5).

Overall, the surface characteristics for the produced samples which include texture, sheen, base tint and weight were observed as being almost identical as those of the manufacturers' samples. The exception would be the manufacturers' samples have a ferrotype finish but this did not deter from the comparison. The observations lead to the conclusion that the papers found in the boxes were a match to the identifying information on the boxes.

4.2 Comparison of Surface Characteristics of Prints Made with Expired Paper to a Standardized Comparator

Another type of comparison was done following the standardized comparator characteristics developed by photograph conservator Tania Passafiume, in her research project “A Silver Gelatin DOP Sample Book and a Characteristic Catalogue of the Edward Weston Collection at the George Eastman House”. Following this standard language of paper characteristics enables a general, but descriptive labelling which in turn assists professionals in allotting a common description to photographic papers. By using this general surface characteristics visual identification tool, it was possible to identify and allocate general surface characteristics to each paper type. The characteristics to choose from are as follows: Sheen: Glossy, Semi-Matte, Matte; Texture: Fine-Grained, Smooth, Rough, Pattern; Base Tint: Cool, Warm White, Cream; and Weight: Single, Double (Table 4).

Both sets of characteristics (manufacturer and general) along with a deterioration description will allow for a more thorough surface characterisation of prints. Again, having a hands-on tool to allow visual surface characteristics to be quickly and efficiently labelled, is an important factor for the promotion of a tactile surface characteristics identification tool.

The comparison of the expired silver gelatin sample book prepared in this study to that of the manufacturers’ sample books for prints made with fresh paper was significant in clarifying any possible differences that may exist between the two samples of the same nominal make. One considerable difference observed was that most of the papers in the manufacturers’ sample books had a ferrotype finish, which creates a high gloss finish¹⁷, sometimes leaving small flaws on the surface. Flaws were observed on the surface of some of the manufacturers’ samples, (e.g. Velox). Working on hundreds of condition reports at the Preservation Centre, Library and

¹⁷Michael R. Peres, *The Focal Encyclopedia of Photography*, 4th edition, (Amsterdam: Elsevier/Focal Press, 2007) 76.

Archives Canada, and having confirmation of ferrotyping flaws by the senior photograph conservator, made it easy to identify ferrotyping flaws on print surfaces. Ferrotyping can leave scattered, small dull or shiny spots in certain areas or sometimes over the entire surface of a print. The ferrotyping process not only left a glossier surface, but also a flatter one. Texture was still visible, but to a reduced extent.

The most noticeable difference between the produced samples and the prints in the manufacturers' sample booklets was the ferrotype surface finish. Other than a slight yellowing of the edges of the prints in the manufacturer's sample books, most likely due to either environmental conditions or pollutants, the expired sample books prepared in this study were easily matched up in all characteristics with those of the manufacturers. This supports the premise that having a hands-on visual identification tool is a useful source in the identification of paper types or at least surface characteristics. This being said, specifically identifying paper types by product name is a difficult task to achieve if there is no initial clue to the manufacturer of the paper being identified. One could look for and compare characteristics of visible deterioration of the surface of the unknown paper, which could prove to be a useful additional identifier of particular paper types. For example, deterioration features such as mottled patterns, or overall greying of the whites are described as being observations made for the Kodabrome II RC F4 paper type. These observations have also been noted on a photo.net forum regarding the same type of RC paper by photographer Peter Galuszewski, who often works with old supplies.¹⁸ This practitioner described the exact grey tone, which meant that the paper had indeed expired. However, including such information in the list of characteristics may assist in narrowing down

¹⁸ PHOTO.NET: A Community of Photographers, "B&W Photo – Printing & Finishing Forum", Photo.net, <http://photo.net/black-and-white-photo-printing-finishing-forum/ooMuvG>. (July 24, 2009)

the choice of paper type. Further research is needed to achieve a better understanding of such deterioration, but this is something a conservator would have to undertake.

4.3 Chroma Meter Readings and Comparisons of Control Paper to Printed Samples

A final comparison was done to establish concrete values to the white areas of the print samples. A Chroma Meter was employed in order to gather the $L^*a^*b^*$ readings that were required. Nancy Binnie, Senior Conservation Scientist at the Canadian Conservation Institute supervised the session. After studying the print samples, the decision was made to take readings of the black and white areas only since the mid-tone areas were smaller than the required 4 millimetre area needed to use the Spectra Photometer, therefore, the Chroma Meter was used since this system is more accurate from model to model. This will allow for a more consistent reading over time.

A Konica Minolta Chroma Meter CR-300 was used along with Spectra Magic version 1.9 colour system software. This system allowed to take a reading and directly transfer the information to an Excel spreadsheet. The D65 standard illuminant or light source's purpose represents average daylight. The data recorded was CIE $L^*a^*b^*$ (Commission internationale de l'éclairage) coordinates calculated from colorimetric data, the colour space being CIE (1976) $L^*a^*b^*$ (L=lightness, a=green-red, b=blue-yellow) which contains the colours relative to the ones the human eye can see.

A white ceramic tile #18333050 was used as a calibration standard. A calibration check was done after each set of readings for one paper type. The readings of the paper types were conducted on a standard backing (white tile #13231507). For each reading, the paper sample was placed on the standard backing white tile. The hand-held Chroma Meter unit was then placed on top of the selected area for reading. The unit was held with the power cord facing

forward away from the user; this was done for consistency of placement. For the sample readings, the fixed out paper had three samples read. The printed samples with image had both white and black areas read three times each. After all the values were downloaded to an Excel spreadsheet, the three readings for each area were then averaged out to give an average value. The values for the white control area of the fixed out paper were then compared to the white area of the printed samples. This was done for each paper type. (see Tables 6-9)

In comparing the white control values with the whites on the printed samples, there is a noticeable shift in colour. Some can be seen immediately simply by visual comparison which can be noted as the fogged samples with mottled grey areas and yellowing in the whites.

By giving the white areas a standardized value of $L^*a^*b^*$, this allows concrete data to be recorded close to the time of production. Reassessing the values in the following years by repeating the sample reading process and comparing them to the previous data creates a control mechanism to monitor shift in colour, which can determine deterioration rates. This process is simple to execute and is certainly an effective monitoring system of the deterioration of silver gelatin prints.

Characteristics of the paper types along with deterioration and $L^*a^*b^*$ values are key elements to include with the expired silver gelatin print samples in order to establish a useful resource tool. By using the tactile tool, a physical side-by-side comparison can be done between the sample print and the original photograph being characterised. Online tools such as the “Graphics Atlas” which present an online version of print surface characteristics are useful tools so long as you have an appropriate workspace. However, not every organisation has a computer next to their work surfaces (or available wireless laptops) which would make it difficult to use an on-line tool.

Producing a sample book with a wide range of paper types has its challenges. Though the collection of papers accessible for this research project is limited there is still a variety of paper types and different characteristics within the collection that were able to be included in the sample booklet. To further increase the diversity of samples available and ensure a more complete range of characteristics to choose from, steps can be taken to collect paper from various manufacturers still in production, or to arrange for collection of unused paper from the public, as some organisations (e.g., Getty Research Institute) are currently doing. A diverse collection can also be achieved with the assistance of several organisations and donations of duplicate stock from their paper collections. The production of the paper samples can be made in such a way that multiples can be produced with the use of one sheet of paper by printing with the exposure modulator created as part of this applied thesis project.

5. Interviews

For this project, two photographers, two collection managers, one who specifically deals with a photographic collection (representing small and large organisations), one photo archivist, and one photo conservator were chosen to participate in an interview. The criterion for choosing the photographers is that they use expired or outdated silver gelatin paper in their practice. The criterion for choosing the collections managers, archivist and conservator is that they deal directly with the photographic material in their organisations. The latter may be a broad criterion, but is a starting point to understand the collections managers' level of awareness in regards to the use of outdated materials such as expired silver gelatin papers by photographers and artists. The aim was to gain knowledge of whether the collection caretakers were aware of the growing popularity of the use of expired photographic papers, and exactly how they dealt with photographs, specifically what information they gather about the work prior to acquiring, in order to determine housing choices for long-term preservation.

Before the interview process was employed to collect information from the selected photographers and collections managers/archivists, an approval was obtained from Ryerson University's Research Ethics Committee. I prepared the questionnaire, (Appendix 11) which was sent by e-mail to the interviewees after receiving confirmation of their willingness to participate. Once the responses were received, the information collected explains the current use of expired silver gelatin paper, concerns attached to its uses as well as its possible implications on preservation of collections.

The information presented demonstrates the need for specialised identification tools relating to expired silver gelatin papers and the continued challenges that arise from both current and continuous use of these papers.

5.1 Photographers who use Expired Silver Gelatin Papers in their Practice

A desire to distinguish this research on expired silver gelatin papers from previous endeavours has led to an exploration of contemporary photographers who use expired paper in their practice. This was a new area worth exploring because the issue of expired silver gelatin papers is certainly a topic of interest in the photographic field. Such papers are rapidly disappearing but there appears to be a trend developing to make use of remaining stocks. Some photographers and artists have made the choice, (some from need, some by chance and some by intention) to continue to use paper stock that has a past-due expiry date. Photographers/artists have the freedom in their practice to take full advantage of the possibilities the photographic medium and its materials have to offer. New approaches and experimentation with the medium lead to both new discoveries and concepts. Some photographers use expired papers as a means of expression, while some stockpile papers out of necessity in order to preserve and achieve consistency in their products.

5.1.1 David Plowden

David Plowden has been photographing both the changes in industry and landscapes of America for over fifty years.¹⁹ His work documents the past industries key to the development

¹⁹ David Plowden, "David Plowden: Vanishing Point", David Plowden, <http://www.davidplowden.com/vanishing.html> (June 29, 2009)

of the United States; trains, bridges, farms. It captures scenes that are vanishing from the landscape.²⁰

This was brought to my attention by Ms. Jamie M. Allen, Assistant Curator of Photographs, GEH,²¹ who presented on Plowden and his work at the conference “Conversations about Photography” (Chicago, Illinois, April 2009). Ms. Allen also informed me that Mr. Plowden has recently started producing digital prints both for practical reasons, (such as sending copies to publishers) as well as due to the fact that the preferred stock of paper he has been using throughout his entire career was depleting. He had stockpiled multiple freezers full of the photographic paper when it was discontinued, and has roughly one thousand sheets left.

After interviewing Mr. Plowden,²² the story of his practice was revealed. His printing methods, specifically the control of developing papers, were learned by studying with Minor White. In the early 1980’s, according to Plowden, the Oriental Paper Industries stopped producing for some time. Since Oriental Seagull Grade 3 is the only type of paper he uses for his prints, he purchased an entire stock of paper which amounted to several thousand sheets. The entire lot has been kept frozen in multiple freezers since being purchased, along with various other paper types that Mr. Plowden has collected over the years, but finds unsuitable to print. These include newer versions of Oriental Seagull still in production (“the box with the green stripe” as described by Plowden), which, from his description, can one assume to be the Grade 3 fibre paper. This newer “unsuitable” Oriental Seagull paper, he was informed, may have had the brightener removed. He also stockpiles some Calumet Brilliant Bromide #4 papers that he tested

²⁰ Lawrence Miller Gallery, “David Plowden: Vanishing Point”,
http://www.laurencemillergallery.com/plowden_vanishing1.htm (June 29, 2009)

²¹ Jamie M. Allen, e-mail message to author, April 21, 2009.

²² David Plowden, telephone conversation with the author, July 5, 2009.

over a period of one year which he found were good but inconsistent throughout a package since they carried flaws in the emulsion.

As a point of interest, Plowden also stockpiled film because of discontinuance. He stockpiled 3000 rolls of Panatomic X Ilford, but finds the skies are uneven and thinks it may be due to improperly rolled emulsion. He still uses Kodak TXP 320 ASA and finds the quality is as good as the day he bought it. However, the film most consistently used is Ilford HP5. This is however, a point for further research.

Plowden briefly discussed his acclimatisation method for both paper and film. When removed from the freezer, the item is transferred to the refrigerator, leaving it in the Ziploc bag for 24 hours. It is then removed both from the refrigerator and Ziploc bag then left in the darkroom and brought to room temperature for a 24 hour period. This freezing/thawing method was taught to him by a good friend and the former editor of Timeline Magazine.

In the last year or so, David Plowden and his assistant noticed that his stockpile of the "old blue box Seagull" (which was discontinued in the 1980's) has degraded in quality. He mentioned that compared to prints in the past, he and his assistant both feel that the separation between the tones is "not there", meaning the variance in tonal range is not as sharp as it previously was. This could potentially be a result of being frozen for a prolonged period. Plowden feels that freezing his materials is the best way to preserve or slow the deterioration process, but mentioned that there is no perfect solution.

Plowden has recently started to scan prints and negatives in order to send out files for publication, as he was tired of having his prints returned to him damaged.²³ He uses Photoshop PS 3, scans with an Epson 1640 XL flatbed and prints with an Epson R2400 using Harrington

²³ David Plowden, telephone conversation with the author, July 5, 2009.

Quadtone RIP software, and Hahnemuhle Photo Rag Bright White 310gsm inkjet paper to produce the final prints.²⁴

5.1.2 Alison Rossiter

Alison Rossiter is part of the team at The Better Image (Dedicated to the Conservation and Preservation of Art and Historic Photographs) in New York. Her background in photography stems from studies undertaken at the Rochester Institute of Technology and the Banff Centre School of Fine Arts (Alberta, Canada). She has also taught photography at several universities. Her education in the conservation of photography developed over a two-year period where she was a volunteer at the Metropolitan Museum of Art (New York City) as well as conservation and preservation workshops through the Rochester Institute of Technology (Rochester, New York) and Andrew Mellon workshops at the Library of Congress, Washington. Her work as a photographer can be found in several institutions including the J. Paul Getty Museum (Los Angeles) and the National Gallery of Canada (Ottawa).²⁵

Her series "Lament" "pays homage to the disappearing materials of analogue photography"²⁶. Her art relies on the "intrinsic qualities" of the expired photographic papers.²⁷ Her work produced with expired silver gelatin papers began in 2003 when a purchase of large format sheet film through eBay from a North Dakota studio included a few boxes of expired photographic paper from 1945 (see figures 3-5). Her curiosity led her to test the paper's sensitivity and, to her surprise, rendered a wonderful abstract image. This experiment led Rossiter to start a collection of expired papers. Over the years, her paper collection has grown to

²⁴ David Plowden, "FAQ's", David Plowden, <http://www.davidplowden.com/info/faq.html> (July 4, 2009)

²⁵ The Better Image, "Our Staff", The Better Image, http://www.thebetterimage.com/our_staff.html (July 2, 2009)

²⁶ Stephen Bulger Gallery, " "Lament" Press Release", Bulger Gallery, http://www.bulgergallery.com/dynamic/fr_exhibit_press_release.asp?ExhibitID=193 (July 2, 2009)

²⁷ Stephen Bulger Gallery, " "Lament" Press Release", Bulger Gallery, http://www.bulgergallery.com/dynamic/fr_exhibit_press_release.asp?ExhibitID=193 (July 2, 2009)

over 800 boxes and packages.²⁸ She mentioned that silver gelatin papers are a rare find on eBay today compared to her almost daily finds when she first started collecting. The earliest samples of paper in her collection are dated with an expiration date of January 1st, 1900 (with a possible manufacturer date of 3 years prior to the printed date of expiration – according to Paul Messier LLC, Conservation of Photographs and Works on Paper).²⁹ Her goals with this collection of papers are to process a sample from every box to include in her Lament series and to keep a few samples aside for research purposes³⁰ (e.g. Paul Messier has acquired some samples from Rossiter that were missing from his collection) and in the future to make the contents of her collection available for research through a concise cataloguing of the collection. Her intention with the collection of papers is, first and foremost, to use it for artistic purposes, but it would undeniably be a useful reference tool for photographic professionals.

5.1.3 Others – Joseph Mills, Mark Ruwedel

Joseph Mills' series "Inner City", images of downtown Washington depicting "a period of urban transition"³¹ was shot in the 1980's. His decision to print them in 1999 was made by "chance". He acquired a batch of expired silver gelatin paper and decided to use it to create a series from the collection of negatives. This resulted in a series of prints with surface flaws, yellowing, and darkened edges, which for Mills, enhanced the decay and despair of the images. Mills does not pretend to pass the prints off as old prints but, simply wanted them to have the visual appeal of a vintage print. A coat of varnish adds another layer to the yellowing finish. He is open about the fact that he used expired papers for his series; it is integral to the final work.

²⁸ Alison Rossiter, e-mail message to author, July 7, 2009.

²⁹ Alison Rossiter, telephone conversation with the author, July 10, 2009.

³⁰ Alison Rossiter, e-mail message to author, July 10, 2009.

³¹ The Corcoran Gallery of Art, "Past Exhibitions:", Corcoran, http://www.corcoran.org/exhibitions/previous_results.asp?Exhib_ID=58 (July 2, 2009)

Alison Rossiter mentioned Mark Ruwedel and his work. She wrote to him in regards to his printing techniques³² since she was interested in the quality of the final products. He informed her of his use of older and expired papers. There is no mention of Ruwedel's use of older papers on gallery/dealer websites³³³⁴³⁵. His work is documentary in nature and so it would not be an immediate supposition that he would use expired or outdated papers since it is not experimental work such as that of other contemporary artists and photographers.

Interviewing artists who use expired or outdated silver gelatin papers in their practice brings to light the existence of such works of art and their potential stability issues. It also brings awareness of such types of works of art to collection caretakers. When it comes to acquiring the items in question, the more familiar caretakers are with these works, the more likely they will be focused on ways to ensure long-term preservation instead of the potential instability. These points provide additional justification in the creation of a sample booklet of expired silver gelatin papers as it will assist in the identification of characteristics of papers as well as possibly identifying various deterioration events of photographic papers.

5.2 Interviews of Collection Caretakers

To gain a better understanding of the acquisition process of photographic materials, as well as their care, storage and preservation, interviews were conducted with various museum professionals to get a better understanding of their concerns with the use of expired papers by photographers and how this may impact long-term preservation of prints made with such materials. Since not every museum/archive professional has a specialised background in

³² Alison Rossiter, e-mail message to author, July 7, 2009.

³³ Stephen Bulger Gallery, "'Shelter' Press Release", Bulger Gallery, http://www.bulgergallery.com/dynamic/fr_exhibit_press_release.asp?ExhibitID=144 (July 8, 2009)

³⁴ Museum of Contemporary Photography, "Marc Ruwedel", MoCP, http://www.mocp.org/collections/permanent/ruwedel_mark.php (July 8, 2009)

³⁵ Yossi Milo Gallery, "Artists – Mark Ruwedel – Press (pdf)", Yossi Milo, http://www.yossimilo.com/artists/mark_ruwe/press-mark_ruwe.pdf (July 8, 2009)

photography, I felt it relevant to include their concerns and needs regarding the care of photographic materials in their collection.

5.2.1 Jennifer Gilliland, Ottawa Art Gallery, Collections Manager³⁶

As the collections manager for Ottawa's designated municipal gallery, (an independent, non-profit public gallery) Gilliland is required to care for a mixed collection in a limited space, which requires that photographs be stored in the general storage rooms at reasonable relative humidity (RH) of 45-50% and 18-20 degrees Celsius. (Environmental guidelines of temperature and relative humidity as proposed by the Canadian Conservation Institute for storage of chemically stable collections - Set point: 50% RH with the temperature between 15 and 25°C).³⁷ As part of the acquisition of new works for the collection (done by director, curator and acquisition committee) there exists no formal questionnaire for artists to fill out in regards to the artworks, however, the Gallery requires general information such as title, date and medium. She added that it would be important to identify specific information such as paper type and mentioned the potential for information to be omitted by the photographers in regards to the use of expired or outdated papers because they may be concerned with the acceptance or refusal of the acquisition. As far as she knows, there are no prints in the collection that were made on expired or outdated papers. Gilliland's concerns about acquiring photographs printed on expired papers under the assumption they are in good condition (meaning they are printed on fresh papers and properly processed) may lead to an improperly documented history of the print. The proper preservation for the longevity of the work is undermined. If the works were identified as being on expired papers, consultation with a photograph conservator would be needed as well,

³⁶ Unless otherwise stated, all information in this section is taken from questionnaire responses from Jennifer Gilliland, e-mail message to the author, July 7, 2009.

³⁷ Canadian Conservation Institute, "Environmental Guidelines for Museums – Temperature and Relative Humidity (RH)", CCI, <http://www.cci-icc.gc.ca/crc/articles/enviro/index-eng.aspx> (July 24, 2009)

the conservator would also be brought in during the acquisition process to review the works. Gilliland mentioned that as a collections manager without a scientific background, means she must rely on a conservator to help make decisions on the care of the collection. She added that it would be helpful to have tools to assist to identify signs of deterioration and characteristics for various types of papers. Helping to identify paper types and signs of deterioration assists with preventive conservation, storage and if necessary, the conservation of the photograph itself. She added that hands-on tools would be especially helpful since lack of resources and time prevent her from researching the paper types in detail.

5.2.2 Janet Kepkiewicz, LAC, Collections Manager, Art, Photo, Philatelic Records³⁸

As the Collections Manager, Art, Photo, Philatelic in the Preventive Care and Maintenance Section of Library and Archives Canada, Janet Kepkiewicz is very much concerned with the longevity of photographic materials. She feels that it would be good to know if an artist uses expired papers for their artwork and that this information requested could be in the artist questionnaire that is used when acquiring contemporary works. Understanding certain criteria of deterioration is helpful and she added that knowing that one type of paper may deteriorate more rapidly may lead to multiple suggestions in regards to caring for the artwork. Such suggestion may include immediate digitization and copying, special housing and storage depending on the type of deterioration or simply not acquiring a work depending on the severity of deterioration. Her main concern would be to capture the intellectual information of the photograph. Possible implications of preservation of works (depending on the information provided through further research of works printed on expired photographic paper) might mean storing black and white photographs with colour photographs in the cold vaults to ensure long-term preservation.

³⁸ All information in this section is taken from interview responses with Janet Kepkiewicz, interview by the author, July 16, 2009.

Resource issues such as space, money and time are key factors in the decision making during the acquisition process.

5.2.3 Shannon Perry, LAC Photo Archivist, Library and Archives Canada

As a photo archivist for the Art and Photography division of Library and Archives Canada, Ms. Perry's issues or concerns with possible deterioration and characteristics of paper types would most likely be directed to a photograph conservator. Identifying the types of paper is not essential to her work. Mainly, deterioration would be noted and recorded if it is described at the item level or if the work she is viewing is for a National Archival Appraisal Board (NAAB) appraisal where deterioration in the paper would be noted. Perry does not anticipate photographer's use of outdated or expired silver gelatin paper to be an issue for archivists in her division since documentary photography is what they collect. She did mention that a sample booklet to assist in determining possible deterioration would certainly be of interest.

5.2.4 Greg Hill, Photo Conservator, Canadian Conservation Institute

Hill feels that photographers using expired papers should be obliged to provide specific information on the materials used including any unusual steps taken during the production, and processing of the work as well as the extent of deterioration prior to and after use by the artists. This information would allow identification of any possible implications in the preservation of the art works and help predict the long-term stability of the material. Hill mentioned that as long as the papers are processed properly and not undergone any harsh treatments or unusual processing procedures, they should not have a huge impact on a collection as the materials would be the same as fresh papers. His concerns are more directed to acquiring knowledge of materials to ensure authentication. He believes a sample book can be useful since the knowledge

necessary to authenticate photographs is “not just based on [...] pristine new print[s] sample but on a range of states of deterioration/fogging, etc.”³⁹

As experimentation with silver gelatin papers (as well as other photographic materials) by artists and photographers lead to new forms of artistic expression, these artworks are making their way into collections. In addition, collections managers have become increasingly aware of the diverse deterioration of photographic materials, therefore creating an immediate need for tools and resources to aid in the identification of surface characteristics, deterioration of papers and proper preservation of these new acquisitions.

With what seems to be a developing trend in the use of expired or outdated papers by artists/photographers, and with the information collected through interviews, collection caretakers are seemingly unaware that works produced on expired or outdated papers may be entering their collections. It is reasonable to assume there is a need for a tactile tool to assist in the awareness of these types of papers as well as to facilitate the identification of surface characteristics and deterioration.

³⁹ All information in this section is taken from questionnaire responses from Greg Hill, e-mail message to the author, July 13, 2009.

6. Implications of the Use of Expired Papers by Artists

From the research on this project, there is no direct answer to whether or not the use of expired silver gelatin papers by photographers in their practice, and consequently collected by galleries, archives, collections, will have any implications on the preservation of the works or the surrounding collection. There is some cause for concern that has surfaced through the interviews with museum/archive professionals but have no information that would justify changes to their current preservation standards and practices. The best preservation approach at this point, along with standard housing and storage requirements, would be to note any issue of deterioration (if present) and explicitly note whether the artist uses expired papers. At least then there would be a record of it which would be catalogued for future reference. The information requested with new acquisitions (sometimes in the form of a questionnaire – see Appendix 9) may in the near future require full disclosure from artists/photographers in regards to their printing processes and the materials used. Current practice in some organisations requires only a general description of the materials (e.g., fibre-based print as opposed to digital output). Even the newly released questionnaire template “Photograph Information Record” available through the American Institute for Conservation (AIC) does not specifically inquire about the use of expired or outdated papers but rather leaves it open to the artist to list (Appendix 10).

While they did not have particular issues regarding the deterioration of their prints on expired paper, the photographers did have other concerns. David Plowden had no reason for concern in regards to ensuring collections are informed of his use of expired papers since he had not seen or encountered any reason to identify this information. He does insist however, on the use of ultra violet Plexiglas for any framing of his prints⁴⁰. Alison Rossiter also did not seem concerned that further deterioration beyond that normally encountered with silver gelatin prints

⁴⁰ David Plowden, telephone conversation with the author, July 5, 2009.

would occur. The questionnaire that she answered for the purpose of this research has however, prompted her to include information regarding light levels, archival storage materials and framing requirements along with her prints.⁴¹

⁴¹ Alison Rossiter, e-mail message to author, July 7, 2009.

7. Future Research

My research has lead to an interesting point for future research. David Plowden mentioned that his stockpiled paper of almost 30 years is starting to lose tonal range when printed. The prolonged freezing of papers is an area that may need further research. Freezing is the recommended procedure for the stabilisation of many photographic materials. It is a preservation method that allows film and paper to keep. There may be a need to do research on the long term effects of freezing. This would require a lengthy study, which may surpass the production lifetime of silver gelatin papers.

Alison Rossiter mentioned in her comments that she has not yet had a discussion with a scientist or chemist about the “destabilization of silver salts in an emulsion”⁴². She feels that this would open up a completely new discussion on the causes of deterioration of silver gelatin prints and help her better understand the processes, which create her works of art.

Experimental photographer Marco Breuer takes his use of photographic papers to another level. Though his works may not be produced on expired photographic papers, (at least I have not found any information to support it) the artistic destruction of the photographic paper stratum by scratching, abrading, sanding,⁴³ scraping and burning⁴⁴ and other methods creates wonderful abstract images but also a new approach or possible concern to dealing with the preservation of such works. Further research is needed on how this type of manipulation of the medium paired with processing chemicals may affect the works long-term preservation. Breuer’s work is interesting to include since it may well have future implications on the current methods of

⁴² Alison Rossiter, e-mail message to author, July 7, 2009.

⁴³ Aperature Foundation, “Marco Breuer: Early Recordings”, Aperature Foundation, <http://www.aperture.org/books/browse-by-photographer/a-c/marco-breuer-early-recordings.html> (July 8, 2009)

⁴⁴ ARTnews, “Past Issues: The Indecisive Image”, ARTnews, http://artnews.com/issues/article.asp?art_id=2457 (April 22, 2009)

preservation of these types of work. (Breuer uses chromogenic, silver gelatin papers, cyanotype and gum bichromate).

In addition to the preservation issues listed above, an area that would be interesting to follow up on in the future, would be the $L^*a^*b^*$ values to monitor deterioration. The use of the Chroma Meter allows for a standardized value to be associated with a specific colour of an area on the print samples. For the purpose of this research project, only the white of the control sample, as well as the white and black areas of the print samples were given $L^*a^*b^*$ values. For future research, the entire 21 step scale would be useful to monitor with values in order to identify whether shifts also occur in the mid-tones. Due to time constraints, values from the manufacturers' samples were not taken. This would also be a future point of research to associate a value to the base tint and compare it to the newer printed expired samples.

8. Summary and Conclusion

Currently, collaboration efforts by the Getty Conservation Institute, Image Permanence Institute as well as the Centre de recherches sur la conservation des documents graphiques (France) are focussing on the Conservation of Photographic Materials project which aims to “provide a foundation for the later development of new tools to diagnose the causes of deterioration of photographic materials, and for the development of new treatment and preventive conservation strategies for these materials”⁴⁵. There is however, an immediate need for a utilitarian tool that will assist in the identification of paper characteristics and allow for the possibility of identifying paper type, or at least narrowing the number of options by determining a specific set of characteristics along with a description of its deterioration (if present). The online resources for the identification of characteristics are continuing to develop and remain a good source of information for researchers. However, a tactile tool to aid in the identification of characteristics of papers can only surpass an online source since the samples can be directly compared side by side, not missing out on any texture, sheen or variance of tints viewed in a variety of light sources. The best tool is always a hand tool, one not having being distanced from the original such as an original print, scanned, saved as digital file, uploaded to computer, then imputed on a website.

This applied thesis project enabled not only a collaboration on the production of an exposure modulator that will be used in the future to create multiple productions of sample booklets from the 20th and 21st century silver gelatin paper, but also brought awareness of artists and photographers who use expired or outdated photographic paper in their practice. This research has also allowed to gain a better understanding of the level of hands-on resources

⁴⁵ The Getty Conservation Institute, “Newsletter 16.2 Summer 2001”, Getty, http://www.getty.edu/conservation/publications/newsletters/16_2/gcinews1.html (July 31, 2009)

available to collection caretakers responsible for the long-term preservation of photographic works as well as the range of knowledge in regards towards the works collected.

There is room for additional samples within the booklet, which would complete the range of surface characteristics available for comparison. This could be possible through the future production of sample booklets, a project initiated by Tania Passafiume (LAC, GPC) and Greg Hill (CCI).

I believe that this applied thesis project will be useful to better understand tools that are needed in the characterisation and identification of expired silver gelatin papers. I also believe I have demonstrated that the sample booklet that accompanies this thesis will prove to be a useful tactile tool to assist in the identification of characteristics of papers as well as assist in possibly identifying various deterioration events among photographic papers. This tool will not only be useful for collection caretakers who do not necessarily have a specialised background in photography, but also as an educational tool for students, and other professionals in the photographic field.

APPENDIX 1

Chemicals Used for Processing of Photographic Papers

Kodak Professional Indicator Stop Bath

General Use: Add this concentrate to water in the proportion of 16mL per litre – 2 fluid ounces per gallon – to make a stop bath of normal working strength

-Use the stop bath at 18°C to 21°C (65 to 70 F)

Kodak Fixer (a general purpose hardening fixer)

Prepare: 1. Start with 3 U.S. quarts – 2.84 litres – of water not above 26.5°C – 80°F

2. With rapid and continuous stirring slowly pour the contents into water

3. When the powder is dissolved, add water to bring the total volume to 1 U.S. gallon – 3.8 litres. Stir until completely mixed.

Papers: Most Kodak papers should be fixed for 5 to 10 minutes at 18-21°C – 65-70°F with agitation. Fix capacity can be increased by using 2 fixing baths in succession.

Kodak Hypo Clearing Agent

To make 3.8 Litres – 1 U.S. Gallon – stock solution

Water 27°C (80°F)

3 litres – 0.80 gallons – water → stir and add contents → add water to end with 3.8 litres – 1 gallon

		At 18 - 21°C	(65-70°F)
	Water Rinse after Fixer*	Hypo Clearing Agent (with agitation)	Running Water Wash
Papers			
Single Weight	1 min.	2 min.	10 min.
Double Weight	1 min.	3 min.	20 min.

Directions: After normal fixing, transfer fibre prints to the clearing agent solution with or without a water rinse.

*The water rinse increases the capacity (200 8x10s or equivalent) of papers per gallon of clearing agent solution.

Kodak Dektol

To prepare stock solution:

1. Start with 3 ½ U.S. quarts – 3.32 litres of water at 38°C – 100°F.

2. Slowly add the contents of this packet with sufficient stirring to keep chemicals suspended.

3. Add enough water at 38°C – 100°F to make 1 U.S. gallon – 3.8 litres. Stir until the chemicals are dissolved completely and the solution is completely mixed.

Recommended Development: Temperature: 20°C – 68°F.

Dilution: (see paper information)

(Source: All information in this section was taken directly from the manufacturer printed information on the chemical packages)

APPENDIX 2 (Table 1)

Table – List of 15 types of Photographic Papers Printed

Given #	Mfr.	name	cat.#	product #	paper tone	surface finish	image tone	paper weight
35	Kodak	Elite Fine Art	128-7549	16601-0260 TG 87	white	ultra smooth high lustre		premium
17	Kodak	Azo	142-0215	18002-121 10L OV	white	smooth glossy		single
11	Kodak	Velox F2s	141-1719	66301-01365G 55	white	smooth glossy		single
14	Kodak	Studio Proof F	143-3168	07103-75287V VI	white	smooth glossy		double
9	Kodak	Kodabromide F2 D	144-1609	40505-79298J 20	white	smooth glossy		double
7	Kodak	Azo E2s	141-8078	18402-79525C UV	white	fine grain lustre		single
8	Kodak	Polycontrast N	154-0970	33801-799261	white N	smooth lustre	warm black	double
25	Kodak	Polycontrast III RC F	183-5594	96557-000FSN 63	white	smooth glossy		medium
26	Kodak	Kodabrome II RC F4 (process before 09/03)	192-2517	61201 0612011 IL	white	smooth glossy		medium
19	Kodak	Panalure Select RC FM	122-0318	82901-04MTC5 56	white	smooth glossy		medium
13	Kodak	Portrait Proof R	143-3374	02501-73251 W	cream white	tweed lustre	brown black	single
24	Kodak	Polymax FD Fine Art	8 766 040	99001-04N JW6 53	white	smooth glossy		double
33	Ilford	Ilfobrome 2 2.1K				glossy		double
32	Ilford	Ilfospeed 1.1M				glossy		medium
4	Ilford	Galerie 2.1K	94C10 1A99			glossy		double

APPENDIX 3 (Table 2)

Printing Results		
Paper	Results	Use?
#4 –	slight grey tone instead of crisp white	yes
#7 –	good	yes
#8 –	whites turn grey in stop bath (first batch of chemicals) , overall grey (2 nd batch chemicals)	yes
#9 –	light leak /box – fogged on one edge, otherwise printable	yes
#11 –	good	yes
#13 –	greyish whites	yes
#14 –	mottled (darker overall with white spots/mottled) will have to reprint/max. min. not achieved	yes
#17 –	slight grey on one strip (possible edge fog?), otherwise printable	yes
#19 –	n/a	no
#24 –	grey mottled (1 st and 2 nd batch chemicals)	no
#25 –	light leak (one edge) otherwise printable	yes
#26 –	replaced with 26c (paper from first box turned grey a few days after processed) suggests expired paper (http://photo.net/black-and-white-photo-printing-finishing-forum/ooMuvG (grey after development)	yes
#32 –	whites not as crisp after one week	yes
#33 –	good	yes
#35 –	whites turn grey in stop bath	no

APPENDIX 4

Various Tests

Safelight safeness Test

Darkness

- Ensure darkroom is free of light.
- Turn off all the lights, wait for your eyes to adjust, any light leaks will be visible.
- Plug any holes with black cardboard, cloth or tape.

Stray Enlarger Light

- Turn on enlarger lamp. If light reflects off any shiny objects, mask them off with black cardboard or tape.

(Source: http://www.freestylephoto.biz/tl_safe_lights.php)

Enlarger Light Leak Test

Coin test

- In dark room (no safelight) cap lens, put paper on easel, put a coin in centre of paper, turn enlarger on, and expose for a minute (can vary). Also look around and see if any light leaks bounce off white walls, or metallic surfaces (if so, mask these surfaces with black cardboard or tape).
- Process paper, if you can see where the coin was, the light leaks are bouncing onto the easel and must be masked or corrected.

(Source: Learned over years of experience working in darkrooms)

The Beilstein Test (PVC test)⁴⁶

- the presence of PVC in plastics is unsuitable for storage use of photographic materials as it can harm objects
- supplies:copper wire 12/14 gauge without insulation
- bunsen burner or propane torch
- plastic that is being tested
- fume hood
- wash wire – with distilled water, removes unwanted colouration
- flame should be heated until colourless
- heat copper wire until red hot
- touch plastic sample and immediately return to flame
- green colouring in flame represents a positive test for chlorine

⁴⁶ CCI Notes 17/1

APPENDIX 5 (Table 3)

Room Temperature: 21.0°C / Relative Humidity (RH): 51.7%

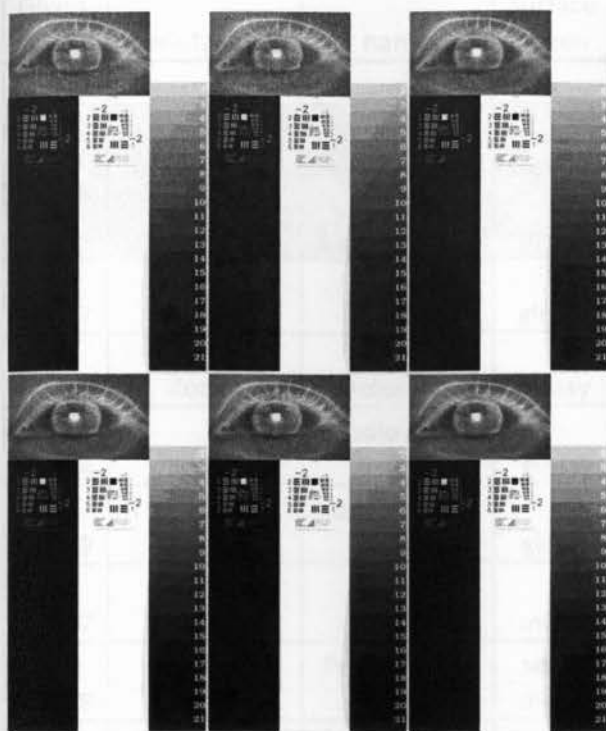
Safelight: 0.4 Lux / UV light box: 1.1 Lux

Enlarger light source @ f16: 4.7 Lux (all prints were exposed with f stop 16 – otherwise UV states they were exposed with UV light box)

#	Name	Exposure Time (seconds/minutes)	Filter/ White Light (WL)/ UV	Developer 1:2	Stop 1:63	Wash	Fix1 1:4	Fix2 1:4	Wash	Wash Aid 1:4	Final Wash
25	Kodak Polycontrast III RC F	12	15 Magenta	1-3 min.	5 sec.	10 sec.	2 min.				4 min.
26c	Kodak Kodabrome II RC F4	12	WL	1 min.	10 sec.		2 min.				5-10 min.
32	Ilford Ilfospeed 1.1M	20	30 Yellow	1 min. max.	5 sec.		30 sec.				2 min.
13	Kodak Portrait Proof R	8	WL	2 min.	5-10 sec.	5 sec.	3-5 min.	3-5 min.	1 min.	2 min.	10-20 min.
33	Ilford Ilfbrome 2 2.1K	20	WL	1-3 min.	5 sec.		3-5 min.	3-5 min.		3 min.	20 min.
4	Ilford Galerie 2.1K	30	WL	1.5 min.	10- 15 sec.		3-5 min.	3-5 min.	5 min.	10 min.	
9	Kodak Kodabromide F2 D	30	WL	1-3 min.	15 sec.		3-5 min.	3-5 min.			20 min.
11	Kodak Velox F2s	300 (5 min.)	WL	1 min.	15 sec.		3-5 min.	3-5 min.		2 min.	10-20 min.
17	Kodak Azo	0.5	UV	.75-2 min.	10- 15 sec.		3-5 min.	3-5 min.		2 min.	10 min.
7	Kodak Azo E2s	0.5	UV	1 min.	10- 15 sec.		3-5 min.	3-5 min.		2 min.	10-20 min.
14	Kodak Studio Proof F	30min.	UV	2 min.	5-10 sec.	5 sec.	3-5 min.	3-5 min.	1 min.	3 min.	20 min.
35	Kodak Elite Fine Art	20 sec.	WL	2 min.	15 sec.		3-5 min.	3-5 min.		3 min.	30 min.
8	Kodak Polycontrast N	30 sec.	15 magenta	1.5 min.	5-10 sec.		3-5 min.	3-5 min.	1 min.	3 min.	20 min.
19	Kodak Panalure Select RC FM	n/a	n/a	1 min.	10 sec.		2 min.				4 min.
24	Kodak Polymax FD Fine Art	20 sec.	WL	1 min.	10- 15 sec.		3-5 min.	3-5 min.		3 min.	

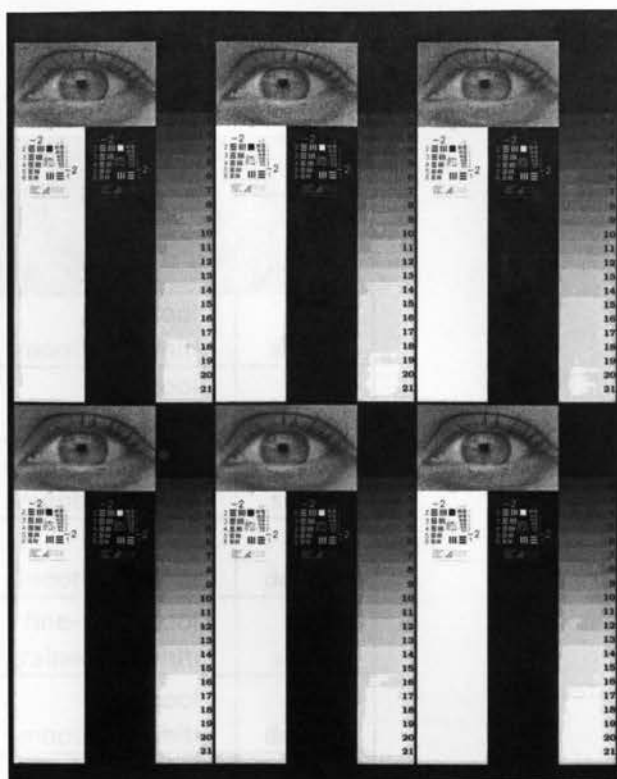
(Source: Processing information taken directly from manufacturer information sheets)

APPENDIX 6



(Figure 1) Exposure Modulator (Negative)

Note: These images are smaller than actual size



(Figure 2) Print example

APPENDIX 7 (Table 4)

Comparison of surface characteristics of Prints made with Expired Paper to Standardized Comparator

Given #	manufacturer	name	surface sheen	surface texture	base tint	paper weight
35	Kodak	Elite Fine Art	ultra smooth high lustre			premium
17	Kodak	Azo	glossy	smooth	cool white	single
11	Kodak	Velox F2s	glossy	smooth	cool white	single
14	Kodak	Studio Proof F	glossy	smooth	cool white?	single
9	Kodak	Kodabromide F2 D	glossy	smooth	cool white	double
7	Kodak	Azo E2s	matte	fine-grained	cool white	single
8	Kodak	Polycontrast N	semi-matte	smooth	cool white	double
25	Kodak	Polycontrast III RC F	glossy	smooth	cool white	double
26c	Kodak	Kodabrome II RC F4 (process before 09/03)	glossy	smooth	cool white	double
19	Kodak	Panalure Select RC FM	smooth glossy			medium
13	Kodak	Portrait Proof R	matte	rough	cool white	single
24	Kodak	Polymax FD Fine Art	smooth glossy			double
33	Ilford	Ilfobrome 2 2.1K	glossy	smooth	warm white	double
32	Ilford	Ilfospeed 1.1M	glossy	smooth	cool white	double
4	Ilford	Galerie 2.1K	glossy	smooth	cool white	double

APPENDIX 8 (Table 5)

Comparison of surface characteristics of Prints made with Expired Paper to Manufacturer's Sample Books

	Source of paper	#	Mfr.	Type of Paper	Surface Base Tint	Surface Base Texture	Surface Sheen	Base Material	Base Weight	Deterioration	Other
Compare:	Prints made with expired paper	35	Kodak	Elite Fine Art	white	ultra smooth	high lustre		premium		
To:	Mfr.'s Sample Books			not used							
Compare:	Prints made with expired paper	17	Kodak	Azo	white	smooth	glossy	fibre	single		blue-black tone
To:	Mfr.'s Sample Books		✓	✓	✓	✓	✓	✓	✓	edges soiled, some physical damage due to handling	✓
Compare:	Prints made with expired paper	11	Kodak	Velox F2s	white	smooth (more visible than mfr. sample)	glossy (less glossy than mfr. Sample)	fibre	single		
To:	Mfr.'s Sample Books		✓	✓	✓	texture less pronounced - seems more smooth -	more glossy	✓	✓		possible ferrotyping - can change surface
Compare:	Prints made with expired paper	14	Kodak	Studio Proof F	white	smooth	glossy	fibre	double		
To:				not found							

Compare:	Prints made with expired paper	9	Kodak	Kodabro -mide F2 D	white	smooth	glossy	fibre	double	minimal greying	neutral black tones
To:	Mfr.'s Sample Books		✓	✓	✓	✓	✓	✓	✓	slight yellowing	✓
Compare:	Prints made with expired paper	7	Kodak	Azo E2s	white	fine grain (more texture than mfr. sample)	lustre	fibre	single		
To:	Mfr.'s Sample Books		✓	✓	✓	less textured surface	✓	✓	✓	overall yellowing	Possible ferro-typing
Compare:	Prints made with expired paper	8	Kodak	Polycont rast N	white N	smooth	lustre	fibre	double	grey mottled	warm black
To:	Mfr.'s Sample Books		✓	✓	less white	✓	✓	✓	✓	overall yellowing in whites	✓
Compare:	Prints made with expired paper	25	Kodak	Polycont rast III RC F	white	smooth	glossy (not as glossy as mfr. Sample)	resin coated (RC)	medium		
To:	Mfr.'s Sample Books		✓	✓	✓	✓	more glossy	✓	✓	slightly yellowing edges	Possible ferro-typing
	Source of paper	Given #	Manufacturer	Type of Paper	Surface Base Tint	Surface Base Texture	Surface Sheen	Base Material	Base Weight	Deterioration	Other
Compare:	Prints made with expired paper	26	Kodak	Kodabro me II RC F4 (process before 09/03)	white	smooth	glossy	resin coated (RC)	medium		higher contrast (contrast graded higher - 4)
To:	Mfr.'s Sample Books		✓	Kodabro me II RC F2	✓	✓	✓	✓	✓	slight yellowing of edges	lower contrast (graded 2)

Compare:	Prints made with expired paper	19	Kodak	Panalure Select RC FM	white	smooth	glossy	resin coated (RC)	medium		
To:	Mfr.'s Sample Books			not used							
Compare:	Prints made with expired paper	13	Kodak	Portrait Proof R	cream white	tweed	lustre	fibre	single		brown black
To:	Mfr.'s Sample Books			not found							
Compare:	Prints made with expired paper	24	Kodak	Polymax FD Fine Art	white	smooth	glossy	fibre	double		
To:	Mfr.'s Sample Books			not used							
Compare:	Prints made with expired paper	33	Ilford	Ilfobrom e 2 2.1K	slight yellow / not as white	glossy		fibre	double		
To:	Mfr.'s Sample Books		✓	Ilfobrom Galerie 1K		✓		✓	✓		
Compare:	Prints made with expired paper	32	Ilford	Ilfospeed 1.1M		glossy		fibre	medium		
To:	Mfr.'s Sample Books		✓	✓		✓		✓	✓		
Compare:	Prints made with expired paper	4	Ilford	Galerie 2.1K	slight grey / not as white	glossy		fibre	double		
To:	Mfr.'s Sample Books		✓	Ilfobrom Galerie 1K		✓		✓	✓		

APPENDIX 9

LIBRARY AND ARCHIVES CANADA

Material and Technique Information Sheet

In order to help us better catalogue, interpret, care and preserve the photograph we are considering acquiring from you, we ask you to verify the printed information below and to complete any relevant portions of the questionnaire that follows. Please attach a current photographer's résumé and any other materials you think appropriate for our artist files. All information is confidential and will not be distributed unless permission is given.

Contact Information

Name: _____

Photograph Information

Creator's Name: _____

Website: _____

Title of Work: _____

Date of Negative/Digital File: _____

Date of Print: _____

Edition: Is the work: Unique ____ Edited ____ Not limited in number ____

If editioned, this print is numbered: _____

Medium: _____

Dimensions (H x W x D) (image size / support size / frame size): _____

Format of Original Digital File/Resolution: _____

Provenance and History

Are editions of this work in other collections? Yes ____ no ____

If yes, which collections? _____

Has this photograph, or editions of it been published? Yes ____ no ____

If yes, which publications? _____

Has this work been exhibited? Yes ____ no ____

If yes, please specify exhibition venues (include dates) _____

Technical Information

Printing technology: Silver Gelatin____Inkjet ____ Fuji Pictography____
Direct thermal transfer____
Dye Sublimation (dye diffusion thermal transfer) ____
Electrostatic (photocopier, laser printer) ____
Cibachrome ____
Other/comments:

Did you print the photograph yourself? If not, what is the name, address, and phone number of the printer, for future reference.

Printer: (please give manufacturer name and model number)

Paper: (please give as much information as possible –manufacturer name, brand name and number, manufacturer's descriptive words)

Media –ink set, toners, etc.: (please give as much information as possible –manufacturer name, brand name and number, manufacturer's descriptive words)

Post-printing treatment –fixative, coating, laminate: (please give as much information as possible – manufacturer name, brand name and number, manufacturer's descriptive words)

If laminated by someone other than yourself, what is the name, address, and phone number of the technician?

If any additional media has been applied to the surface of the photograph, please provide information such as: material, brand names and method.

Mounting and Installation

Is the photograph mounted to a secondary support? (please give as much information as possible – manufacturer name, brand name and number, manufacturer's descriptive words, if it was dry mounted –what type of tissue was used.)

If mounted by someone other than yourself, what is the name, address, and phone number of the technician?

Display

Are there specific display requirements such as mounting hardware, split batten/cleat? Is the hardware provided as part of the acquisition? Please explain.

Conservation

Please feel free to provide any historical, descriptive, anecdotal, or technical information that you think might be useful. Do you have any conservation concerns regarding this work?

Thank-you for your assistance.

Signature _____ Date: _____

(Courtesy of Library and Archives Canada)

20/07/09 TP

APPENDIX 10

Photograph Information Record

This questionnaire is used internationally to obtain essential information detailing the materials and techniques used in the creation of photographic works and their history. This allows institutions and individuals to better catalogue, interpret, and care for their photographs. Please provide as many details as you can. Extra space is provided at the end for responses that exceed the space allotted.

Contact information for the person completing this form:

Name	Date
Address	
Email	Telephone

Please complete or verify the following information.

Artist name	
Nationality	Birth date or life dates
1.1 Title of work	
1.2 Image date	1.3 Print date
1.4 Is the work editioned? <input type="radio"/> Yes <input type="radio"/> No	If yes, this print is number _____ from an edition of _____ plus _____ artist's proofs.
1.5 Is this work editioned in any other size or format? If so, provide details.	

1.6 If not editioned, are there other known prints of this image?

1.7 Is the work part of a series or portfolio? If so, please describe.

2.1 History of ownership, including dates:

2.2 Exhibition history for this print (indicate length of time and light levels if possible):

2.3 Publication or reproduction history for this image (including other prints):

2.4 Conservation history for this print. Has the work been examined or received treatment? ☐ Yes ☐ No
Is documentation or information available? ☐ Yes ☐ No ☐ Attached

3.1 This image derives from ☐ film ☐ digital capture ☐ scanned film ☐ other (e.g., paper negative, glass negative)
Provide film type and size, camera type, digital file specifications, or other information as applicable.

3.2 Describe any image manipulation prior to printing.

continued on other side

3.3 This print is a ☐ gelatin silver print ☐ chromogenic print (C-print, Ektacolor, etc.) ☐ ink jet print (Iris, Giclée, Epson, etc.)
☐ silver dye bleach print (Cibachrome, Ilfochrome) ☐ other

3.4 If the support/paper is commercially produced, please identify the manufacturer and product name. If produced by hand, please describe the materials and techniques used.

3.5 If this is an ink jet print, please provide ink set information (for example: Epson UltraChrome K3 ink). If the inks are altered or mixed by the artist or printer, please describe.

3.6 This work was printed by ☐ the artist ☐ the artist's studio ☐ a commercial printer ☐ other

Provide printer's name and contact information if applicable.

3.7 Please provide any available information regarding printing equipment such as model, chemistry type, etc. (e.g. Light Jet, Lambda, RA4, Epson, Fuji, etc.).

4.1 Once printed, this work has been ☐ toned ☐ spotted ☐ retouched ☐ coated ☐ treated with other applied media
☐ framed ☐ laminated (with plastic film) ☐ face-mounted (to glazing material)
☐ back-mounted (adhered to solid support) ☐ lined (adhered to flexible paper or textile support)
☐ other

For each procedure checked above, please specify materials, application techniques, mounter's name and contact information as appropriate.

4.2 Are there aspects of presentation (framing, installation details) that are considered integral to the work?

5.1 Are there aspects of the work that are particularly vulnerable and in need of special care?

5.2 If appropriate, please provide contact information for a conservator, assistant, or other individual who is familiar with the work and can be consulted on preservation matters.

5.3 Any other comments or information that you would like to offer regarding the creation and preservation of this work of art would be greatly appreciated.

Additional space for answers to questions above

This form is endorsed by The American Institute for Conservation and its Photographic Materials Group. It is used by The Art Institute of Chicago; Atelier de Restauration et de Conservation des Photographies de la Ville de Paris; George Eastman House, Rochester, New York; High Museum of Art, Atlanta; J. Paul Getty Museum, Los Angeles; Los Angeles County Museum of Art; The Metropolitan Museum of Art, New York; Milwaukee Art Museum; Museum of Fine Arts, Boston; The Museum of Fine Arts, Houston; The Museum of Modern Art, New York; National Gallery of Art, Washington, D.C.; National Gallery of Australia, Canberra; The National Gallery of Canada, Ottawa; The New York Public Library; Philadelphia Museum of Art; Rijksmuseum, Amsterdam; San Francisco Museum of Modern Art; (list in formation).

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(Source: www.conservation-us.org/PIR)

APPENDIX 11

Alison Rossiter - Questionnaire

If you feel that some questions are irrelevant or you do not feel you wish to answer, simply write that it is *not applicable* (N/A).

1. Why do you use expired silver gelatin papers?
2. When did you start using expired silver gelatin papers?
3. Do you only use expired silver gelatin papers in your photography practice? If yes or no, why?
4. What specific type (s) of expired silver gelatin paper do you use? Is it exclusive?
5. Would you use others if you ran out of a specific type of paper? Please explain.
6. Are you concerned that the expired paper may deteriorate? Please explain.
7. Are you aware of other photographers who use expired photography paper in their practice? If yes, who?
8. Do you believe this is a common trend in the analogue world of photography? If so, why?
9. Do you inform agents, gallerists, collectors of your use of expired paper? If yes or no, why? Do you believe it matters? Do you believe full disclosure of materials used and process is important? If yes or no, why?
10. If collections are not informed of the use of expired papers, does this concern you in regards to the possible deterioration of your prints in the future?
11. Have you experienced or noticed deterioration (or further deterioration) after printing? If yes, is this your intent to have it continue deteriorating even after the prints have been acquired by collector/gallery? Please explain.
12. Have you had pieces returned or in need of replacement because of deterioration? Please explain.
13. Have you encountered any other problems in regards to the use of expired silver gelatin papers? Please explain.
14. Are you concerned about how the photographs are stored in collections? Or exhibited? Do you inform clients/collectors/galleries of specific requirements for preservation?

15. How do you store prints in your possession? (matted, framed, boxed, interleaving, specific temperature and relative humidity) Is this a concern for you?
16. Do you think that a sample booklet of various expired silver gelatin papers could be a useful tool for photographers to have on hand in order to visibly identify possible present or future deterioration of different paper types (various manufacturers)?
17. If yes, would it be of use to you to have a sample booklet of various expired silver gelatin papers of late 20th century to early 21st century photographic papers available as a visual tool to determine possible deterioration that may possibly occur in various photographic papers?
18. May I use a digital sample image of your photography in my thesis? If so, how many may I use, what is the max. or min. size you prefer, and what information would you like to include with the photograph? Would you be willing to send me samples? Otherwise which source (web-based or from a book) is best for me to use?
19. Do you have any other photographs or prints on any type of photographic paper in their prints? If so, what?
20. Do you think this is a common event? In a digital world of photography? If so, why?
21. Do you have any other galleries, collections of your work of expired paper? If yes or no, why?
22. Do you have any other sources? Do you believe full disclosure of materials used as well as printing process is a must? If yes or no, why?
23. Do you have any other sources of information about expired papers, does this concern you in regards to the deterioration of your prints in the future?
24. Do you have any other pieces related or not related to the subject because of your collection? Please explain.
25. Do you have any other sources of information about the subject, or any other sources? If so, what?
26. Do you have any other sources of information about the subject, or any other sources? If so, what?
27. Do you have any other sources of information about the subject, or any other sources? If so, what?
28. Do you have any other sources of information about the subject, or any other sources? If so, what?
29. Do you have any other sources of information about the subject, or any other sources? If so, what?
30. Do you have any other sources of information about the subject, or any other sources? If so, what?
31. Do you have any other sources of information about the subject, or any other sources? If so, what?
32. Do you have any other sources of information about the subject, or any other sources? If so, what?
33. Do you have any other sources of information about the subject, or any other sources? If so, what?
34. Do you have any other sources of information about the subject, or any other sources? If so, what?
35. Do you have any other sources of information about the subject, or any other sources? If so, what?
36. Do you have any other sources of information about the subject, or any other sources? If so, what?
37. Do you have any other sources of information about the subject, or any other sources? If so, what?
38. Do you have any other sources of information about the subject, or any other sources? If so, what?
39. Do you have any other sources of information about the subject, or any other sources? If so, what?
40. Do you have any other sources of information about the subject, or any other sources? If so, what?
41. Do you have any other sources of information about the subject, or any other sources? If so, what?
42. Do you have any other sources of information about the subject, or any other sources? If so, what?
43. Do you have any other sources of information about the subject, or any other sources? If so, what?
44. Do you have any other sources of information about the subject, or any other sources? If so, what?
45. Do you have any other sources of information about the subject, or any other sources? If so, what?
46. Do you have any other sources of information about the subject, or any other sources? If so, what?
47. Do you have any other sources of information about the subject, or any other sources? If so, what?
48. Do you have any other sources of information about the subject, or any other sources? If so, what?
49. Do you have any other sources of information about the subject, or any other sources? If so, what?
50. Do you have any other sources of information about the subject, or any other sources? If so, what?

David Plowden - Questionnaire

If you feel that some questions are irrelevant or you do not feel you wish to answer, simply write that it is *not applicable (N/A)*.

1. Why do you use expired silver gelatin papers?
2. When did you start using expired silver gelatin papers?
3. Do you only use expired silver gelatin papers in your photography practice? If yes or no, why?
4. What specific type (s) of expired silver gelatin paper do you use? Is it exclusive?
5. Would you use others if you ran out of a specific type of paper? Please explain.
6. Are you concerned that the expired paper may deteriorate? Please explain.
7. Are you aware of other photographers who use expired photography paper in their practice? If yes, who?
8. Do you believe this is a common trend in the analogue world of photography? If so, why?
9. Do you inform agents, gallerists, collectors of your use of expired paper? If yes or no, why? Do you believe it matters? Do you believe full disclosure of materials used as well as printing process is important? If yes or no, why?
10. If collections are not informed of the use of expired papers, does this concern you in regards to the possible deterioration of your prints in the future?
11. Have you had pieces returned or in need of replacement because of deterioration? Please explain.
12. Have you experienced or noticed deterioration (or further deterioration) after printing? If yes, is this acceptable? Please explain.
13. Have you encountered any other problems in regards to the use of expired silver gelatin papers? Please explain.
14. Are you concerned about how the photographs are stored in collections? Or exhibited? Do you inform clients/collectors/galleries of specific requirements for preservation?
15. How do you store prints in your possession? (matted, framed, boxed, interleaving, specific temperature and relative humidity) Is this a concern for you?

16. Do you think that a sample booklet of various expired silver gelatin papers could be a useful tool for photographers to have on hand in order to visibly identify possible present or future deterioration of different paper types (various manufacturers)?

17. If yes, would it be of use to you to have a sample booklet of various expired silver gelatin papers of late 20th century to early 21st century photographic papers available as a visual tool to determine possible deterioration that may occur in various photographic papers and that could allow for the identification of a specific type of paper?

18. May I use a digital sample image of your photography in my thesis? If so, how many may I use, what is the max. or min. size you prefer, and what information would you like to include with the photograph? Would you be willing to send me samples? Otherwise which source (web-based or from a book) is best for me to use?

Sent to: Madeleine Trudeau,
Eva Major-Marjory

Questionnaire

If you feel that some questions are irrelevant or you do not feel you wish to answer, simply write that it is *not applicable (N/A)*.

(For the purpose of this research project, I am looking for information on photographs only)

1. As someone who deals with the acquisition of contemporary artists work, have you encountered instances where you could not identify the type of photographic paper? How did you proceed with preservation/storage? Were there signs of deterioration? Did you make note of deterioration? (If you do not deal with this directly, who would you contact on these issues?)
2. When deciding on an acquisition, is it important to identify the type of photographic papers when describing an item? Is it necessary to identify the types of paper? If yes, why?
3. As a collection manager/archivist/**curator**, would it be of use to you to have a sample booklet of various expired silver gelatin papers of late 20th century to early 21st century photographic papers available as a visual tool to determine possible deterioration that may occur in photographic papers and assist in the identification of the paper type?
4. Are you aware of many photographers in your collection that use expired papers (or have you encountered any photographic objects that are on expired photographic paper)?
5. Are you aware of any photographers (in general) that use expired papers in their practice?
6. Are you concerned that this may be a growing trend for analogue photographers (in regards to collecting photographs)? What possible implications could this have on your collection (or collecting practice)?
7. What are your recommendations for the preservation of expired silver gelatin paper in general? Specifically? Relating to your collection? If you do not deal with this matter directly, who do you consult with on these matters?
8. What are the specific preservation conditions for silver gelatin photographs in your organisation?
9. What is the procedure for acquiring photographs?
10. If there is a questionnaire for artists to fill out, could you make the questionnaire available to me? What do you feel is missing on the questionnaire? (in regards to collecting photographs and disclosure of information).

Sent to: Shannon Perry
Jennifer Gilliland

Questionnaire

If you feel that some questions are irrelevant or you do not feel you wish to answer, simply write that it is *not applicable (N/A)*.

1. Have you encountered instances where you could not identify the type of paper? How did you proceed with preservation/storage? Were there signs of deterioration? Did you make note of deterioration?
2. Is it important to identify the type of photographic papers when describing an item? Is it necessary to identify the types of paper? If yes, why?
3. As a collection manager/archivist/curator, would it be of use to you to have a sample booklet of various expired silver gelatin papers of late 20th century to early 21st century photographic papers available as a visual tool to determine possible deterioration that may occur in photographic papers and assist in the identification of the paper type?
4. Are you aware of many photographers in your collection that use expired papers (or have you encountered any photographic objects that are on expired photographic paper)?
5. Are you aware of any photographers (in general) that use expired papers in their practice?
6. Are you concerned that this may be a growing trend for analogue photographers (in regards to collecting photographs)? What possible implications could this have on your collection (or collecting practice)?
7. What are your recommendations for the preservation of expired silver gelatin paper in general? Specifically? Relating to your collection? If you do not deal with this matter directly, are you consulted on these issues? Who do you deal with that makes these decisions?
8. What are the specific preservation conditions for silver gelatin photographs in your organisation?
9. What is the procedure for acquiring photographs? If you do not directly deal with an acquisition, are you consulted on possible preservation issues?
10. If there is a questionnaire for artists to fill out, could you make the questionnaire available to me? What do you feel is missing on the questionnaire? (in regards to collecting photographs and disclosure of information).

Janet Kepkiewicz - Questionnaire

If you feel that some questions are irrelevant or you do not feel you wish to answer, simply write that it is *not applicable* (N/A).

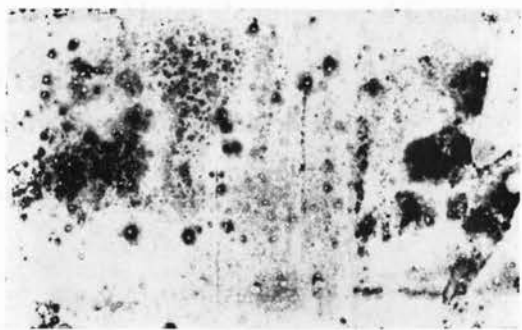
1. Have you encountered instances where you could not identify the type of paper? How did you proceed with preservation/storage? Were there signs of deterioration?
2. Is it important to identify the type of papers used? Is it necessary to identify the types of paper? If yes, why?
3. As a collection manager/archivists/curator, would it be of use to you to have a sample booklet of various expired silver gelatin papers of late 20th century to early 21st century photographic papers available as a visual tool to determine possible deterioration that may occur in various photographic papers and assist in the identification of the paper type?
4. Are you aware of many photographers in your collection that use expired papers?
5. Are you aware of any photographers (in general) that use expired papers in their practice?
6. Are you concerned that this may be a growing trend for analogue photographers (in regards to collecting photographs)? What possible implications could this have on your collection?
7. What are your recommendations for the preservation of expired silver gelatin paper in general? Specifically? Relating to your collection? If you do not deal with this matter directly, are you consulted on these issues? Who do you deal with that makes these decisions?
8. What are the specific preservation conditions for silver gelatin photographs in your organisation?
9. What is the procedure for acquiring photographs? If you do not directly deal with an acquisition, are you consulted on possible preservation issues?
10. If there is a questionnaire for artists to fill out, could you make the questionnaire available to me? What do you feel is missing on the questionnaire? (in regards to collecting photographs).

Greg Hill - Questionnaire

If you feel that some questions are irrelevant or you do not feel you wish to answer, simply write that it is *not applicable* (N/A).

1. Have you encountered instances where you could not identify the type of paper? How did you proceed with preservation/storage? Were there signs of deterioration? Did you make note of deterioration?
2. Is it important to identify the type of photographic papers when describing an item? Is it necessary to identify the types of paper? If yes or no, why?
3. I have previously asked collection manager/archivist/curator, but as a conservator, would it be of use to you to have a sample booklet of various expired silver gelatin papers of late 20th century to early 21st century photographic papers available as a visual tool to determine possible deterioration that may occur in photographic papers and assist in the identification of the paper type?
4. Are you aware of many photographers in your collection that use expired papers (or have you encountered any photographic objects that have been, to your knowledge, on expired photographic paper)?
5. Are you aware of any photographers (in general) that use expired papers in their practice?
6. Are you concerned that this may be a growing trend for analogue photographers (in regards to collecting photographs)? What possible implications could this have on a collection (or collecting practice)?
7. What are your recommendations for the preservation of expired silver gelatin paper in general? Specifically? Relating to your collection? If you do not deal with this matter directly, are you consulted on these issues? Who do you deal with that makes these decisions?
8. What are the specific preservation conditions for silver gelatin photographs in your organisation?
9. What is the procedure for acquiring photographs? If you do not directly deal with an acquisition, are you consulted on possible preservation issues?
10. If there is a questionnaire for artists/owners to fill out in regards to information of the work, could you make the questionnaire available to me? What do you feel is missing on the questionnaire? (in regards to collecting photographs or disclosure of information).

APPENDIX 12



(Figure 3) *Kodak Velox F2, expires September 1941, processed in 2008, 2 ¾ x 4 ½ inches*
Courtesy of Alison Rossiter, Navesink, NJ



(Figure 4) *Kodak Kodabromide F2, expires March 1955, processed in 2008, 4 x 5 inches*
Courtesy of Alison Rossiter, Navesink, NJ



(Figure 5) *Kodak Azo F2 expires June 1967, processed in 2008, 2 ½ x 2 ½ inches*
Courtesy of Alison Rossiter, Navesink, NJ

APPENDIX 13

Chroma Meter Readings and Comparisons of Control Paper to Printed Sample

(Table 6)

Downloaded L*a*b* Values

Raw Chroma Meter Readings

Data Name	DOWNLOADED VALUES BELOW – CALCULATED BY DEVICE/SOFTWARE		
	MEASURED VALUES		
	L*(C)	a*(C)	b*(C)
Data download for September 8, 2009			
Data Name	L*(D65)	a*(D65)	b*(D65)
Calibration tile	97.30	0.13	2.11
Reference paper over black tile	93.61	0.36	7.14
Reference paper over white tile	93.85	0.07	7.57
Galerie 2.1 K	94.08	0.43	7.48
Galerie 2.1 K	94.06	0.37	7.54
Galerie 2.1 K	94.06	0.37	7.60
Calibration check	97.26	0.13	2.09
Air	2.77	0.34	-0.40
Galerie 2.1 K black	27.03	-0.03	1.17
Galerie 2.1 K black	27.01	-0.02	1.19
Galerie 2.1 K black	26.95	0.07	1.17
Galerie 2.1 K white	86.71	0.41	6.25
Galerie 2.1 K white	86.71	0.39	6.26
Galerie 2.1 K white	86.66	0.37	6.29
Calibration check	97.29	0.18	2.10
Azo E2s	96.12	0.37	3.78
Azo E2s	96.09	0.34	3.76
Azo E2s	96.11	0.25	3.77
Azo E2s black	29.14	0.70	1.66
Azo E2s black	29.16	0.67	1.64
Azo E2s black	29.06	0.73	1.64
Azo E2s white	89.37	-0.30	2.29
Azo E2s white	89.20	-0.30	2.24
Azo E2s white	89.15	-0.32	2.23
Air	2.88	0.48	-0.38
Calibration check	97.29	0.06	2.14
Polycontrast N	93.75	0.58	4.49
Polycontrast N	93.79	0.56	4.47
Polycontrast N	93.77	0.57	4.49
Polycontrast N black	27.05	0.33	0.21

Polycontrast N black	26.97	0.32	0.20
Polycontrast N black	27.03	0.26	0.21
Polycontrast N white	84.81	-0.07	2.65
Polycontrast N white	84.78	-0.09	2.65
Polycontrast N white	85.05	-0.08	2.68
Calibration check	97.30	0.10	2.13
Kodabromide F2D	93.64	1.37	1.54
Kodabromide F2D	93.48	1.40	1.54
Kodabromide F2D	93.55	1.37	1.58
Kodabromide F2D black	26.32	0.39	0.11
Kodabromide F2D black	26.31	0.44	0.12
Kodabromide F2D black	26.32	0.48	0.10
Kodabromide F2D white	84.71	0.36	0.20
Kodabromide F2D white	84.42	0.44	0.20
Kodabromide F2D white	84.10	0.39	0.20
Calibration check	97.28	0.11	2.12
Velox F2s	94.38	1.14	1.81
Velox F2s	94.37	1.12	1.82
Velox F2s	94.40	1.09	1.86
Velox F2s black	25.40	0.33	0.86
Velox F2s black	25.66	0.28	0.84
Velox F2s black	25.69	0.27	0.82
Velox F2s white	87.92	-0.16	0.64
Velox F2s white	87.79	-0.18	0.66
Velox F2s white	87.61	-0.19	0.63
Calibration check	97.29	0.08	2.14
Portrait Proof R	96.28	-0.44	5.71
Portrait Proof R	96.30	-0.47	5.69
Portrait Proof R	96.36	-0.51	5.68
Portrait Proof R black	28.98	0.17	0.47
Portrait Proof R black	28.96	0.13	0.48
Portrait Proof R black	28.86	0.16	0.40
Portrait Proof R white	82.62	-0.36	5.72
Portrait Proof R white	82.45	-0.36	5.71
Portrait Proof R white	82.40	-0.37	5.71
Calibration check	97.30	0.09	2.12
Azo	95.11	1.36	2.01
Azo	95.04	1.34	2.05
Azo	95.10	1.34	2.00
Azo black	25.36	0.60	2.29
Azo black	25.31	0.68	2.27
Azo black	25.54	0.66	2.21
Azo white	87.34	0.13	0.52

Azo white	87.37	0.13	0.51
Azo white	87.41	0.10	0.51
Calibration check	97.30	0.09	2.14
Polycontrast III RC F (unsure if area had logo)	95.48	-0.35	2.93
Polycontrast III RC F (unsure if area had logo)	95.44	-0.38	2.88
Polycontrast III RC F (unsure if area had logo)	95.49	-0.40	2.92
Polycontrast III RC F black (unsure if area had logo)	24.18	0.58	0.28
Polycontrast III RC F black (unsure if area had logo)	24.20	0.57	0.34
Polycontrast III RC F black (unsure if area had logo)	24.25	0.69	0.28
Polycontrast III RC F white (unsure if area had logo)	90.75	-0.45	2.39
Polycontrast III RC F white (unsure if area had logo)	90.78	-0.47	2.48
Polycontrast III RC F white (unsure if area had logo)	90.85	-0.51	2.51
Calibration check	97.31	0.10	2.12
Polycontrast III RC F (re-done) all white back	95.58	-0.18	3.23
Polycontrast III RC F (re-done) all white back	95.59	-0.20	3.22
Polycontrast III RC F (re-done) all white back	95.62	-0.24	3.22
Polycontrast III RC F black no logo area	24.27	0.58	0.22
Polycontrast III RC F black no logo area	24.21	0.60	0.24
Polycontrast III RC F black no logo area	24.14	0.67	0.24
Polycontrast III RC F white no logo area	90.99	-0.44	2.51
Polycontrast III RC F white no logo area	90.91	-0.47	2.50
Polycontrast III RC F white no logo area	90.87	-0.44	2.49
Polycontrast III RC F white + mfr logo print on back	95.25	-0.33	3.05
Polycontrast III RC F white + mfr logo print on back	95.27	-0.33	3.07
Polycontrast III RC F white + mfr logo print on back	95.25	-0.27	3.04
Polycontrast III RC F white + mfr logo print on back	95.31	-0.24	3.19
Polycontrast III RC F white + mfr logo print on back	95.25	-0.31	3.06
Calibration check	97.29	0.08	2.12
Kodabrome II RC F4 white + mfr logo print on back	94.98	0.20	3.58
Kodabrome II RC F4 white + mfr logo print on back	94.94	0.21	3.58
Kodabrome II RC F4 white + mfr logo print on back	94.91	0.23	3.58
Kodabrome II RC F4 white + mfr logo print on back	94.92	0.24	3.62
Kodabrome II RC F4 white + mfr logo print on back	94.97	0.26	3.63
Kodabrome II RC F4 all white back	95.27	0.28	4.03
Kodabrome II RC F4 all white back	95.28	0.22	4.00
Kodabrome II RC F4 all white back	95.27	0.21	4.00
Kodabrome II RC F4 black	25.10	0.51	0.41
Kodabrome II RC F4 black	25.11	0.51	0.47
Kodabrome II RC F4 black	25.18	0.45	0.48
Kodabrome II RC F4 white	82.41	-0.34	2.91
Kodabrome II RC F4 white	82.44	-0.30	2.88
Kodabrome II RC F4 white	82.45	-0.30	2.87
Calibration check	97.30	0.08	2.12

Ilfospeed 1.1M	94.48	0.85	6.07
Ilfospeed 1.1M	94.50	0.87	6.08
Ilfospeed 1.1M	94.49	0.89	6.08
Ilfospeed 1.1M black	25.53	0.41	0.80
Ilfospeed 1.1M black	25.63	0.43	0.81
Ilfospeed 1.1M black	25.57	0.49	0.82
Ilfospeed 1.1M white	87.55	0.76	5.88
Ilfospeed 1.1M white	87.48	0.75	5.90
Ilfospeed 1.1M white	87.47	0.76	5.88
Calibration check	97.30	0.09	2.15
Ilfobrome 2 2.1K	93.57	0.35	7.44
Ilfobrome 2 2.1K	93.54	0.34	7.46
Ilfobrome 2 2.1K	93.56	0.36	7.45
Ilfobrome 2 2.1K black	26.83	0.25	1.31
Ilfobrome 2 2.1K black	26.91	0.19	1.32
Ilfobrome 2 2.1K black	26.85	0.23	1.31
Ilfobrome 2 2.1K white	88.39	0.21	6.69
Ilfobrome 2 2.1K white	88.20	0.21	6.65
Ilfobrome 2 2.1K white	88.20	0.21	6.68
Galerie 2.1K (repeat first paper)	94.17	0.26	7.84
Galerie 2.1K (repeat first paper)	94.13	0.26	7.91
Galerie 2.1K (repeat first paper)	94.12	0.26	7.90
Calibration check	97.30	0.04	2.14

(Table 7)

Calculation of Average L*a*b* Values

Calculation set

Data Name	DOWNLOADED VALUES BELOW - CALCULATED BY DEVICE/SOFTWARE			CALCULATED VALUES BELOW					
	MEASURED VALUES			AVERAGE VALUES AND SAMPLE STANDARD DEVIATION					
	L*(C)	a*(C)	b*(C)	L*	SD	a*	SD	b*	SD
	-	-	-	-	-	-	-	-	-
Calibration tile	97.30	0.13	2.11						
Reference paper over black tile	93.61	0.36	7.14						
Reference paper over white tile	93.85	0.07	7.57						
Galerie 2.1K	94.08	0.43	7.48	94.07	0.01	0.39	0.03	7.54	0.06
	94.06	0.37	7.54						
	94.06	0.37	7.60						
Calibration check	97.26	0.13	2.09						
Air	2.77	0.34	-0.40						
Galerie 2.1K black print	27.03	-0.03	1.17	27.00	0.04	0.01	0.06	1.18	0.01
	27.01	-0.02	1.19						
	26.95	0.07	1.17						
Galerie 2.1K white solid print	86.71	0.41	6.25	86.69	0.03	0.39	0.02	6.27	0.02
	86.71	0.39	6.26						
	86.66	0.37	6.29						
Calibration check	97.29	0.18	2.10						
Azo E2s	96.12	0.37	3.78	96.11	0.02	0.32	0.06	3.77	0.01
	96.09	0.34	3.76						
	96.11	0.25	3.77						
Azo E2s black	29.14	0.70	1.66	29.12	0.05	0.70	0.03	1.65	0.01
	29.16	0.67	1.64						
	29.06	0.73	1.64						
Azo E2s white	89.37	-0.30	2.29	89.24	0.12	-0.31	0.01	2.25	0.03
	89.20	-0.30	2.24						
	89.15	-0.32	2.23						
Air	2.88	0.48	-0.38						
Calibration check	97.29	0.06	2.14						
Polycontrast N	93.75	0.58	4.49	93.77	0.02	0.57	0.01	4.48	0.01
	93.79	0.56	4.47						
	93.77	0.57	4.49						
Polycontrast N black	27.05	0.33	0.21	27.02	0.04	0.30	0.04	0.21	0.01
	26.97	0.32	0.20						
	27.03	0.26	0.21						

Polycontrast N white	84.81	-0.07	2.65	84.88	0.15	-0.08	0.01	2.66	0.02
	84.78	-0.09	2.65						
	85.05	-0.08	2.68						
Calibration check	97.30	0.10	2.13						
Kodabromide F2D	93.64	1.37	1.54	93.56	0.08	1.38	0.02	1.55	0.02
	93.48	1.40	1.54						
	93.55	1.37	1.58						
Kodabromide F2D black	26.32	0.39	0.11	26.32	0.01	0.44	0.05	0.11	0.01
	26.31	0.44	0.12						
	26.32	0.48	0.10						
Kodabromide F2D white	84.71	0.36	0.20	84.41	0.31	0.40	0.04	0.20	0.00
	84.42	0.44	0.20						
	84.10	0.39	0.20						
Calibration check	97.28	0.11	2.12						
Velox F2s	94.38	1.14	1.81	94.38	0.02	1.12	0.03	1.83	0.03
	94.37	1.12	1.82						
	94.40	1.09	1.86						
Velox F2s black	25.40	0.33	0.86	25.58	0.16	0.29	0.03	0.84	0.02
	25.66	0.28	0.84						
	25.69	0.27	0.82						
Velox F2s white	87.92	-0.16	0.64	87.77	0.16	-0.18	0.02	0.64	0.02
	87.79	-0.18	0.66						
	87.61	-0.19	0.63						
Calibration check	97.29	0.08	2.14						
Portrait Proof R	96.28	-0.44	5.71	96.31	0.04	-0.47	0.04	5.69	0.02
	96.30	-0.47	5.69						
	96.36	-0.51	5.68						
Portrait Proof R black	28.98	0.17	0.47	28.93	0.06	0.15	0.02	0.45	0.04
	28.96	0.13	0.48						
	28.86	0.16	0.40						
Portrait Proof R white	82.62	-0.36	5.72	82.49	0.12	-0.36	0.01	5.71	0.01
	82.45	-0.36	5.71						
	82.40	-0.37	5.71						
Calibration check	97.30	0.09	2.12						
Azo	95.11	1.36	2.01	95.08	0.04	1.35	0.01	2.02	0.03
	95.04	1.34	2.05						
	95.10	1.34	2.00						
Azo black	25.36	0.60	2.29	25.40	0.12	0.65	0.04	2.26	0.04
	25.31	0.68	2.27						
	25.54	0.66	2.21						

Azo white	87.34	0.13	0.52	87.37	0.04	0.12	0.02	0.51	0.01
	87.37	0.13	0.51						
	87.41	0.10	0.51						
Calibration check	97.30	0.09	2.14						
Polycontrast III RC F	95.48	-0.35	2.93	95.47	0.03	-0.38	0.03	2.91	0.03
	95.44	-0.38	2.88						
	95.49	-0.40	2.92						
Polycontrast III RC F black	24.18	0.58	0.28	24.21	0.04	0.61	0.07	0.30	0.03
	24.20	0.57	0.34						
	24.25	0.69	0.28						
Polycontrast III RC F white	90.75	-0.45	2.39	90.79	0.05	-0.48	0.03	2.46	0.06
	90.78	-0.47	2.48						
	90.85	-0.51	2.51						
Calibration check	97.31	0.10	2.12						
Polycontrast III RC F all white back	95.58	-0.18	3.23	95.60	0.02	-0.21	0.03	3.22	0.01
	95.59	-0.20	3.22						
	95.62	-0.24	3.22						
Polycontrast III RC F black	24.27	0.58	0.22	24.21	0.07	0.62	0.05	0.23	0.01
	24.21	0.60	0.24						
	24.14	0.67	0.24						
Polycontrast III RC F white	90.99	-0.44	2.51	90.92	0.06	-0.45	0.02	2.50	0.01
	90.91	-0.47	2.50						
	90.87	-0.44	2.49						
Polycontrast III RC F white with back printing	95.25	-0.33	3.05	95.27	0.03	-0.30	0.04	3.08	0.06
	95.27	-0.33	3.07						
	95.25	-0.27	3.04						
	95.31	-0.24	3.19						
	95.25	-0.31	3.06						
Calibration check	97.29	0.08	2.12						
Kodabrome II RC F4	94.98	0.20	3.58	94.94	0.03	0.23	0.02	3.60	0.02
	94.94	0.21	3.58						
	94.91	0.23	3.58						
	94.92	0.24	3.62						
	94.97	0.26	3.63						
Kodabrome II RC F4 white back	95.27	0.28	4.03	95.27	0.01	0.24	0.04	4.01	0.02
	95.28	0.22	4.00						
	95.27	0.21	4.00						
Kodabrome II RC F4 black	25.10	0.51	0.41	25.13	0.04	0.49	0.03	0.45	0.04
	25.11	0.51	0.47						
	25.18	0.45	0.48						

Kodabrome II RC F4 white	82.41	-0.34	2.91	82.43	0.02	-0.31	0.02	2.89	0.02
	82.44	-0.30	2.88						
	82.45	-0.30	2.87						
Calibration check	97.30	0.08	2.12						
Ilfospeed 1.1M	94.48	0.85	6.07	94.49	0.01	0.87	0.02	6.08	0.01
	94.50	0.87	6.08						
	94.49	0.89	6.08						
Ilfospeed 1.1M black	25.53	0.41	0.80	25.58	0.05	0.44	0.04	0.81	0.01
	25.63	0.43	0.81						
	25.57	0.49	0.82						
Ilfospeed 1.1M white	87.55	0.76	5.88	87.50	0.04	0.76	0.01	5.89	0.01
	87.48	0.75	5.90						
	87.47	0.76	5.88						
Calibration check	97.30	0.09	2.15						
Ilfobrome 2 2.1K	93.57	0.35	7.44	93.56	0.02	0.35	0.01	7.45	0.01
	93.54	0.34	7.46						
	93.56	0.36	7.45						
Ilfobrome 2 2.1K black	26.83	0.25	1.31	26.86	0.04	0.22	0.03	1.31	0.01
	26.91	0.19	1.32						
	26.85	0.23	1.31						
Ilfobrome 2 2.1K white	88.39	0.21	6.69	88.26	0.11	0.21	0.00	6.67	0.02
	88.20	0.21	6.65						
	88.20	0.21	6.68						
Galerie 2.1K	94.17	0.26	7.84	94.14	0.03	0.26	0.00	7.88	0.04
	94.13	0.26	7.91						
	94.12	0.26	7.90						
Calibration check	97.30	0.04	2.14						

(Table 8)

Summary of L*a*b* Values - Averages























AVERAGE COLOUR VALUES MEASURED AND SAMPLE STANDARD
DEVIATION (SD)

Data Name	L*	SD	a*	SD	b*	SD
-	-	-	-	-	-	-
Galerie 2.1K	94.07	0.01	0.39	0.03	7.54	0.06
Galerie 2.1K black print	27.00	0.04	0.01	0.06	1.18	0.01
Galerie 2.1K white solid print	86.69	0.03	0.39	0.02	6.27	0.02
Azo E2s	96.11	0.02	0.32	0.06	3.77	0.01
Azo E2s black	29.12	0.05	0.70	0.03	1.65	0.01
Azo E2s white	89.24	0.12	-0.31	0.01	2.25	0.03
Polycontrast N	93.77	0.02	0.57	0.01	4.48	0.01
Polycontrast N black	27.02	0.04	0.30	0.04	0.21	0.01
Polycontrast N white	84.88	0.15	-0.08	0.01	2.66	0.02
Kodabromide F2D	93.56	0.08	1.38	0.02	1.55	0.02
Kodabromide F2D black	26.32	0.01	0.44	0.05	0.11	0.01
Kodabromide F2D white	84.41	0.31	0.40	0.04	0.20	0.00
Velox F2s	94.38	0.02	1.12	0.03	1.83	0.03
Velox F2s black	25.58	0.16	0.29	0.03	0.84	0.02
Velox F2s white	87.77	0.16	-0.18	0.02	0.64	0.02
Portrait Proof R	96.31	0.04	-0.47	0.04	5.69	0.02
Portrait Proof R black	28.93	0.06	0.15	0.02	0.45	0.04
Portrait Proof R white	82.49	0.12	-0.36	0.01	5.71	0.01
Azo	95.08	0.04	1.35	0.01	2.02	0.03
Azo black	25.40	0.12	0.65	0.04	2.26	0.04
Azo white	87.37	0.04	0.12	0.02	0.51	0.01
Polycontrast III RC F	95.47	0.03	-0.38	0.03	2.91	0.03
Polycontrast III RC F black	24.21	0.04	0.61	0.07	0.30	0.03
Polycontrast III RC F white	90.79	0.05	-0.48	0.03	2.46	0.06
Polycontrast III RC F all white back	95.60	0.02	-0.21	0.03	3.22	0.01
Polycontrast III RC F black	24.21	0.07	0.62	0.05	0.23	0.01

Polycontrast III RC F white	90.92	0.06	-0.45	0.02	2.50	0.01
Polycontrast III RC F white with back printing	95.27	0.03	-0.30	0.04	3.08	0.06
Kodabrome II RC F4 w back printing	94.94	0.03	0.23	0.02	3.60	0.02
Kodabrome II RC F4 all white back	95.27	0.01	0.24	0.04	4.01	0.02
Kodabrome II RC F4 black	25.13	0.04	0.49	0.03	0.45	0.04
Kodabrome II RC F4 white	82.43	0.02	-0.31	0.02	2.89	0.02
Ilfospeed 1.1M	94.49	0.01	0.87	0.02	6.08	0.01
Ilfospeed 1.1M black	25.58	0.05	0.44	0.04	0.81	0.01
Ilfospeed 1.1M white	87.50	0.04	0.76	0.01	5.89	0.01
Ilfobrome 2 2.1K	93.56	0.02	0.35	0.01	7.45	0.01
Ilfobrome 2 2.1K black	26.86	0.04	0.22	0.03	1.31	0.01
Ilfobrome 2 2.1K white	88.26	0.11	0.21	0.00	6.67	0.02
Galerie 2.1K reference check	94.14	0.03	0.26	0.00	7.88	0.04

(Table 9)

Comparison of data
Comparison of whites between
control sample and print sample

Data Name	AVERAGE VALUES AND SAMPLE STANDARD DEVIATION						Comparison of colour			Colour swatch
	L*	SD	a*	SD	b*	SD	dL*	da*	db*	
	-	-	-	-	-	-	-	-	-	
Galerie 2.1K	94.07	0.01	0.39	0.03	7.54	0.06	0.00	0.00	0.00	
Galerie 2.1K white print	86.69	0.03	0.39	0.02	6.27	0.02	7.37	0.00	1.27	
Azo E2s	96.11	0.02	0.32	0.06	3.77	0.01	0.00	0.00	0.00	
Azo E2s white	89.24	0.12	-0.31	0.01	2.25	0.03	6.87	0.63	1.52	
Polycontrast N	93.77	0.02	0.57	0.01	4.48	0.01	0.00	0.00	0.00	
Polycontrast N white	84.88	0.15	-0.08	0.01	2.66	0.02	8.89	0.65	1.82	
Kodabromide F2D	93.56	0.08	1.38	0.02	1.55	0.02	0.00	0.00	0.00	
Kodabromide F2D white	84.41	0.31	0.40	0.04	0.20	0.00	9.15	0.98	1.35	
Velox F2s	94.38	0.02	1.12	0.03	1.83	0.03	0.00	0.00	0.00	
Velox F2s white	87.77	0.16	-0.18	0.02	0.64	0.02	6.61	1.29	1.19	
Portrait Proof R	96.31	0.04	-0.47	0.04	5.69	0.02	0.00	0.00	0.00	
Portrait Proof R white	82.49	0.12	-0.36	0.01	5.71	0.01	13.82	0.11	0.02	
Azo	95.08	0.04	1.35	0.01	2.02	0.03	0.00	0.00	0.00	
Azo white	87.37	0.04	0.12	0.02	0.51	0.01	7.71	1.23	1.51	
Polycontrast III RC F white back	95.60	0.02	-0.21	0.03	3.22	0.01	0.00	0.00	0.00	
Polycontrast III RC F white	90.92	0.06	-0.45	0.02	2.50	0.01	4.67	0.24	0.72	
Kodabrome II RC F4 all white back	95.27	0.01	0.24	0.04	4.01	0.02	0.00	0.00	0.00	
Kodabrome II RC F4 white	82.43	0.02	-0.31	0.02	2.89	0.02	12.84	0.55	1.12	
Ilfospeed 1.1M	94.49	0.01	0.87	0.02	6.08	0.01	0.00	0.00	0.00	
Ilfospeed 1.1M white	87.50	0.04	0.76	0.01	5.89	0.01	6.99	0.11	0.19	
Ilfobrome 2 2.1K	93.56	0.02	0.35	0.01	7.45	0.01	0.00	0.00	0.00	
Ilfobrome 2 2.1K white	88.26	0.11	0.21	0.00	6.67	0.02	5.29	0.14	0.78	

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