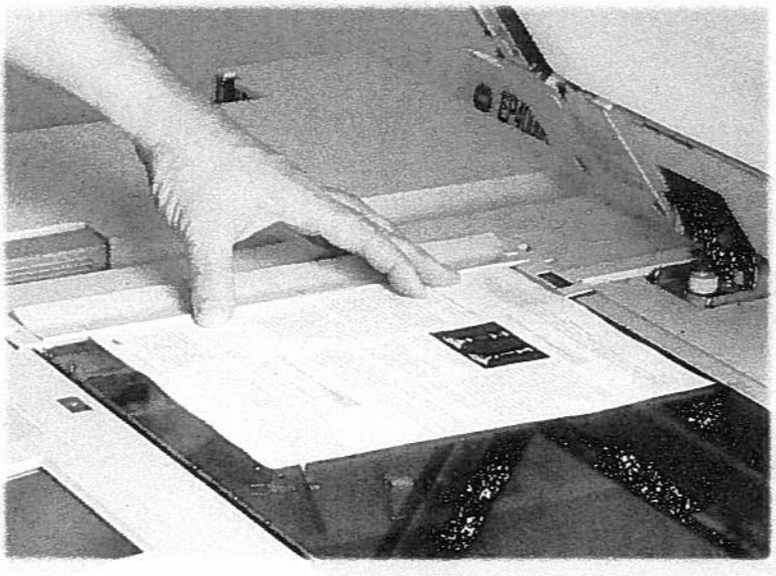
Technical Bulletin 22

Canadian Conservation Institute
Institut canadien de conservation

The Stability of Photocopied and Laser-printed Documents and Images: General Guidelines



Canadian Heritage Patrimoine canadien

Canada

Technical Bulletin No. 22

The Stability of Photocopied and Laser-printed Documents and Images: General Guidelines

by David Grattan

Published by the
Canadian Conservation Institute
Department of Canadian Heritage
1030 Innes Road
Ottawa ON K1A 0M5
Canada

Cat. No.: NM95-55/22-2000E
ISSN 0706-4152
ISBN 0-662-28503-4

Text also available in French.
Stabilité des documents et des images photocopiés ou imprimés au moyen d'une imprimante laser : lignes directrices.

Printed in Canada

CCI Technical Bulletins

Technical Bulletins are published at intervals by the Canadian Conservation Institute in Ottawa as a means of disseminating information on current techniques and principles of conservation of use to curators and conservators of Canada's cultural artifacts. The author welcomes comments.

Abstract

This bulletin reviews the technology of photocopiers and laser printers, and discusses the stability and preservation of copies. The conclusion is that black-and-white copies (i.e. those using carbon-based toner) on alkaline paper form very stable records, but colour photocopies do not. A full-sheet test for assessing the adhesion of toner to paper is described, and the results of testing papers according to the American Society for Testing and Materials (ASTM) standard for permanency of copy paper are given. The bulletin also includes a list of preservation concerns that will be useful to archivists responsible for the care of photocopied documents, and a number of current technical references that discuss the topic in more depth.

Author

David Grattan received a Ph.D. from the University of Keele in 1973, followed by work as a Research Fellow at the National Research Council of Canada where he combined his experience in polymers and photochemistry in a study of the stabilization of plastics against light. Since joining CCI in 1977, his research has included various topics such as waterlogged wood; treatment of fossils from the Fossil Forest, Canadian Arctic; parylene for museum and forensic use; stabilization of modern materials by use of anoxic conditions; degradation of polyethylene glycol, Polyox, and parylene; and the development of a light ageing apparatus for museum materials. David has been involved with numerous international organizations and has also authored many professional publications. For the last few years he has been leading CCI's research team in paper stability studies for the American Society for Testing and Materials and the Canadian General Standards Board standards for paper permanency.

Canadian Heritage Patrimoine canadien

This publication is printed on recycled paper.

Table of Contents

Introduction

There are a number of major concerns relating to the permanence of photocopied materials. These can be summarized as follows.

- *Preservation photocopying* is a technique used to preserve information when the source has little intrinsic value. The copy becomes the *preservation copy* and thus the primary source of information; therefore the photocopied record must have high permanence.
- Some records created by their sponsoring organizations should be produced on permanent media. Photocopiers and laser printers are universally used for this purpose, and guidelines are needed to ensure that these records have maximum permanency.
- Collections contain a wide variety of photocopied documents, and information is needed on how to care for this material and any possible problems.
- Colour photocopies are frequently used in exhibits because they are inexpensive, but they have very poor permanence.

The principal factors determining the stability of photocopied documents are the permanence of the paper and of the image. These issues are dealt with separately, followed by a list of practical recommendations.

Paper Permanence

If photocopies are to survive as permanent records, it is important that the copy paper does not become brittle or yellow. Industrial standards exist to ensure that copy papers are not only capable of being handled by photocopy machines, but also possess high permanency. Permanency standards specifically for copy paper have been set by the American Society for Testing Materials (ASTM). More general permanency standards have been set by many organizations such as the American National Standards Institute (ANSI), the National Information Standards Organization (NISO), and the International Standards Organization. A Canadian Standard is currently being developed by the Canadian General Standards Board (CGSB)

Copy Paper

Copy papers are usually modified bond grades made from chemical and wood pulps. The most common basis weight is 75 g/m^2 (20 lb.), but it may range from 60 g/m^2 (16 lb.) to 90 g/m^2 (24 lb.). Copy papers have a smooth finish, heat stability, non-curling qualities, and good aesthetic properties such as colour brightness and cleanliness.[1] Papers are often internally sized with rosin and surface sized. Up to 30% (by weight) of calcium carbonate may be present as a filler.

Permanent Copy Paper

Permanent copy paper is very similar to ordinary copy paper, except that a permanency standard has been established for it. ASTM D 3458-96[2] specifies criteria for "Copies from Office Copying Machines for Permanent Records." The most permanent paper described by the standard is coded "LE-1000" (or Type 1) and is expected to last several hundred years.[3]

Summary of the ASTM D 3458-96 Requirements for LE-1000 (Type 1—high permanency) Paper

The key permanence requirements are as follows:

- Papers should be made from cotton, linen, or fully bleached chemical fibre, and virgin or recycled fibre may be used in any proportion, "as agreed upon between buyer and seller at time of purchase."
- Papers should contain less than 0.7% lignin (i.e. Kappa number below 5).
- Papers should contain at least 2% calcium carbonate.
- The cold extract pH must be between 7.5 and 10.
- Papers must meet various strength requirements as defined in tear strength, tensile, and fold endurance testing. Two strength grades are defined: Grade 1 and Grade 2[4] (high referral papers that are stronger than Grade 1 papers). [It is extremely unusual for papers to meet the fold endurance required for Grade 2 status, so for most practical purposes only Grade 1 paper need be considered.]
- Papers must retain a high percentage of strength as determined in a prescribed ageing test.[5]
- Papers must meet certain requirements for opacity and brightness.

CCI Test Results for Commercially Available Papers

The Canadian Conservation Institute (CCI) conducted tests with four commercially available papers to see how well they performed against the ASTM D 3458-96 standard: Permalife (25% cotton, 50% recycled; Howard paper), Perma-dur bond (University Products Inc.), Repro Plus (Rolland Inc.), and Econosource (dual purpose Xerography - Unisource Inc.). The first three were high quality "permanent" papers, and the fourth was a typical economical office copy/laser-printer paper.

Endnotes

1. *The Dictionary of Paper*, 4th ed. (New York: American Paper Institute, 1980).

2. It is important to use the most recent (1996) version of the ASTM standards, as earlier versions contain errors. Other closely related standards for permanency are ANSI/NISO Z39.48-1992, "American National Standard for Permanence of Paper for Publications and Documents in Libraries and Archives," and ISO 9706 (03/94), "Information and Documentation—Paper for Documents—Requirements for Permanence." In these, the requirements for lignin content, pH, and tear resistance harmonize very well with the ASTM standards except that neither demands an ageing test.

3. Though described in the standard, "high life expectancy, LE-100" or "medium life expectancy, LE-50" papers are not permanent.

4. Papers should have a fold endurance of 200.

5. In a non-mandatory specification, Type 1 papers must retain 90% of their internal tearing resistance or tensile energy absorption after 72 h of ageing at 105°C (or 90°C and 50% relative humidity). This is reduced to 80% retention for Type 2 papers. Humid ageing conditions as defined by ASTM D 4714 are recommended by CCI.

6. Permalife paper retained only about 87% of its tear resistance after ageing, thereby failing a non-mandatory requirement for a Type 1 paper. Perma-dur and Repro Plus failed to retain more than approximately 80% of their tensile energy absorption after ageing, and hence they both failed a non-mandatory requirement for a Type 1 paper. Econosource passed all the strength tests.

7. Analysis revealed that Econosource had 15% alkaline reserve and was composed of bleached hardwood and softwood with around 10% of BCTMP hardwood and softwood. [BCTMP is wood pulp that has been bleached for brightness and is produced by both mechanical and chemical pulping methods.] Repro Plus had 14.3% alkaline reserve, with bleached hardwood and softwood. Perma-dur had 4.4% alkaline reserve, with bleached hardwood and softwood. Finally, Permalife had 4.4% alkaline reserve, with bleached hardwood and softwood and also cotton.

8. P. Gregory, "Modern Reprographics," *The Review of Progress in Colouration* 24 (1994): 1–16.

9. M.E. Scharfe, D.M. Pai, and R.J. Gruber, "Electrophotography," ch. 5 in *Imaging Processes and Materials*, Neblette's 8th edn., ed. J. Sturge, V. Walworth, and Allan Shepp (New York: Van Nostrand Reinhold, 1989).

10. A photoconductive material is one that conducts electricity in the presence of light.

11. Manufacturers tend to prefer certain processes: Xerox, Mita, Panasonic, 3M, Sharp, Pitney Bowes, Konica, Ricoh, Toshiba, and Minolta often use two-component dry developers; Kodak and Canon use single-component dry developers; Savin copiers frequently employ liquid development.

12. Henry Wilhelm, *The Permanence and Care of Color Photographs: Traditional and Digital Color Prints, Color Negatives, Slides, and Motion Pictures* (Grinnell, IA: Preservation Publishing Company, 1993), 137 pp.

13. Sylvia Subt and John Koloski, GPO Jacket No. 484-988, *Final Report Archival Xerographic Copying—Special Development Study for National Archives and Administration*, Quality Control and Technical Department U.S. Government Printing Office, August 25, 1987.

14. Twelve months is an estimate based on direct observations of tape behaviour at CCI.

15. This list is similar to one prepared recently for Australian Archives; see "Photocopying and Laser Printing Processes—Their Stability and Permanence," *Australian Archives* (Sept. 1993). Other important references are Sylvia Subt and John Koloski,[13] and Norvell M.M. Jones, *Archival Copies of Thermofax, Verifax and Other Unstable Records*, National Archives Technical Information Paper No. 5 (Washington, D.C.: National Archives and Records Administration, 1990).

16. With the additional requirement that the paper should contain at least 2% calcium carbonate.

17. Also specify that the paper passes the humid oven ageing test (ASTM D4714 at 50% relative humidity). Do not accept results from the dry-oven ageing test.

18. Ellen R. McCrady (ed.), *North American Permanent Papers—A Guide to Permanent Papers Available in the U.S. and Canada* (Austin, TX: Abbey Publications, 1995). See pp. 12 and 13 for a list of copy papers, then see p. 9 followed by p. 15 to identify sources. N.B. Within this document the separation of "copier," "laser print," and "xerographic" papers is largely artificial.

19. Stefan Michalski, *Guidelines for Humidity and Temperature in Canadian Archives and Libraries* (Ottawa: Canadian Conservation Institute), to be published.

Notes