



NBSIR 73-249

Development of Specifications for Archival Record Materials

W. K. Wilson and E. J. Parks

Paper Evaluation Section
Institute for Materials Research
National Bureau of Standards

July 30, 1973

Semi-annual Report Covering the Period
January 1 -- June 30, 1973

Prepared for
National Archives and Records Service
Washington, D. C. 20408



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U. S. DEPARTMENT OF COMMERCE, Frederick B. Dent, Secretary

NATIONAL BUREAU OF STANDARDS, Richard W. Roberts, Director



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1. BACKGROUND

In response to a request by the National Archives and Records Service, the National Bureau of Standards is developing information on the variables associated with the stability of archival record materials, especially paper. Since the inception of the project, several U.S. Government agencies and the Society of American Archivists have joined in sponsorship of the project through National Archives and Records Service.

Many record materials of archival or long-term historical value in repositories in the Federal Government and throughout the United States are in very bad physical condition. If proper specifications were available for materials that are designed to be used for permanent records, future problems concerned with the deterioration of record materials and the cost of repairing the mistakes of the past would be greatly minimized.

Most of the work has been directed toward the development of an accelerated aging method. As this is a long-range effort, in terms of time and scope, and as archivists and librarians need specifications today for record materials, interim specifications based on pH requirements are being prepared for selected materials. Interim specifications for manifold papers have been cleared through the American Society

for Testing and Materials (ASTM). Specifications for bond and ledger papers and for file folders are in progress in the ASTM standardizing process.

There is an urgent need to establish permanence criteria for papers that can be used in office copying machines. An accelerated aging method is required for this. Other materials that merit attention are inks, typewriter ribbons, carbon paper, laminating film, mending tape, and binding materials.

2. OBJECTIVES

The objectives of this program are as follows:

(1) The development of information on the stability of paper and other record materials.

(2) The development of test methods for the evaluation of the stability of paper and other record materials.

(3) The development of specifications for materials suited for permanent records.

3. WORK IN PROGRESS

3.1 Accelerated Aging

No laboratory work on accelerated aging was performed during the last six months. The last semi-annual report, 10 976, covering the period June 30-December 31, 1972, contained a discussion of accelerated aging of a special paper filled with calcium carbonate in which the carboxyls were covered with aluminum. A draft of a report on this work was prepared, but it appears that more questions have been raised by this work than have been answered. More work needs to be done before a report can be written, and some of this work is in progress. It is now perfectly clear that an examination of naturally aged papers must be made in order to provide information about the desirability of using dry accelerated aging or moist accelerated aging.

3.2 Specifications for Manifold Paper for Permanent Records

Specifications for manifold paper for permanent records have cleared the standardization procedure of ASTM, and the standard is designated as D 3208. This document now can be used for procurement purposes.

Three levels of permanence are described in the specification, and these permanence levels are differentiated by pH or filler requirements. An alkaline filler is required for paper with maximum permanence. A neutral sized paper is specified for paper with high permanence. A medium permanence paper requires a minimum pH of 5.5. A paper with maximum permanence is expected to last several hundred years; a paper with high permanence is expected to last in excess of 100 years; and a paper with medium permanence is expected to last at least 50 years and up to 100 years.

This specification represents a milestone as it is the first specification for permanent record papers developed by an ASTM subcommittee. It must be considered an interim specification until an accelerated aging method is developed.

3.3 Specifications for Bond and Ledger Papers for Permanent Records

Interim specifications for bond and ledger papers have cleared ASTM D-6.20, Subcommittee for Permanent Record Papers, and have been balloted by Committee D-6, Paper. Five negative ballots were received. As soon as these are resolved, the document can proceed through the ASTM standardizing process. It is hoped that this will be completed within the next few months.

3.4 Specifications for File Folders for Storage of Permanent Records

This draft specification was unanimously approved by ASTM D-6.20, and has been sent to ASTM for ballot by Committee D-6, Paper. It is hoped that this can be completed during the next reporting period.

3.5 Evaluation of Office Copying Papers

Five years ago, the problem of specifying stability of paper for office copies, at least on an interim basis, would have been fairly simple. As only one principal copying process at that time used ordinary uncoated paper, a specification could have been prepared for the paper alone. Now there is a plethora of office copying processes, and accelerated aging must be part of the specifications for office copy papers for permanent records. Some exploratory work is in progress.

3.6 Cooperation with the Keuffel & Esser Company

A representative of the Keuffel & Esser Company, Mrs. Catherine Feasenmyer, provided us about two years ago with a collection of drawing and tracing papers dating back to 1940. These papers had been tested, before and after accelerated aging, in 1940 and again in 1960. We have now

tested these papers again for Schopper folding endurance, internal tearing resistance, DTA, and pH. A report has been completed and distributed.

3.7 Evaluation of Papers Made in NBS Mill After 37 Years Natural Aging

In 1936, a number of book papers were made under carefully controlled conditions in the NBS paper mill. Samples of these papers were tested before and after accelerated aging for 72 hours at 100°C. These papers are especially valuable as several groups of papers have the same fiber content with different quantities of filler, rosin, and alum. Some of the papers contain calcium carbonate as a filler. It is not known at this time whether natural aging correlates better with moist accelerated aging or dry accelerated aging. It is hoped that the testing of these papers and the papers mentioned in section 3.8 will help answer this question.

The testing is incomplete, but some information is available:

(1) Most of the samples retained 90 percent or more of their initial tensile strength after 37 years natural aging.

(2) Folding endurance is much more sensitive to natural aging than tensile strength. Changes in folding endurance apparently are not related to changes in tensile strength.

(3) For a given group of papers (same fiber content), folding endurance tends to decrease with (a) increasing wet strength, (b) increasing alum content, and (c) decreasing pH.

(4) Within a given group of papers, pH is related to permanence, but other variables in composition generally override the effect of pH.

3.8 Evaluation of Uncoated Book Papers After 10 Years Natural Aging

About 10 years ago, a group of commercial uncoated book papers were tested before and after accelerated aging under humid conditions. Retesting of these papers is in progress. This group included several papers containing neutral sulfite semichemical (NSSC) pulp. Some preliminary conclusions are as follows:

(1) When changes in folding endurance after natural aging are plotted against changes after accelerated aging, a good correlation exists for the eight NSSC papers, but not for the group of 20 papers.

(2) After 10 years natural aging, tensile strength usually increased by a few percent. After humid accelerated aging, tensile strength usually decreased by 10 to 20 percent. The increase in tensile strength after natural aging may be due to crosslinking.

(3) There may be some correlation between changes in tensile strength and changes in folding endurance for accelerated aging, but not for natural aging.

3.9 Production of Acid During Accelerated Aging

Potentiometric titrations have been performed on various kinds of handsheets before and after accelerated aging in moist and in dry air at 90°C. Titratable acidity correlates well with pH of the water extract. There appears to be little difference in the amount of titrant as a function of aging between pH 8 and pH 10, which suggests that lactones are not involved in accelerated aging.

Further experiments are planned.

4. METHODS OF EVALUATION OF NATURALLY AGED PAPERS

In previous NBS reports, several special methods of evaluation were discussed in detail. It appears that zero span tensile strength and wet tensile strength may be of value in determining whether dry accelerated aging or moist accelerated aging correlates with natural aging. A zero span tester only recently was delivered, so these data must be obtained on the papers mentioned under sections 3.7 and 3.8.

5. STATUS OF REPORTS AND MANUSCRIPTS

5.1 Reports

(1) Development of Acidity During the Accelerated Aging of Paper is in preparation.

(2) Accelerated Aging of Commercial Papers in Dry Air, Compared with Natural Aging, NBSIR 73-155.

(3) The Accelerated Aging of Aluminum Treated Paper Buffered at High pH. During the preparation of this report, several questions were raised that require further attention. This information requires further analysis, but it is likely that more laboratory work will be necessary before the report can be completed.

(4) Other reports: About 5 reports are in various stages of preparation, but it would be premature to list them.

5.2 Manuscripts

No manuscripts are in preparation at this time. Depending on how the reporting is divided, there is the potential for about 7 manuscripts for publication in professional journals.

6. PLANS FOR THE PERIOD JULY 1-DECEMBER 31, 1973

The following tasks should be completed by December 31, 1973.

- (1) Specification for bond and ledger papers for permanent records.
- (2) Specification for file folders for storage of permanent records.
- (3) Testing of papers made in the NBS paper mill 37 years ago.
- (4) Testing of the naturally aged papers that were tested about 10 years ago.

In addition, exploratory work will be continued on the evaluation of office copy papers.

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