



Standard Guide for Selection of Permanent and Durable Artist's Paper¹

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1. Scope

1.1 This guide covers artist's papers used in the preparation of permanent or semipermanent artwork. Some works of art are expected to last several hundred years, and others might be expected to last 50 years, or less.

1.2 In selecting artist's papers for a given life expectancy, papers with acceptable strength are evaluated for life expectancy through accelerated aging.

1.3 This guide is to be used for guidance in the purchase of permanent artist's paper.

1.4 As a great variety of artist's papers are to be found in the market place, extensive information on the various kinds of paper in use by artists is beyond the scope of this guide. This guide is concerned mostly with life expectancy of the paper.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

- D 585 Practice for Sampling and Accepting a Single Lot of Paper, Paperboard, Fiberboard, and Related Products²
- D 589 Test Method for Opacity of Paper²
- D 644 Test Method for Moisture Content of Paper and Paperboard by Oven Drying²
- D 645 Test Method for Thickness of Paper and Paperboard²
- D 646 Test Method for Grammage of Paper and Paperboard (Mass per Unit Area)²
- D 689 Test Method for Internal Tearing Resistance of Paper²
- D 774 Test Method for Bursting Strength of Paper²
- D 828 Test Method for Tensile Breaking Strength of Paper and Paperboard²
- D 985 Test Method for Brightness of Pulp, Paper, and Paperboard (Directional Reflectance at 457 nm)²
- D 1030 Test Method for Fiber Analysis of Paper and Paperboard²

D 1968 Test Method for Terminology Relating to Paper and Paper Products²

D 3424 Test Methods for Evaluating the Lightfastness and Weatherability of Printed Matter³

D 4714 Test Method for Determination of Effect of Moist Heat on Properties of Paper and Paperboard²

D 4988 Test Method for Determination of Calcium Carbonate Content of Paper²

D 5634 Guide for Selection of Permanent and Durable Offset and Book Papers²

2.2 TAPPI Test Methods:

T 236 Kappa number of pulp⁴

T 400 Sampling and accepting a single lot of paper, paperboard, fiberboard, or related product⁴

T 401 Fiber analysis of paper and paperboard⁴

T 403 Bursting strength of paper⁴

T 410 Grammage of paper and paperboard (weight per unit area)⁴

T 411 Thickness (caliper) of paper and paperboard⁴

T 412 Moisture in paper and paperboard⁴

T 414 Internal tearing resistance of paper⁴

T 425 Opacity of paper (15°/diffuse illuminant A, 89 % reflectance backing and paper backing)⁴

T 452 Brightness of pulp, paper, and paperboard (directional reflectance at 457 nm)⁴

T 479 Smoothness of paper (Bekk method)⁴

T 480 Specular gloss of paper and paperboard at 75 degrees⁴

T 494 Tensile breaking properties of paper and paperboard⁴

T 509 Hydrogen ion concentration (pH) of paper extracts (cold extraction method)⁴

T 538 Smoothness of paper and board (Sheffield method)⁴

T 544 Effect of moist heat on properties of paper and board⁴

2.3 ISO Standard:

ISO 9706 Paper for documents—Specifications for permanence—Normative Annex—Special instructions for determining kappa number⁵

¹ This guide is under the jurisdiction of ASTM Committee D-6 on Paper and Paper Products and is the direct responsibility of Subcommittee D06.20 on Permanent Records Paper.

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² Annual Book of ASTM Standards, Vol 15.09.

³ Annual Book of ASTM Standards, Vol 06.02.

⁴ Available from the Technical Association of the Pulp and Paper Industry, TAPPI Press, Technology Park, Atlanta, GA 30348.

⁵ Available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.

3. Terminology

3.1 Definitions:⁶

3.1.1 *acid sized paper*—see Terminology D 1968.

3.1.2 *alkaline-filled paper*—see Terminology D 1968.

3.1.3 *alkaline sized paper*—see Terminology D 1968.

3.1.4 *durability*—see Terminology D 1968.

3.1.5 *neutral sized paper*—see Terminology D 1968.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *High Life Expectancy, LE-100*—the object is expected to be usable for 100 years.

3.2.2 *Life Expectancy, LE⁷*—length of time that information is predicted to be retrievable under extended storage conditions.

3.2.3 *Life Expectancy Designation*—life expectancy expressed in years.

3.2.4 *Maximum life expectancy, LE-1000*—the object is expected to be usable for 1000 years.

3.2.5 *medium life expectancy, LE-50*—the object is expected to be usable for 50 years.

3.2.6 *paper with a minimum pH value*—as the stability of record and artist's paper is an approximate function of pH, one approach to describing a stable paper is to specify a minimum pH value, for example, 5.5. This value can be achieved with a rosin-alum sizing system.

3.2.7 *permanence*—that property ascribed to a material which, under specified conditions, resists changes in any or all of its properties with the passage of time.

3.2.7.1 *Discussion*—Life expectancy is a more descriptive term. It is expected that the terms maximum, high, and medium permanence in earlier standards for paper for permanent records will be replaced with maximum, high, and medium life expectancy, or with LE-designations, LE-1000, LE-100, and LE-50.

4. Significance and Use

4.1 As there is no completely foolproof method for determining the life expectancy of paper, one must rely on observations made on historical records and on current knowledge of factors, in terms of paper properties and paper composition, that increase life expectancy, and on retention of selected properties after accelerated aging.

4.2 Acidic materials incorporated in paper during manufacture (for example, rosin-alum sizing) contribute to deterioration. It has been shown (1–5)⁸ that the life expectancy of uncoated papers is an approximate function of the pH of the aqueous extract of the paper.

4.3 The use of papers with controlled acidity, or of papers manufactured under neutral or alkaline conditions, especially papers with a calcium carbonate filler that can absorb acidic gases from the atmosphere or can neutralize acidic materials formed during the aging of paper, would be expected to contribute significantly to the life expectancy of works of art on paper.

4.4 Three pH levels, reflecting three levels of life expectancy, are outlined in this guide. As one cannot rely on pH alone as an indicator of stability, minimum retentions of properties after accelerated aging at 90°C and 50 % relative humidity are suggested for the three levels of life expectancy.

4.5 This guide covers the following:

4.5.1 Physical tests to identify potential durability in service.

4.5.2 A minimum percentage retention of selected properties after accelerated aging for 12 days at 90°C and 50 % relative humidity.

4.5.3 Tests related to composition of paper that are indicative of stability.

4.5.3.1 A pH test, for screening only.

4.5.3.2 For maximum life expectancy, the presence of an alkaline filler, such as calcium carbonate, to serve as a buffering agent against attack by acidic contaminants from the atmosphere, and from the paper during aging.

4.5.3.3 Fiber analysis, or a certificate from the supplier concerning fiber composition.

4.6 Although data from tests that may be performed in the laboratory do not correlate perfectly with use situations, several tests are available that should be useful to estimate the durability of paper. Examples of such tests are tearing force, tensile properties (tensile strength, elongation, and tensile energy absorption) and burst.

4.7 Papers buffered with a calcium carbonate filler, and with fiber composition as described in 7.1.2, are considered to have maximum life expectancy (1,4,6).

4.8 Papers with a neutral or alkaline pH without a calcium carbonate filler, and acid papers with a surface size formulation containing calcium carbonate, may or may not have the expected life expectancy. An acid paper may have been treated with a surface size containing enough calcium carbonate to give an alkaline extract pH, but an acid paper may or may not have been neutralized. Also, an acid paper may have been coated with a formulation containing calcium carbonate pigment. Therefore, an accelerated aging procedure is necessary to ensure the exclusion of such papers. If a paper is not coated with a formulation containing calcium carbonate, or if it is not surface sized with a sizing agent that contains calcium carbonate, the pH test should be valid.

4.9 In order to estimate the relative life expectancy of paper, it is necessary to develop a database on the accelerated aging of several papers covering a spectrum of life expectancies. This information is summarized in Guide D 5634. Retentions of selected physical properties after accelerated aging are used as indicators of probable longevity. Examples of such tests include tearing force, tensile strength, elongation, tensile energy absorption (TEA), burst, and brightness.

4.10 Although arbitrary retention limits are suggested for various properties in Table 1, these suggested retention limits are for guidance only. There are no limits to properties that can be measured in the laboratory above which a paper is acceptably durable or permanent, or both, and below which it is not acceptable. Selections must be made on the basis of the potential value of the object, resources, cost, and what is available in the marketplace.

⁶ See also the *Dictionary of Paper*, TAPPI Press.

⁷ Adapted from American National Standards Institute Committee IT9.1; approved December 1991.

⁸ The boldface numbers in parentheses refer to the list of references at the end of this guide.