

T 544 sp-03

PROVISIONAL METHOD – 1985
STANDARD PRACTICE – 1997
REVISED – 2003
©2003 TAPPI

The information and data contained in this document were prepared by a technical committee of the Association. The committee and the Association assume no liability or responsibility in connection with the use of such information or data, including but not limited to any liability under patent, copyright, or trade secret laws. The user is responsible for determining that this document is the most recent edition published.

CAUTION:

This Test Method may include safety precautions, which are believed to be appropriate at the time of publication of the method. The intent of these is to alert the user of the method to safety issues related to such use. The user is responsible for determining that the safety precautions are complete and are appropriate to their use of the method, and for ensuring that suitable safety practices have not changed since publication of the method. This method may require the use, disposal, or both, of chemicals, which may present serious health hazards to humans. Procedures for the handling of such substances are set forth on Material Safety Data Sheets, which must be developed by all manufacturers and importers of potentially hazardous chemicals and maintained by all distributors of potentially hazardous chemicals. Prior to the use of this method, the user must determine whether any of the chemicals to be used or disposed of are potentially hazardous and, if so, must follow strictly the procedures specified by both the manufacturer, as well as local, state, and federal authorities for safe use and disposal of these chemicals.

Effect of moist heat on properties of paper and board

1. Scope

1.1 This method specifies the procedure for humidified heat treatment of paper or board and the general procedure for testing the heat-treated materials. The purpose is to obtain inferences regarding the long-term aging qualities of the paper.

1.2 The method is based on work done on printing and writing papers but may be used with discretion for other types of papers and boards.

2. Summary

Properties of paper or board are compared before and after “accelerated aging” in a humidified atmosphere at an elevated temperature (50% RH, 90°C).

NOTE 1: Earlier editions of this test method have specified 25% relative humidity at 90°C as this appeared, with very limited data, to correlate better with natural aging. Fifty percent relative humidity at 90°C has been found preferable for three reasons: 1) it has become the standard through usage, 2) paper degrades twice as fast at 50% relative humidity as at 25%, and 3) humid ovens can maintain 50% relative humidity, but not 25%, at 90°C.

3. Significance

3.1 Exposure of paper or board to a hostile environment, such as some types of radiation, elevated temperature, or chemical attack over a period of hours, may provide information concerning 1) the natural changes that may occur in the material over a period of years, and 2) the ranking of similar papers with respect to stability.

3.2 Hostile environments that have been used include exposure to heat, to heat and moisture, to visible and ultraviolet radiation, and to sulfur dioxide, nitrogen dioxide and ozone gas.

3.3 Properties compared before and after such exposure include, but are not limited to, mechanical properties, such as burst, tensile properties, folding endurance and tearing resistance; optical properties, such as brightness, yellowness and opacity; and chemical properties, such as pH and alkali solubility.

3.4 TAPPI T 453 “Effect of Dry Heat on Properties of Paper” is available for evaluating the effect of dry oven treatment on paper. It has been determined that the degradation rate of cellulose is very sensitive to the amount of moisture in the sample (1,2). Comparison of accelerated aging with natural aging indicates that some moisture should be present in an accelerated aging atmosphere (3). Dry accelerated aging of cellulose is much less sensitive and probably

- 5.1.6 TAPPI T 423 “Folding Endurance of Paper (Schopper-Type Tester).”
- 5.1.7 TAPPI T 430 “Copper Number of Pulp, Paper, and Paperboard.”
- 5.1.8 TAPPI T 452 “Brightness of Pulp, Paper, and Paperboard (Directional Reflectance at 457 nm).”
- 5.1.9 TAPPI T 456 “Wet Tensile Breaking Strength of Paper and Paperboard (“Wet Tensile Strength).”
- 5.1.10 TAPPI T 494 “Tensile Properties of Paper and Paperboard (Using Constant Rate of Elongation Apparatus).”
- 5.1.11 TAPPI T 509 “Hydrogen Ion Concentration (pH) of Paper Extracts (Cold Extraction Method).”
- 5.1.12 TAPPI T 511 “Folding Endurance of Paper (MIT Tester).”
- 5.1.13 TAPPI T 553 “Alkalinity of Paper as Calcium Carbonate (Alkaline Reserve of Paper).”
- 5.1.14 TAPPI T 524 “Color of Paper and Paperboard (45°/0° Geometry)”
- 5.1.15 TAPPI T 1200 “Interlaboratory Evaluation of Test Methods to Determine TAPPI Repeatability and Reproducibility.”
- 5.2 Other methods.
 - 5.2.1 *Zero-span tensile strength*: Although there is a TAPPI procedure for zero-span breaking length of pulp [TAPPI T 231 “Zero-Span Breaking Strength of Pulp (Dry Zero-Span Tensile)”], there is none for paper. Commercial instruments are available for measuring the zero-span tensile strength of paper.
- 5.3 Some general guidelines.
 - 5.3.1 pH must always be determined for all aging periods.
 - 5.3.2 Tensile energy absorption is especially valuable, for it is an index of the capacity of a paper to hold up during use.

6. Sampling

To determine conformance to product specifications, select a sample of paper according to TAPPI T 400 “Sampling and Accepting a Single Lot of Paper, Paperboard, Containerboard, or Related Product.” Otherwise, obtain a sample appropriate to the reason for testing. Use any special directions given in the specific test method used for evaluation.

7. Test specimens

- 7.1 Select at random and prepare seven sets, or whatever number is agreed upon, of test specimens in accordance with TAPPI test methods relevant to the required tests.
- 7.2 Protect the test specimens as much as possible from exposure to light.
- 7.3 Avoid (as much as possible) handling test specimens with the fingers, and avoid undue exposure to the atmosphere of a chemical laboratory.

8. Procedure for heat treatment

- 8.1 *Aging vessels in tandem baths*
 - 8.1.1 Install the test specimens in aging vessels adjusted for internal temperature to be 90°C - one time period in one aging vessel. Retain one set of test specimens as a control.
 - 8.1.2 Pass dry air through the aging vessels at a rate of about 500-mL per minute for about ten minutes.
 - 8.1.3 Switch to air at 50% relative humidity at a rate of about 500 mL per minute for about ten minutes, and then lower the rate to 50 ± 10 mL per minute for the duration of the aging period.
 - 8.1.4 Remove one set of test specimens at each of the following times (in hours) or as agreed upon: 24 ± 0.25 , 48 ± 0.5 , 72 ± 0.75 , 144 ± 1.5 , 288 ± 3 , and 384 ± 4.0 .
- 8.2 *Environmental chambers (temperature and humidity controlled ovens)*
 - 8.2.1 Suspend the sets of test specimens in the test chamber pre-adjusted to an internal RH of 50% at 90°C, so that the specimens do not touch the walls of the oven, or are exposed to radiation from the heating coils.
 - 8.2.2 Remove the sets of test specimens as outlined in 8.1.4, keeping the chamber door open the shortest time possible.

NOTE 2: By agreement between vendor and purchaser, all or some of the specified times may be used and the data plotted, or the data from only one time obtained and compared with the control.