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An American National Standard
Technical Association of Pulp and
Paper Industry
Standard Method T 402

Standard Practice for Conditioning Paper and Paper Products for Testing[1]

This standard is issued under the fixed designation D 685; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This practice defines the standard atmospheres for normal preconditioning, conditioning, and testing of paper and paper products, paperboard, fiberboard, and containers made from them. It also specifies procedures for handling these materials in order that they may reach equilibrium with the respective atmosphere.

1.2 This practice does not include special conditioning and testing atmospheres, such as those that attempt to simulate tropical or arctic environments.

1.3 *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 Product[2]

E 171 Specification for Standard Atmospheres for Conditioning and Testing Flexible Barrier Materials[2]

3. Significance and Use

3.1 The preconditioning requirement is important because physical properties of a sample at 50 % relative humidity depend upon whether the sample is brought to 50 % from a higher or lower relative humidity. A detailed discussion of the importance of preconditioning may be found in Annex A1.

3.2 The conditioning and testing atmospheres are important because both temperature and relative humidity have significant effects on the physical properties of paper and board. A more detailed discussion of the importance may be found in Annex A2.

4. Standard Atmospheres

4.1 *Preconditioning Atmosphere*—10 to 35 % relative humidity and 22 to 40°C (see Annexes).

4.2 *Conditioning Atmosphere*—50.0 ± 2.0 % relative humidity and 23.0 ± 1.0°C.

4.3 *Testing Atmosphere*—Same as 4.2.

NOTE 1—It is important to distinguish between the overall limits of the temperatures within which conditioning and testing may be carried out and the limits within which the temperature must be maintained in order to maintain the specified relative humidity limits; that is, the close temperature tolerance of ±1°C required in 4.2 and 4.3 will not in itself ensure the close relative humidity requirement of ±2 % relative humidity, as a sudden change of 1°C when at 23°C and 50 % relative humidity will change the relative humidity about 5 to 6 %.

5. Apparatus

5.1 *Preconditioning Chamber*—A room or cabinet in which sample sheets or specimens may be individually exposed to circulating air at the preconditioning relative humidity and temperature.

NOTE 2—For smaller sheets or specimens, the required preconditioning may be achieved easily with a simple cabinet, if no other means are available. If this cabinet is operated in a room maintained at 50 % relative humidity and 23°C and so designed that room air is drawn through it, and if the air entering and in the cabinet is heated to a temperature of 39 ± 1°C, the relative humidity in the cabinet will be in the required range (that is, 20 ± 3 % relative humidity). Commercially available forced-ventilation "ovens" should prove satisfactory. Input air to the oven should be drawn from the standard room, output should be vented *outside* of the standard room.

5.1.1 For many papers and boards, approximately the same preconditioning moisture content obtained by the above procedure may be achieved by using a sealed cabinet operated in

[1] This practice is under the jurisdiction of ASTM Committee D06 on Paper and Paper Products and is the direct responsibility of Subcommittee D06.92 on Test Methods.

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[2] *Annual Book of ASTM Standards*, Vol 15.09.

a room maintained at 23 ± 1°C and using a saturated solution of lithium chloride (LiCl) to obtain a relative humidity of about 12 to 13 %.

5.1.2 For larger rooms needed for preconditioning sealed containers and large sheets, the required low relative humidity may be achieved by drawing air over a refrigerator expansion coil operating at a few degrees above freezing temperature.

5.2 *Conditioning and Testing Chamber*—One or more rooms or cabinets in which sample sheets or specimens may be individually exposed to circulating air at the conditioning relative humidity and temperature, and then tested under the same conditions.

NOTE 3—The required relative humidity (50.0 ± 2.0 %) and temperature (23.0 ± 1.0°C) are difficult to achieve and therefore careful attention must be given to the design, evaluation, and maintenance of the "standard room."

5.3 *Hygrometer*—Any instrument that can indicate directly or indirectly the relative humidity of the air with a calibrated accuracy of ±0.5 % relative humidity.

5.4 *Thermometer*—Either the dry bulb of a psychrometer (that is, a hygrometer of the wet- and dry-bulb type) or a separate thermometer of any convenient design. If a separate thermometer, it should be graduated to 0.2°C or closer with scale errors not exceeding these values. (Psychrometer thermometers must be graduated and correct to 0.1°C or closer and carefully matched to each other to give the required accuracy and repeatability in the measurement of relative humidity.)

6. Procedure

6.1 Obtain and preserve the sample in accordance with Practice D 585. In particular, avoid exposure of the sample to direct sunlight, to extremes of temperature, and, to relative humidities above 58 % (see Annex A1). If the sample is to be held for some time before testing, preserve it at a temperature below 25°C and relative humidity below 58 %, but not below 10 % as the paper may curl or cockle and change in other respects.

NOTE 4—It has been reported that low-temperature storage below 10°C slows aging effects. Samples should be protected against condensation.

6.2 Cut the specimens from a sample where critical dimensions are involved only after conditioning the sample. Where there are no critical dimensions, the specimens may be cut before preconditioning or conditioning.

6.3 If shipping containers are to be sealed with aqueous adhesives, make the seal prior to preconditioning.

6.4 Expose the sample sheets or specimens to the preconditioning atmosphere so that both surfaces of single sheets and exterior surfaces of laminated products or sealed containers are freely exposed. This is best achieved by suspending them from overhead or supporting them on a wire grid or rack.

6.5 Precondition the sample sheets or specimens by exposing them as specified in 6.4 to the preconditioning atmosphere. Precondition for a minimum of 24 h, unless a lesser time has been found to give satisfactory results.

NOTE 5—For preconditioning apparatus of ample capacity and air circulation, the following preconditioning times have usually been found satisfactory: single sheets of paper, less than 1 h; liners corrugating medium, chip board, box board, 1 to 2 h; corrugated and solid fiber board in sheet form, 5 to 10 h; sealed boxes and shipping containers, 12 to 16 h; specially treated water vapor resistant papers and boards, 24 h and more.

NOTE 6—If the sample is to be stored for some time after preconditioning, store at a temperature below 25°C and a relative humidity below 40 % but not below 10 %.

6.6 Condition the sample sheets or specimens by exposing them as specified in 6.4 to the standard conditioning atmosphere for a sufficient time for them to come into equilibrium with the atmosphere. Determine that equilibrium has been obtained by weighing the sheets or specimens at time intervals which increase roughly geometrically. Plot the weight against log time (that is, on semilogarithmic paper); the desired equilibrium exists when the plotted curve becomes essentially parallel to the time axis.

NOTE 7—With good air circulation and ample capacity, a conditioning period of 4 h is usually sufficient for paper of ordinary weight and composition. A minimum time of exposure of 5 to 8 h will be required for boards, and unsealed boxes, with a minimum time of 16 h or more for sealed fiberboard boxes, and much longer periods for boards of heavy substances and specially treated water-vapor resistant papers (for example, a minimum of 72 h for wax treated containers).

6.7 Handle the preconditioned and conditioned sheets or specimens as little as possible; especially avoid touching or breathing on test areas.

6.8 Test the specimens in the standard testing atmosphere.

7. Report

7.1 The report shall include the following:

7.1.1 Temperature, relative humidity, and total time of:

7.1.1.1 Preconditioning,

7.1.1.2 Conditioning before testing,

7.1.2 Minimum and maximum temperature and relative humidity during testing, and

7.1.3 Any variations in procedure from this practice.

8. Precision and Bias

8.1 No statement is made about either the precision or the bias of the practice since it merely states the environmental conditions under which paper tests are to be carried out. They could affect the precision and bias of the test methods, but such effects are reflected in the precision and bias statement appearing in the individual test method.

9. Keywords

9.1 conditioning; paper; paper products; reconditioning; standard atmosphere

ANNEXES

(Mandatory Information)

A1. IMPORTANCE OF PRECONDITIONING

A1.1 The physical properties of a sample at 50 % relative humidity depend on whether the sample was brought to 50 % from higher or lower relative humidities. This "humidity hysteresis effect" is 5 to 25 % of the test value for many physical properties. For example, a hysteresis effect of 1.5 % moisture content (or 25 % of the test value of 6 % moisture content) is typical. Preconditioning on the dry side within the range specified will avoid most of the hysteresis effect and result in the moisture content of a given sample being established within 0.15 % when the sample is later conditioned to 50 % relative humidity and 23 °C. Conditioning *down* to 50 % gives most papers a moisture content very nearly the same as conditioning *up* to 60 %.

A1.2 For the sake of obtaining close interlaboratory agreement, especially on physical properties, a specified preconditioning procedure is necessary but not always sufficient. While preconditioning practically eliminates the hysteresis effect, it has little influence on strain relaxation effects. The latter depend on the entire previous moisture history of the sample, especially on the conditions of initial drying and tension, and on the duration and degrees of subsequent excursions to high humidities (that is, above about 58 % relative humidity). Consequently, for very close interlaboratory agreement a standardized procedure for handling the sample from manufacture to testing is required.

A1.3 For mill control and similar intra-laboratory purposes, the preconditioning step may often be eliminated. For some properties and materials, preconditioning may not be necessary, either because of the smallness of the humidity hysteresis effect or because of lower test accuracy requirements.

A2. IMPORTANCE OF TEMPERATURE

A2.1 A tolerance of 1.0°C has been adopted in a number of countries. It is recommended along with ±2 % relative humidity, by Specification E 171 and by the technical committee, ISO/TC 125 on Enclosures and Conditions for Testing, whenever close tolerances are required, as in paper and board testing. Both temperature and relative humidity have significant effects on the physical properties of paper and board. For some properties of paper and board (for example, MD tensile and CD stretch) a change of 1°C may have nearly as much effect as a change of 2 % relative humidity. For synthetic fibers and plastic laminates the temperature effect may be greater than the relative humidity effect.