INTERNATIONAL STANDARD

ISO 8226-1

Second edition
1994-12-15

STANDARDSISO.COM : Click to view the full PDF of ISO 8226-1:1994

Paper and board — Measurement of hygroexpansivity —

Part 1:
Hygroexpansivity up to a maximum relative humidity of 68 %

Papiers et cartons — Détermination de la dilatation à l'humidité —

Partie 1: Dilatation à l'humidité jusqu'à une humidité relative maximale de 68 %

Reference number
ISO 8226-1:1994(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 8226-1 was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps,* Subcommittee SC 2, *Test methods and quality specifications for paper and board.*

This second edition cancels and replaces the first edition (ISO 8226-1: 1985), which has been technically revised.

ISO 8226 consists of the following parts, under the general title *Paper and board — Measurement of hygroexpansivity*:

— *Part 1: Hygroexpansivity up to a maximum relative humidity of* 68 %

— *Part 2: Hygroexpansivity up to a maximum relative humidity of* 86 %

Annex A forms an integral part of this part of ISO 8226. Annex B is for information only.

STANDARDSISO.COM : Click to view the full PDF of ISO 8226-1:1994

© ISO 1994

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

Introduction

Knowledge of the dimensional changes in paper and board to be expected when the ambient humidity changes is essential for accurate control of printing and similar processes. The change in dimensions, or hygroexpansivity, is due to stress relaxation of the constituent fibres and swelling or contraction of the fibres caused respectively by absorption or desorption of water. The proportion of the two mechanisms causing hygroexpansivity depends upon the upper limit of relative humidity. For the purposes of this part of ISO 8226, an upper limit of 68 % relative humidity is imposed to minimize the effects of stress relaxation on the hygroexpansivity.

Part 2 of this International Standard specifies a method for the determination of hygroexpansivity up to a maximum relative humidity of 86 %, a value at which stress relaxation may have a significant effect on hygroexpansivity.

STANDARDSISO.COM : Click to view the full PDF of ISO 8226-1:1994

This page intentionally left blank

STANDARDSISO.COM : Click to view the full PDF of ISO 8226-1:1994

Paper and board — Measurement of hygroexpansivity —

Part 1:
Hygroexpansivity up to a maximum relative humidity of 68 %

STANDARDSISO.COM : Click to view the full PDF of ISO 8226-1:1994

1 Scope

This part of ISO 8226 specifies a method for the determination of the hygroexpansivity of paper and board when subjected to a change in the relative humidity with which it is in equilibrium from (33 ± 2) % to (66 ± 2) %.

This method is applicable to paper and board generally.

It is not, however, suitable for crêpe papers and corrugated fibreboard.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 8226. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 8226 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 186:1994, *Paper and board — Sampling to determine average quality.*

ISO 187:1990, *Paper, board and pulps — Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples.*

ISO 536:—[1], *Paper and board — Determination of grammage.*

3 Definitions

For the purposes of this part of ISO 8226, the following definition applies.

3.1 hygroexpansivity: Change in length that occurs in a given length of paper or board when the relative humidity with which it is in equilibrium is raised from a specified lower relative humidity to a specified higher relative humidity.

The change in length is expressed as a percentage of the given length when the paper or board is in equilibrium with 50 % relative humidity.

NOTE 1 A contraction of the test piece is regarded as negative hygroexpansivity.

4 Principle

To ensure that all test pieces being tested are brought to the initial relative humidity from an immediate similar moisture level, this method includes a preliminary conditioning step at a very low relative humidity.

Preliminary conditioning of test pieces of paper or board at a specified temperature (preferably 23 °C ± 1 °C), under zero load and a relative humidity of (22 ± 3) % and then at relative humidities of (33 ± 2) % and (66 ± 2) %. Measurement of the change in length between the latter two relative humidities under a load appropriate to the grammage of the sample. The change in length is expressed as a percentage of the length measured at 50 % relative humidity.

1) To be published. (Revision of ISO 536:1976)

5 Apparatus and materials

5.1 Cabinet, with air circulation, capable of being maintained at one of the temperatures specified in ISO 187, preferably 23 °C ± 1 °C, and attaining the required relative humidities, measured as specified in 5.5, uniformly within the whole cabinet and within not more than 30 min.

NOTES

2 The cabinet should preferably be located in an environment controlled to a temperature of 23 °C ± 1 °C.

3 All cabinets, irrespective of the method of relative humidity generation, are subject to humidity variations within the cabinet unless exceptional care is taken to minimize temperature variations (temperature variations greater than 0,4 °C can be significant).

5.2 Saturated salt solutions (see annex A), to provide relative humidities of (22 ± 3) %, (33 ± 2) % and (66 ± 2) % as measured in accordance with 5.5.

NOTES

4 Other methods of generating the required relative humidity may be used provided equivalent accuracy is obtained.

5 The initial length (see 7.1) at 50 % relative humidity should be determined by maintaining the cabinet in a conditioned test room operating at the preferred atmosphere of ISO 187.

5.3 Clamps, upper and lower, or other means of suspending the test pieces vertically within the cabinet such that, when there is no load on the test piece, the distance between the inner clamping faces is a set value, known to within 1 mm (preferably 100 mm ± 1 mm). A means shall be provided for tensioning the test pieces with the known loads (see table 1), and releasing this tension without removing the loads and without opening the cabinet.

5.4 Loading weights, including the loads attributable to the mass of the clamps, for application to the test pieces during measurement (see table 1).

Table 1 — Test load

Sample grammage, g g/m²	**Total load** N/m	**Equivalent mass** (including clamp) g/15 mm
$g \leqslant 125$	15 ± 1	23 ± 1,5
$125 < g \leqslant 200$	30 ± 1	46 ± 1,5
$200 < g \leqslant 275$	50 ± 1	76 ± 1,5
$g > 275$	80 ± 1	122 ± 1,5

5.5 Means of measuring relative humidity (for example humidity probes) or the air in the cabinet (5.1) with a precision of ± 1 % (maximum error of reading) and an accuracy of ± 2 % (maximum departure from true relative humidity).

The measuring probe should be capable of detecting a change of 0,5 % relative humidity within 10 s, at the equilibrium relative humidity level.

NOTES

6 Care must be taken to ensure that the corrosive nature of the "salt mist" does not affect the performance of any humidity probe. It is recommended that probes be protected by a polytetrafluoroethylene (PTFE) screen or other suitable means.

7 All humidity probes require regular calibration, preferably by a nationally accredited laboratory. Calibration certificates normally quote the known error of the instrument. The known error should be used to correct the measured value.

5.6 Means for measuring the temperature in the cabinet (5.1).

5.7 Devices for measuring the length or change in length of the test pieces to the nearest 0,01 mm. These devices may be mechanical or electronic.

6 Sampling and preparation of test pieces

6.1 If a lot is being sampled, select the specimens to be tested in accordance with ISO 186.

6.2 From undamaged specimens free from watermarks, folds and wrinkles, cut five test pieces in the machine direction and/or five in the cross direction as required. Each test piece shall be at least 20 mm longer than the nominal free span between the clamps, and the minimum free span shall be 100 mm. The width of the test piece shall be at least 15 mm. For the determination of hygroexpansivity in the machine direction or in the cross direction, cut the test pieces with the longer side parallel to the relevant direction.

6.3 Determine the sample grammage, g, in accordance with ISO 536.

7 Test procedure

7.1 Initial length (l_0)

Set the clamps (5.3) inside the cabinet (5.1) to a span of at least 100 mm (known to within 1 mm). Clamp,

STANDARDSISO.COM : Click to view the full PDF of ISO 8226-1:1994

then condition the unloaded test pieces for at least 30 min at the selected temperature (see 5.1) and at a relative humidity of (50 ± 2) %. Gently apply the appropriate load in accordance with table 1 and note the readings on the length-measuring devices (5.7) to the nearest 1 mm. Record this length as (l_0).

7.2 Preliminary conditioning of test pieces

Condition the unloaded test pieces for at least 30 min at a relative humidity of (22 ± 3) %. Gently apply the appropriate load in accordance with table 1 and note the readings on the length-measuring devices. Remove the load and repeat the conditioning and measurement sequence until the length under load changes by no more than 0,02 % between readings.

NOTE 8 These readings are not used in the calculation.

7.3 Measurement of hygroexpansivity

Change the conditioning atmosphere to (33 ± 2) %, and record the relative humidity value obtained. Condition the unloaded test pieces for at least 30 min at a relative humidity of (33 ± 2) %. Gently apply the appropriate load in accordance with table 1 and note the readings on the length-measuring devices. Remove the load and repeat the conditioning and measurement until the length under load changes by no more than 0,01 mm. Record these lengths to the nearest 0,01 mm (l_{33}).

Condition the test pieces in the same way in an atmosphere having a relative humidity of (66 ± 2) %. Note the relative humidity value obtained. Record the new readings (l_{66}) of the test piece lengths to the nearest 0,01 mm.

8 Expression of results

Calculate the hygroexpansivity, X, expressed as a percentage, between 33 % and 66 % relative humidity, using the equation:

$$X = \frac{(l_{66} - l_{33}) \times 100}{l_0}$$

where

l_0 is the reading, in millimetres, on the length-measuring device, for the test piece under the appropriate load at a relative humidity of (50 ± 5) %;

l_{33} is the reading, in millimetres, on the length-measuring device, for the test piece under the appropriate load at a relative humidity of (33 ± 2) %;

l_{66} is the reading, in millimetres, on the length-measuring device, for the test piece under the appropriate load at a relative humidity of (66 ± 2) %.

Express the mean result to the nearest 0,05 % separately for the machine direction and/or cross direction as required.

Calculate also the standard deviation for the machine direction and/or cross direction respectively.

9 Precision

For test results, each of which consisted of the average of five determinations, the following precision data were obtained from an international cross-check involving six laboratories testing five papers.

9.1 Repeatability

The repeatability at the 95 % confidence level, for the difference between two test results obtained in a single laboratory, was between 0,02 % and 0,03 % for samples tested in the machine direction, and between 0,04 % and 0,06 % for samples tested in the cross direction.

NOTES

9 The range in repeatability values quoted is due to large differences between mean values of different paper samples.

10 All values for repeatability are percent absolute hygroexpansivity.

9.2 Reproducibility

There were insufficient data from different laboratories for reproducibility to be assessed accurately.

10 Test report

The test report shall include the following information:

a) a reference to this part of ISO 8226;

b) all information necessary for complete identification of the sample;

c) the date and place of testing;

d) the test span between the clamps at the start of the test;

e) the width of the test piece;

STANDARDSISO.COM : Click to view the full PDF of ISO 8226-1:1994

f) the mean value for the hygroexpansivity in the machine direction and/or cross direction;

g) the standard deviation for the machine direction and/or cross direction;

h) the measured values of temperatures and relative humidities used for the test;

i) any deviation from the requirements of this part of ISO 8226 and any incidents which may have affected the test results.

STANDARDSISO.COM : Click to view the full PDF of ISO 8226-1:1994

Annex A
(normative)

Preparation of salt solutions

At constant temperature, saturated salt solutions reach equilibrium with the amount of water vapour in the atmosphere in a closed container, thereby maintaining a constant relative humidity. Saturated salt solutions can absorb or give up large quantities of water without changing the equilibrium relative humidity, making them suitable for studies of water vapour absorption or desorption.

A wide range of relative humidity conditions can be obtained, using various salt solutions, as reviewed by Young[1].

Saturated salt solutions should be prepared from reagents of recognized analytical grade and distilled water or water of equivalent purity, since the presence of impurities may affect the equilibrium relative humidity. In most cases, the solution can be prepared by dissolving a quantity of the salt in excess of that required to saturate the solution, at a temperature slightly above the required testing temperature. Because certain salts can change their hydrated form, care should be taken to avoid dissolving at elevated temperatures.

The approximate solubility values at 23 °C and the relative humidities given by salts recommended for use in this part of ISO 8226 are listed in table A.1.

Table A.1 — Saturated salt solutions

Salt	Solubility g/l	Relative humidity %
Potassium acetate ($KC_2H_3O_2$)	2 620	22 ± 3
Magnesium chloride ($MgCl_2 \cdot 6H_2O$)	1 700	33 ± 2
Sodium nitrite ($NaNO_2$) [1)]	880	66 ± 2

1) WARNING — Sodium nitrite presents an explosion hazard if stored improperly. For safety, storage in polyethylene bottles is recommended.

STANDARDSISO.COM : Click to view the full PDF of ISO 8226-1:1994