INTERNATIONAL STANDARD

ISO 14968

First edition
1999-03-01

Paper and board — Cut-size office paper — Measurement of curl in a pack of sheets

Papier et carton — Papier en format à usage de bureau — Mesurage du tuilage dans un paquet de feuilles

Reference number
ISO 14968:1999(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 14968 was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*, Subcommittee SC 2, *Test methods and quality specifications for paper and board*.

Annexes A and B of this International Standard are for information only.

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet iso@iso.ch

Printed in Switzerland

Introduction

Curl in cut-size office papers plays an important part in the performance of these papers in copying processes. Frequently, cut-size papers are used on copier and other printing devices, operating at high speeds. Curl which exists in the ream before the paper enters the imaging process, and curl developed during the imaging process, can affect office paper performance, especially if two-sided printing or collating is involved. Common problems experienced include jamming and misregistration.

The experience used in developing this test method was limited to uncoated papers in the commonly used cut sizes. The technique is basic and could be used with coated papers as well as paperboard to identify the type and magnitude of curl.

The test method identifies the type and degree of curl in a pack of sheets but does not address variations that might be present in individual sheets. The method of ISO 11556 can be used to measure curl in individual sheets.

It should be recognized that the curl occurring after processing in a copier or a printing device may bear no relation to the curl of the paper as received.

Paper and board — Cut-size office paper — Measurement of curl in a pack of sheets

1 Scope

This International Standard specifies a method for the measurement of curl in cut-size office papers. The test method would typically be used in evaluating papers of the type described in ISO 216.

This method is limited to papers with a maximum dimension of 300 mm in both directions.

The measurement may be made on papers as received, after conditioning, or after processing in a copier or printing device.

2 Normative references

The following standards contains provisions which, through reference in the text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard 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 216:—[1)], *Writing paper and certain classes of printed matter — Trimmed sizes — A and B series.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1
curl
deviation from a flat surface which has three major components: magnitude, direction of curl axis and the side towards which the paper curls

1) To be published. (Revision of ISO 216:1975)

3.1.1
curl magnitude
quantitative measure of the deviation of a paper test piece from a flat surface

NOTE 1 It is expressed as the reciprocal of the radius of curvature, R, of the curled test piece with units of reciprocal metres (m^{-1}).

NOTE 2 The radius of curvature for the curled test piece is the distance from the arc to the centre of a circle, of which the arc forms a part. The reciprocal radius (R^{-1}) has a value of zero for a flat sheet.

NOTE 3 Curl characteristics of paper and board are time-dependent and the magnitude of any curl may be transient.

3.1.2
curl axis direction
direction of the curl axis of paper and board, characterized as follows:

— curl axis which is perpendicular to the paper's machine direction;

— curl axis which is parallel to the paper's machine direction;

— curl axis which is neither parallel nor perpendicular to the paper's machine direction.

NOTE See figures A.1 to A.3 respectively.

3.1.3
concave side
side towards which the paper or board curls

NOTE See also annex A.

3.2
double curl
form of curl which tends to alternate between the two sides, when the sheet is manipulated lightly

NOTE This tendency is a phenomenon which may be described as two curl patterns that are finely balanced within the same sheet of paper.

3.3
cut-size office papers
papers in the range 60 g/m^2 to 150 g/m^2 which are used for writing and/or in various printing and copying devices

3.4
reference side
for a non-imaged paper that side indicated by arrows on the end labels of a sealed ream, that side facing the top of a box of unwrapped sheets or, if arrows, or other instructions, are not present, that side facing the wrapper seam

4 Principle

A pack of approximately 10 to 15 sheets is taken from the sample to be tested and the magnitude of the curl is measured, noting the curl axis direction and the side towards which the paper curls.

5 Apparatus

5.1 curl gauge, consisting of a straight line 210 mm long and companion arcs at least 210 mm long of radii such that their curl magnitude varies between 1,00 m^{-1} and 10,00 m^{-1}. The construction of such a gauge is shown in annex B.

NOTE 1 Copies of the curl gauge made on a toner-imaging device should not be used because such a device frequently has a built-in enlargement which would change the dimensions of the arcs.

NOTE 2 It may be convenient to use a set of templates with their edges corresponding to the curl of magnitudes given in annex B. Each template should be labelled with its curl magnitude.

6 Test atmosphere

The purpose of this method is usually to test the inherent curl of the paper at the moisture content that it has immediately following its removal from a ream, or after processing in a copier or other printing device.

In this case the paper shall not be conditioned in a standard atmosphere. The actual testing may be carried out either in the standard atmosphere described in ISO 187, or under the measured ambient conditions of the area surrounding the imaging device.

7 Sampling

7.1 If tests are being made to evaluate a lot, the sample shall be selected in accordance with ISO 186:1994, 5.1.

7.2 For the purposes of this International Standard, a test piece is understood to be a pack of 10 to 15 consecutive sheets.

7.3 When taking paper from unopened packages, open the package, pull out 10 to 15 consecutive sheets and make the measurement, in accordance with the procedure (clause 8). To ensure that only samples which have experienced minimum exposure to the atmosphere are selected, do not pull sheets from near the top or bottom of the pack.

7.4 When taking paper from stacks that are not wrapped, pull 10 to 15 sheets from some distance down the stack so as to avoid paper that has been exposed to the atmosphere. Make the measurement, in accordance with the procedure (clause 8) without delay.

7.5 Identify the machine direction and referenced side of the paper.

NOTE 1 The referenced side is the side that should be imaged first.

NOTE 2 If the machine direction (MD) is unknown, it may be determined by reference to the Bibliography.

7.6 When sampling paper after copying or from a printing device, allow at least 2 min of continuous operation for a stack to build and then pull out 10 to 15 sheets from the machine and make the measurement in accordance with clause 8 without delay. Do not pull sheets from the top or bottom of the printed stack.

8 Procedure

8.1 It is recommended that the curl for all four edges be measured, except when there is a very dominant curl with axis parallel or perpendicular to the paper's machine direction. In this case only the curl of the two short or two long edges needs to be measured. The procedure that follows applies to all four edges of the test piece. If no dominant curl is apparent, begin at any of the four edges.

8.2 Select the test piece in accordance with 7.3, 7.4 or 7.6.

8.3 Hold the test piece on one edge vertically between the thumb and forefinger at mid-height, about 10 mm from the edge. Immediately superimpose the opposite free edge without contact over the curl gauge arcs and read the radius of curvature for whichever arc is the nearest match to the test piece.

NOTE In the event of a diagonal curl, a more accurate estimate of the curl magnitude can be obtained if the test piece is suspended at such a point on its edge that the curl axis is vertical. Using a set of templates as suggested in note 2 of 5.1 will facilitate this measurement.

8.4 For non-processed test pieces, record the side towards which the paper curls, that is, towards or away from the referenced side. For test pieces processed through a copier or other printing device, record whether the test piece curls towards or away from the last imaged side.

NOTE For determining curl after copying or processing through a printing device: if there is significant splaying in the pack of sheets, such that no single curl value can be measured, it is probable that the copier or printer has not reached a satisfactory operating temperature. In this case it is advisable to rerun the test after feeding at least 100 copies through the machine before pulling out the test sheets.

8.5 Note and record the dominant direction of the curl axis as parallel to, or perpendicular to the machine direction. Note if there is any evidence for a diagonal curl.

NOTE In the case of a significant diagonal curl, the results shall be interpreted with caution.

8.6 Record the presence of any double curl.

9 Expression of results

9.1 Dominant curl axis — parallel to, or perpendicular to the machine direction axis

Calculate the mean of the two measured edges, in reciprocal metres.

9.2 No dominant curl

Report all four measured edges separately, in reciprocal metres.

NOTE In this case the highest curl value and curl direction may be highlighted.

9.3 Concave side

Report the side to which the paper curls, that is, towards or away from the referenced side.

10 Precision

Eight curl measurements carried out in accordance with this International Standard, on each of four reams of different qualities of cut-size office papers, produced results which ranged between $\pm 0{,}25\ m^{-1}$ and $\pm 0{,}375\ m^{-1}$ around the mean for each ream. No data are available to assess reproducibility between laboratories at this time.

11 Test report

The test report shall include the following information:

a) reference to this International Standard;

b) date and place of testing;

c) full identification of the paper sample as to grade, type, grammage, dimensions, and any other pertinent information;

d) the number of sheets in each test piece (pack);

e) the ambient test atmosphere and conditioning time, where appropriate;

f) details of image, full identification of any imaging device used (trade name or brand name, type) and the feeding direction of the paper;

g) for each test piece and each direction of curl, the curl magnitude and side towards which the test piece curls as described in clause 9;

h) any double curl tendency;

i) for test pieces that have been imaged, in addition to the information required in g), the side imaged or, in the case of two-sided imaging, the side imaged first;

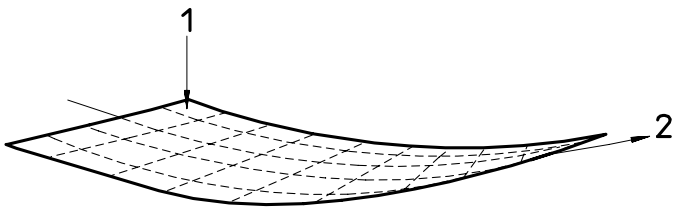
j) any significant amount of diagonal curl;

k) any departure from this International Standard or any circumstances that may have affected the results.

Annex A
(informative)

Types of curl

If a symmetrical curl occurs, depending on the dimensions of the test piece and the test properties, the following types of curl may occur.

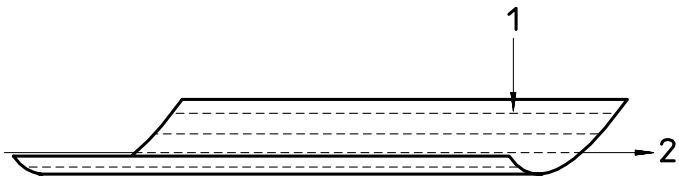


Key

1 Referenced side

2 Machine direction

Figure A.1 — Referenced side curl, with axis perpendicular to machine direction

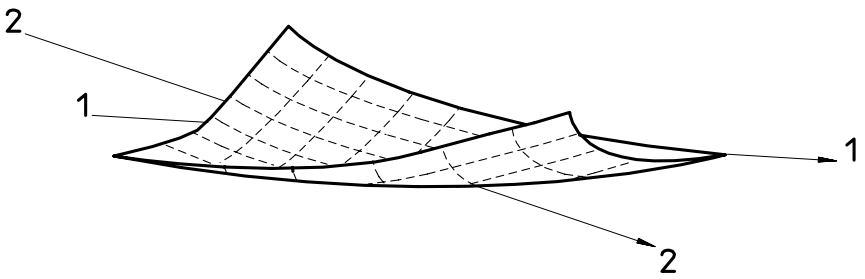


Key

1 Referenced side

2 Machine direction

Figure A.2 — Referenced side curl, with axis parallel to machine direction



Key

1 Curl axis

2 Machine direction

Figure A.3 — Referenced side, diagonal curl

Annex B
(informative)

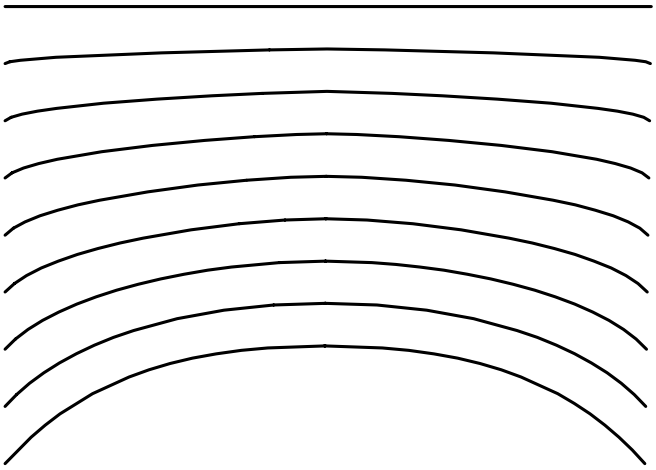
Curl gauge construction

A curl gauge can be constructed by drawing on a sheet of suitable size paper a series of arcs of specified radii with their centres of curvature aligned parallel to the side with the smaller dimension. The arcs should be at least 210 mm long, separated vertically with the largest radius at the top of the sheet and the smallest at the bottom. It is suggested that a distance of 12 mm be kept between the centre of each arc.

The radii of the arcs (mm) and the curl magnitudes (m^{-1}) to which they correspond are given in table B.1. Each arc should be labelled with its curl magnitude. A diagram representing a typical gauge is shown in figure B.1.

Table B.1 — Radii of arcs and corresponding curl magnitudes

Radius of arc R mm	**Curl magnitude** R^{-1} m^{-1}
∞	0
1 000	1,00
800	1,25
667	1,50
571	1,75
500	2,00
444	2,25
400	2,50
364	2,75
333	3,00
285	3,50
250	4,00
222	4,50
200	5,00
154	6,50
100	10,00



NOTE 1 Illustration only — not to scale and not to be enlarged.

NOTE 2 Copies of the curl gauge made on a toner imaging device should not be used because such a device frequently has a built-in enlargement which would change the dimensions of the arcs.

Figure B.1 — Curl gauge

Bibliography

[1] ISO 11556:— [2], *Paper and board — Determination of curl using a single vertically suspended test piece.*

[2] TAPPI 2409, *Machine direction of paper and paper board*.

[3] CPPA standard D1, *Machine direction of paper and paper board*.

[4] SCAN P9, *Paper and board — Identification of machine and cross direction*.

2) To be published.

ICS 85.060

Price based on 8 pages