INTERNATIONAL STANDARD

ISO 15755

First edition
1999-06-15

Paper and board — Estimation of contraries

Papiers et cartons — Estimation des défauts

Reference number
ISO 15755:1999(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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 15755 was prepared by the European Committee for Standardization (CEN) in collaboration with ISO Technical Committee TC 6, *Paper, board and pulps*, Subcommittee SC 2, *Test methods and quality specifications for paper and board*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this standard, read "...this European Standard..." to mean "...this International Standard...".

Annexes A and B form a normative part of this International Standard. Annex C is for information only.

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

Printed in Switzerland

Content

Foreword

The text of EN ISO 15755:1999 has been prepared by Technical Committee CEN/TC 172 "Pulp, paper and board", the secretariat of which is held by DIN, in collaboration with Technical Committee ISO/TC 6 "Paper, board and pulps".

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 1999, and conflicting national standards shall be withdrawn at the latest by December 1999.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This European Standard is based on a visual inspection, and a normative Annex B is added where the inspection is perfomed using instrumental devices. This is justified by the present state of instrument development. For the time being, the visual procedure is the foremost European Standard. This can eventually be changed when more experience with instrumental devices is gained and it has been shown that such equipment can estimate contraries to a level of precision at least equal to visual inspection.

Estimation of dirt and shives by a visual technique is a well established method in the pulp and paper industry and the estimation of these contraries is important for trade purposes.

1 Scope

This European Standard specifies the test method for the estimation by reflected light of the visible contraries in paper. Visual inspection is applicable to most kinds of paper and board.

Paper and board with an apparently high content of contraries require to be inspected by instrumental means as described in Annex B, as the tedium of large counts diminishes the judges' precision.

However, papers which are not flat, have a low lightness (Y value below 30 %) and contain holes may cause particular problems for instrumental techniques (see Annex B). Fluorescent spots will not be detected by the methods described in this European Standard.

2 Normative References

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN ISO 186
Paper and board – Sampling to determine average quality (ISO 186 : 1994)

3 Definitions

For the purposes of this Standard, the following definitions apply:

3.1 sheet: a sheet of paper or board taken from a packet, bale or roll of paper.

3.2 test piece: an area recognized for inspection.

3.3 contrary (in paper or board): any unwanted particle or spot of specified minimum size and having a sufficiently contrasting light reflectance with respect to the surrounding area of the sheet, according to the comparison chart in Annex A (see figure A.1).

NOTE: A contrary can include any blemish on the paper surface.

4 Principle

The test pieces to be examined have to be inspected in reflected light. The area of each contrary larger than a specified value and showing contrasting light reflectance with respect to the surrounding area of the sheet, according to the comparison chart presented in Annex A has to be estimated. The areas of the contraries are added and the total area of contraries is reported as square millimetre per square meter of paper (mm^2/m^2).

If required, the areas of contraries in different classes can also be reported.

5 Apparatus

5.1 Illumination device: a suitable light source for investigation of the paper in reflected light. The light shall be strong enough to ensure that all contraries having the minimum area agreed upon (see subclause 7.2) are visible. Natural daylight or direct light from any external source shall be avoided.

5.2 Comparison chart: a film with a series of black and grey spots of different shapes, areas and contrasts. This shall be used for visual inspection and for checking the performance of an instrument. The chart is included in Annex A of this European Standard.

Do not use the illustration in Annex A, or any copy thereof in any inspection, because reproduction can change the size and the contrast of the spots.

6 Preparation of sample

6.1 Sampling

If the dirt count is to represent the contraries in a lot of paper, the number of samples to be inspected and the method of selecting them shall be in accordance with EN ISO 186.

For minimum size of sample see 6.2.

6.2 Selection of areas for inspection

Identify a number of areas (test pieces) randomly distributed over the different parts and equally representing both sides of the samples. The total area to be inspected is such, as to allow for the counting of at least 300 contraries. However, if very few contraries can be found, as in a very clean paper, the area to be inspected need not exceed 3 m^2.

However, the judgement on a lot of paper or board shall be based on not less than 1000 contraries or 10 m^2 of paper or board.

NOTE 1: The above number of contraries are arrived at by accepting a relative error of 10% at a confidence level of 90% [1].

NOTE 2: The contraries are likely to be unevenly distributed in the paper and the result can vary considerably depending on how the test areas are selected. It is important that these areas are randomly distributed over the whole sample if this is larger than the minimum size indicated above.

NOTE 3: In some cases only one side of the sample is inspected. This should be stated in the test report.

7 Procedure

7.1 Examination

Examine the test pieces (6.2) visually to determine the area of the contraries. Use the comparison chart in Annex A. Normally, only contraries having an area of at least 0,04 mm^2 shall be noted.

Classify the contraries according to their area (see table 1).

Do not count any atypical, non-representative piece of dirt, such as a crushed insect or a blotch of dirt, but report it together with the result. Do not count fluorescent spots.

NOTE: On request, the size of contraries of different types can be noted separately, as for example plastics, dirt, shives etc.

7.2 Classification of contraries

It is usual to report only the total area, though when required the contrary area in each class can be reported. In this case the classification given in table 1 shall be used. Size class 6 is used only by special agreement and this shall be stated in the test report.

Table 1: Recommended classification of contraries according to area

Size class	Area mm²	Logarithmic mean area mm²
1	above 5	-
2	1,00 to 4,99	2,234
3	0,40 to 0,99	0,629
4	0,15 to 0,39	0,242
5	0,04 to 0,14	0,075
6	0,01 to 0,03	0,017

NOTE: The number of classes used can be varied to some degree depending on the grade of paper or board tested and agreement between the parties concerned.

8 Expression of results

8.1 Calculation

For all contraries calculate the total area, or the area in each size class (see table 1), according to the formula:

$$X = \Sigma \frac{c_i n_i}{b} \quad (1)$$

where

X is the total area of contraries (or of the contraries in each size class per area of paper), expressed in square millimetres per square meter;
c_i is the logarithmic mean area of each class, as reported in table 1, expressed in square millimetres;
n_i is the number of contraries in the class;
b is the area of the inspected sample, expressed in square metres.

For contraries exceeding 5 mm² $c_i n_i$ must be replaced by the contraries' true area, which shall be evaluated separately for each contrary and stated in the test report.

NOTE: The logarithmic mean area of a class is justified, as there is a tendency towards enrichment of contraries towards the lower limit of the class.

EXAMPLE

If 8 contraries are counted within the size class 0,15 to 0,39, their area $c_i \cdot n_i$ is calculated as follows:

$8 \times 0{,}242\ \text{mm}^2 = 1{,}9\ \text{mm}^2$ (see table 1).

8.2 Results

Report the total area of contraries per area of paper to the nearest integer. Results below 5 mm^2/m^2 shall be reported to one decimal place.

NOTE: On request, the result can be expressed separately for each size class. However, categories containing few contraries will be subject to much higher sampling uncertainty.

8.3 Precision

It is difficult to obtain exact precision data for a visual dirt count because of the subjective nature of the test method. It is an established fact that the reproducibility is unsatisfactory because of differences in personal judgement.

Five laboratories tested 16 paper samples visually. The coefficient of variation between the laboratories was found to vary from 62 % to 99 %, the mean value being 82 %.

9 Test report

The test report shall refer to this European Standard and state:

a) all information necessary for complete identification of the sample or lot;

b) the result expressed in square millimetres per square metre of paper or board. On request, the result can be divided into classes according to size or type;

c) the area of paper inspected in square metres;

d) whether the result is based on a visual or an instrumental inspection;

e) any optional points observed in the course of the test;

f) any departure from this European Standard, or any circumstances regarded as optional that may have affected the result.

(Blank page)

Annex A (normative)

Comparison chart

Use the chart here enclosed.

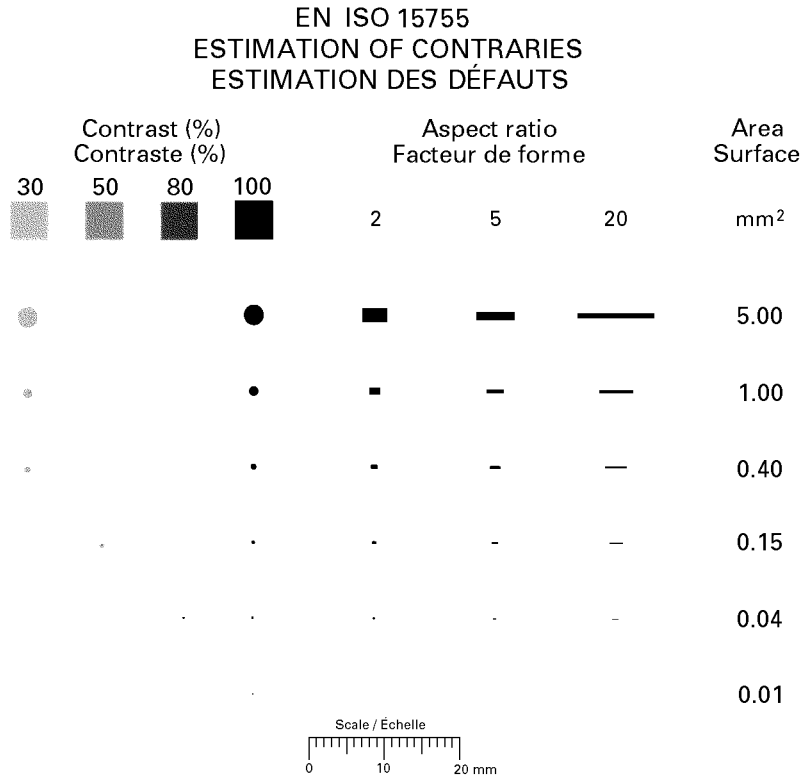

Figure A.1: EN ISO 15755 Paper and Board - Estimation of contraries, Comparison chart

The left part of the chart is intended for checking of an instrumental device and as an aid for visual inspection. The spots having the minimum contrast to be considered in each size class are indicated, i. e. 30 %, 50 % and 80 % minimum contrast for contraries equal to or larger than respectively 0,40 mm²; 0,15 mm² and 0,04 mm².

The spots on the right hand indicate contraries of different aspect ratios. The contrast ratio is 100 %. This part of the chart is to be used as an aid for size classification.

Copies of this International Standard printed by ISO include a comparison chart reproduced on transparent film (see 5.2). Users having only an electronic copy, or a printed copy reproduced from an electronic copy, may obtain an original transparent film comparison chart from the ISO Central Secretariat (price code: A).

Annex B (normative)

Instrumental procedure

B.1 Introduction

Instruments are commonly used for inspection of contraries in paper. Such techniques are preferably used for papers with a high number of contraries. However, it should be noted that results obtained by visual inspection may not be equivalent to those found by instrumental methods.

B.2 Scope

This Annex of this European Standard is not directly applicable to inspection of light contraries on paper of low brightness. For inspection of transparent paper or board with holes use a clean, white backing sheet.

B.3 Equipment

B.3.1 An instrumental dirt counting device, including a light source suitable for inspection by reflected light and so constructed that the contraries having areas and contrasts corresponding to table 1 and table B.1 can be evaluated, counted and reported. The repeatability of the device shall fulfil the requirement that the coefficient of variation does not exceed 15% when a test area is inspected five times. The angular distribution of illumination should be such as to minimize the background reflectance variation caused by surface shadowing and gloss mottle.

NOTE: It is recommended that the instrument exhibits a minimum pixel size of 0,01 mm² and a minimum grey-scale resolution of ½ % reflectance.

B.3.2 Comparison chart for instrumental dirt count. A chart with a series of spots of different areas and contrasts. The contrasts are given in table B.1. This chart shall be used for checking the instrument. Further information is given in Annex A.

B.4 Procedure

Follow the principles outlined in the normative part of this European Standard. Apply the instructions provided by the manufacturer of the apparatus.

Check the instrument regularly by the use of the comparison chart. Place the chart on a white, even tile or sheet of paper. All the contraries in the actual classes indicated on the comparison chart shall be noted by the instrument. If this is not the case, adjust the instrument, if possible, or contact the manufacturer.

NOTE: The instruments are usually equipped with means for automatic calculation of the result, based on the contraries' true area. In this case, it is not necessary to use the logarithmic mean areas of the size classes.

B.5 Classification of contraries

B.5.1 Size and nature

Follow the recommendations given in 7.2.

B.5.2 Contrast

The parameter used to measure the difference in light intensity between a foreign particle and its background is called contrast. This is derived from the ratio of the intensity of the light reflected by the particle compared to the intensity of the light reflected by the surrounding paper according to formula B.1. The darker the particle compared to its surrounds, the higher is the contrast.

$$C = 1 - \frac{T_{pa}}{T_{su}} \quad \text{(B.1)}$$

where

C is the contrast;
T_{pa} is the reflectance of the particle;
T_{su} is the reflectometer of the surrounding area.

NOTE: It is recommended that the surrounding paper in this respect is regarded as the clean surface extending 1 mm out from the periphery of the contrary.

The contrast needed to make a contrary visible depends on the size of the contrary; small spots are visible only if they have a high contrast to the surrounding paper, whereas large spots are visible at low contrast. Therefore one single contrast cannot be specified as a limit. Table B.1 gives the minimum contrasts to be applied.

For the purpose of this European Standard the contrast values, which are derived from the optical intensity and density values, are so formulated that a value of zero is obtained when the intensities of the light reflected from the contrary and the surrounding paper are equal.

Table B.1 Minimum contrast values for different size classes

Size class	Minimum contrast %
1	30
2	30
3	30
4	50
5	80
6	100

B.6 Precision

Exact figures for repeatability and reproducibility of this European Standard cannot be stated as there is only limited experience of instruments calibrated according to a standard. Some general information is found in the literature [2] and [3] (see Annex C).

Annex C (informative)

Bibliography

[1] Klein, R. et al.: Image analysis - An effective tool for quality assessment of secondary fibre furnishes and recovered papers. Progress in Paper Recycling, 4:4 (1995), Page 35 to 48.

[2] Jordan, B.D., Nguyen, N.G., Bidmade, M.L.: Dirt counting with image analysis. Pulp Paper Can. 84:6 (1983), TR Page 60 to 64.

[3] Klungness, J.H., Fernandez, L.E., Plantinga, P.L.: Image analysis for measuring adhesive contaminants in pulp. Tappi J. 72:1 (1989), Page 89 to 93.

ICS 85.040

Price based on 9 pages