INTERNATIONAL STANDARD

ISO 5350-2

Third edition
2006-08-15

Pulps — Estimation of dirt and shives —

Part 2: Inspection of mill sheeted pulp by transmitted light

Pâtes — Estimation des impuretés et bûchettes —

Partie 2: Examen des pâtes en feuilles par lumière transmise

Reference number
ISO 5350-2:2006(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

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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 2.

The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 5350-2 was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*, Subcommittee SC 5, *Test methods and quality specifications for pulps*.

This third edition cancels and replaces the second edition (ISO 5350-2:1998, ISO 5350-2:1998/Cor.1:1999), which has been technically revised.

With regard to ISO 5350-2:1998 and Technical Corrigendum 1:1999, the following changes have been made:

a) a note for problems concerning thick sheets has been added to the scope;

b) a more precise description of the instrumental procedure in informative Annex B was given;

c) editorial updating.

ISO 5350 consists of the following parts, under the general title *Pulps — Estimation of dirt and shives*:

— *Part 1: Inspection of laboratory sheets by transmitted light*

— *Part 2: Inspection of mill sheeted pulp by transmitted light*

— *Part 3: Visual inspection by reflected light using Equivalent Black Area (EBA) method*

— *Part 4: Instrumental inspection by reflected light using Equivalent Black Area (EBA) method*

Introduction

This part of ISO 5350 is based upon visual inspection. Informative Annex B is used when the inspection is performed by instrumental devices. For the time being, though, visual inspection provides the basis for this part of ISO 5350. This will eventually be changed when more experience with instrumental devices is gained, and it has been shown that such equipment can estimate dirt and shives to an acceptable 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.

This part of ISO 5350 is complementary to ISO 5350-1, which concerns visual inspection of laboratory sheets by transmitted light, and ISO 5350-3, which concerns visual inspection by reflected light.

ISO 5350-4 is based on automatic inspection by reflected light.

Pulps — Estimation of dirt and shives —

Part 2:
Inspection of mill sheeted pulp by transmitted light

1 Scope

This part of ISO 5350 specifies a method for the estimation by transmitted light of the visible dirt and shives in pulp manufactured in sheets.

It does not apply to unbleached kraft pulps or to any other sheeted pulps that are too opaque to allow for the estimation of the minimum size or for minimum contrast specks to be counted, in accordance with this part of ISO 5350. The maximum grammage for most pulp sheets is in the range 800 g/m^2 to 1 000 g/m^2.

If the sheets of the mill sheeted pulp have high grammage or are very opaque for other reasons, ISO 5350-1 should be applied.

NOTE For thick sheets, with highly textured surfaces and/or with density variations, wetting the sheet will cause optical variations, called lens distortions, that will distort the perceived size of a dirt speck, thus reducing the precision of the size estimation. Alternatively, use ISO 5350-1 to disintegrate the sheet and to prepare laboratory sheets for the size estimation.

This part of ISO 5350 is not intended for recycled pulp.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 638, *Pulps — Determination of dry matter content*

ISO 7213, *Pulps — Sampling for testing*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
sheet
a sheet of pulp taken from a bale, or a part of a roll of pulp

3.2
test piece
an area taken for inspection

3.3
contrary in pulp
any unwanted particle, of specified minimum size and having a contrasting colour or opacity with respect to the surrounding area of the sheet, according to the comparison chart given in Annex A

3.3.1
dirt
any non-fibrous contrary

3.3.2
shive
sliver of wood, or fibre bundle

4 Principle

The test pieces to be examined are inspected in transmitted light. The area of all contraries larger than a specified value and showing contrasting opacity, with respect to the surrounding area of the test piece according to the comparison chart given in Annex A, is estimated. The estimated areas of the contraries are added, and the total area of dirt and shives is reported as square millimetres per kilogram of oven-dry pulp (mm^2/kg).

NOTE If required, the areas of dirt and shives in different classes can also be reported.

5 Apparatus

5.1 Viewing table, with an illumination device suitable for inspecting the test pieces in transmitted artificial daylight. The luminance, as measured at the surface of the viewing table, shall be 2 500 cd/m^2 to 3 000 cd/m^2. Daylight or direct light from any external source should be avoided.

NOTE The luminance can be measured by a luminance meter.

5.2 Comparison chart: a transparent film with a series of black and grey spots of different shapes, areas and contrasts. This shall be used for visual inspection or for calibration of an instrumental device. The chart is provided in normative Annex A.

Do not use a photocopy of the chart in any inspection, because reproduction may change the size and contrast of the spots.

6 Sampling and preparation of test pieces

6.1 Sampling

If the test is being made to evaluate a pulp lot, the sample shall be selected in accordance with ISO 7213. If the test is made on another type of sample, report the source of the sample and, if possible, the sampling procedure used. From the sample received, select test pieces so that they are representative of the whole sample.

6.2 Selection of test pieces for inspection

In order to ensure that the results are representative of the sample received, take a number of test pieces evenly distributed over the different parts of the sheet, so that the total mass to be inspected is at least 300 g, the total area being not less than 0,5 m^2.

NOTE The specks may be unevenly distributed in the sheet and the result can vary considerably depending upon how the test pieces to be inspected are selected. It is important that the test pieces for inspection are distributed over the whole sheet if the sheet is larger than 300 g.

It is very time consuming to examine a pulp with a very high dirt count. If a preliminary test shows that the number of contraries exceeds 300 per kilogram of oven-dry pulp, the amount to be inspected can be reduced to 100 g of oven-dry pulp. This shall be reported with the results.

7 Procedure

7.1 Determination of dry matter content

Determine the dry matter content of the test pieces in accordance with ISO 638.

7.2 Wetting of the test pieces

Wet the test pieces evenly in order to make them transparent. Wetting of the test pieces may be omitted if the test pieces are transparent enough to ensure that all contraries are visible, but omission of the wetting procedure shall be reported together with the results.

Even with wetting of the test piece, the opacity of the pulp sheet may not allow for all of the contraries to be counted. To ensure that all contraries are visible, mark a small contrary at the surface of the sheet and check the visibility of this contrary when viewing the sheet from the other side.

7.3 Examination

Examine the test pieces (6.2) visually using the viewing table (5.1). Use the comparison chart in Annex A as an aid to estimate the area of each speck. Only contraries having an area of $\geqslant$ 0,04 mm^2 shall be noted. Size class 5 can be omitted, if agreed upon.

Classify the contraries according to their area (see Table 1). Distinguish between dirt and shives, if required. Ensure that no contraries are counted twice.

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

7.4 Classification of contraries

It is usual to report only the total area of contraries, although 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 5 can be omitted, if agreed upon, but this shall be stated in the test report.

Table 1 — Recommended classification of contraries according to area

Size class	**Area** mm^2	**Logarithmic mean area** $[(A_{max}-A_{min})/\ln(A_{max}/A_{min})]$ mm^2
1	above 5	—
2	1,00 to 4,99	2,482
3	0,40 to 0,99	0,651
4	0,15 to 0,39	0,251
5	0,04 to 0,14	0,080

Dirt and shives may be reported separately by agreement.

8 Expression of results

8.1 Calculation

For all contraries (or separately as dirt and shives, if required) calculate the total area, or the area in each size class according to Formula (1):

$$X = \sum \frac{c_i n_i}{m} \quad (1)$$

where

X is the total area of contraries (or the area of the contraries in each class), expressed in square millimetres per kilogram (mm^2/kg);

c_i is the logarithmic mean area of the size class, indicated in Table 1, expressed in square millimetres (mm^2);

n_i is the number of contraries in the size class;

m is the oven-dry mass of the test pieces, expressed in kilograms (kg).

The logarithmic mean areas are given in Table 1.

For contraries exceeding 5 mm^2, the factor $c_i n_i$ is 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 mm^2 to 0,39 mm^2, their area $c_i n_i$ is calculated as follows:

$$8 \times 0,251\ mm^2 = 2,0\ mm^2$$

8.2 Results

Report the total area of contraries, in square millimetres per kilogram of pulp, to the nearest integer. Results below 5 mm^2/kg shall be reported to one decimal place.

NOTE On request, the results can be expressed separately for each size class, or separately for dirt and shives. However, if the count is reported by categories, the categories containing few contraries will be subjected to a much higher sampling uncertainty.

8.3 Precision

No exact figures concerning the precision can be given. The precision data varies from case to case because of the subjective nature of the test method. The results depend very much on the observer and on the sample. However, five laboratories, by circulating three sets of pulp sheets, found coefficients of variation between 17 % and 61 % with a mean of 49 %. The mean area of the contraries was 36 mm^2/kg.

9 Test report

The test report shall include the following information:

a) a reference to this part of ISO 5350;

b) the date and place of testing;

c) all information needed for complete identification and description of the sample;

d) the results, expressed in square millimetres of contraries per kilogram of oven-dry pulp; on request, the result can be divided into classes according to size and/or nature, i.e. dirt or shive;

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

f) any operations not specified in this part of ISO 5350 or in the International Standards to which reference is made or regarded as optional, which might have affected the results.

Annex A
(normative)

Comparison chart

Use the chart enclosed.

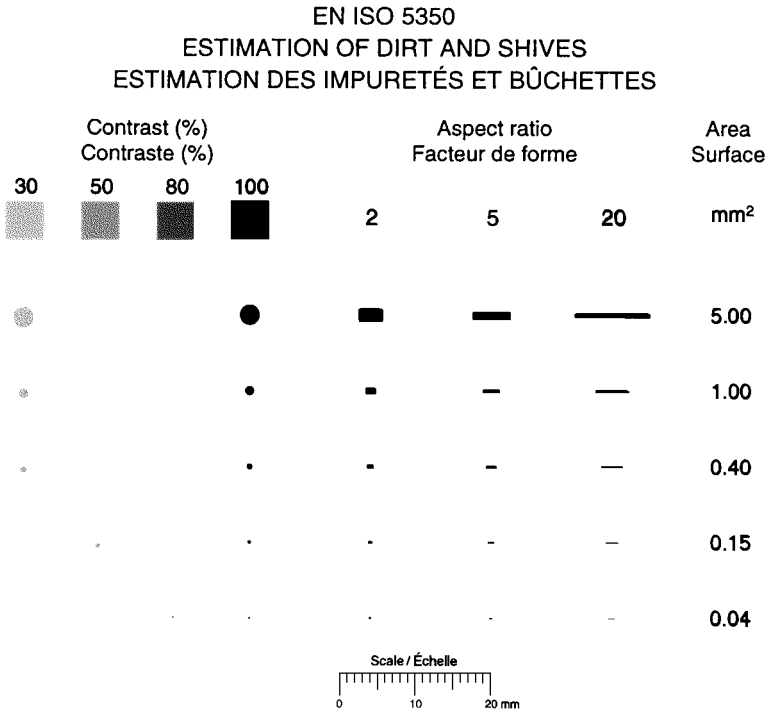

Figure A.1 — Estimation of particle size – Comparison chart

Do not use a photocopy of the chart in any inspection, because reproduction may change the sizes and contrasts of the spots.

The left part of the chart is intended as an aid for visual inspection. The spots having the minimum contrast to be considered in each size class are indicated, i.e. 30 % and 50 % minimum contrast for contraries equal to or larger than 0,40 mm^2 and 0,15 mm^2, respectively.

The spots on the right-hand side 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.

NOTE On this comparison chart, a dot is used as the decimal sign.

Copies of this part of ISO 5350 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
(informative)

Instrumental procedure

B.1 Introduction

In the future, instruments will commonly be used for the inspection of contraries in pulp. Such techniques are preferably used for pulps 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 test methods.

B.2 Equipment

B.2.1 An instrumental dirt-counting device, including a light source suitable for inspection by transmission, constructed so that the contraries having areas and contrasts corresponding to Table 1 and Table B.1 can be counted and reported. The light source spectrum must be in the visible part of the spectrum, with 95 % of the radiation occurring between 380 nm and 740 nm. The illuminant spectrum and detector spectral sensitivity must match (References [1] and [2] in the Bibliography). The repeatability of the device shall fulfil the requirement that the coefficient of variation does not exceed 15 % when a test piece is inspected five times. The device shall be able to identify contraries of an aspect ratio exceeding 3:1, if shives are to be reported separately.

It is recommended that the instrument exhibit a maximum pixel size of 0,01 mm^2 and a minimum grey-scale resolution of 1/2 % transmittance, and that the detection threshold is uniformly set at 10 % contrast. Measure the light transmission of the surrounding area, T_{su}, of 1 mm^2 or equal to twice the area of the particle outside the dirt particle, whichever is greater.

B.2.2 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 calibration of an instrumental device. This chart is found in Annex A.

B.3 Procedure

Follow the principles outlined in the main text and Annex A of this part of ISO 5350. 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.

All contraries having an aspect ratio exceeding 3:1 are reported as “shives” by the apparatus. Make sure, by visual inspection, that these “shives” are fibrous and the classification is justified.

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

B.4 Classification of contraries

B.4.1 Size and nature

Follow the recommendations given in 7.4.

In instrumental inspection, a fibrous contrary is considered as a shive when it has an aspect ratio exceeding 3:1.

The aspect ratio is the ratio of length to width, e.g. of maximum dimension to minimum dimension.

B.4.2 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 transmitted through the particle compared to the intensity of the light transmitted through the surrounding pulp according to Formula (B.1):

$$C = 100 \times \left(1 - \frac{T_{pa}}{T_{su}}\right) \tag{B.1}$$

where

C is the contrast;

T_{pa} is the transmission of the particle;

T_{su} is the transmission of the surrounding area.

The darker the particle compared to its surrounds, the higher is the contrast.

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 pulp, whereas large spots are visible at low contrast). Therefore, one single contrast cannot be specified as a limit. Table B.1 gives the minimum contrast values to be applied.

For the purpose of this part of ISO 5350, 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 transmitted through the contrary and the surrounding pulp 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

B.5 Precision

No values are available on reproducibility, but in an investigation made with one apparatus a coefficient of variation of about 10 % was obtained, when the same sample was examined five times. The mean value was 13 mm^2/kg. In another test, with the same instrument, the coefficient of variation was 3 %. This time the mean value was 33 mm^2/kg. However, the repeatability depends on the equipment used.

B.6 Comparison of values obtained by an instrumental device and by visual inspection

34 specimens were inspected visually and by the use of an instrument. The amount of contraries varied from less than 1 mm^2/kg to 34 mm^2/kg. The resulting correlation coefficient was 0,75.

Bibliography

[1] PAPTAC Useful Method D30.U, *Basic Guidelines for Image Analysis Measurements*

[2] Tappi Technical Information Paper TIP 0804-09, *Basic Guidelines for Image Analysis Measurements*

ICS 85.040

Price based on 11 pages