INTERNATIONAL STANDARD

**ISO 5350-3**

Second edition
2007-12-01

# Pulps — Estimation of dirt and shives —

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

*Pâtes — Estimation des impuretés et bûchettes —*

*Partie 3: Examen visuel par lumière réfléchie utilisant la méthode de la surface noire équivalente (méthode EBA)*

Reference number
ISO 5350-3:2007(E)

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# Contents

Page

# 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 5350-3 was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*, Subcommittee SC 5, *Test methods and quality specifications for pulps*.

This second edition cancels and replaces the first edition (ISO 5350-3:1997), which has been technically revised. This edition is based on TAPPI T 213 om-01.

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 complementary to ISO 5350-1, which concerns visual inspection of laboratory sheets by transmitted light and ISO 5350-2, which concerns visual inspection of mill sheets by transmitted light.

This part of ISO 5350 is based on visual inspection by reflected light using the Equivalent Black Area (EBA) method. ISO 5350-4 is based on automatic inspection by reflected light using EBA.

# Pulps — Estimation of dirt and shives —

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

## 1 Scope

This part of ISO 5350 specifies a procedure for the estimation of the visible dirt and shives by reflected light using the Equivalent Black Area (EBA) method in pulps. It is, in principle, applicable to all types of dry or wet pulp, manufactured in sheets or rolls, including recycled pulp.

NOTE The result of inspection by reflected light represents only the number of specks visible on the surface or near the surface of the pulp sheet. Particles which are embedded in the sheet cannot be detected.

## 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 5269-1, *Pulps — Preparation of laboratory sheets for physical testing — Part 1: Conventional sheet-former method*

ISO 5269-2, *Pulps — Preparation of laboratory sheets for physical testing — Part 2: Rapid-Köthen method*

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

**3.2**
**test piece**
area taken for inspection

**3.3**
**laboratory sheet**
sheet formed from disintegrated pulp

**3.4**
**contrary in pulp**
any unwanted particle, of specified minimum size and having a contrasting colour with respect to the surrounding area of the sheet, according to the comparison chart given in Annex A

**3.4.1**
**dirt**
any non-fibrous contrary

**3.4.2**
**shive**
sliver of wood, or fibre bundle

**3.5**
**Equivalent Black Area**
**EBA**
area of one of the round black spots (a $Y_{c/2}$ value of 2,4 %) in the Comparison Chart (Annex A) that has the same apparent area when examined visually upon its white background (a $Y_{c/2}$ value of 81,5 %) as does the dirt speck when examined visually upon the particular sheet in or upon which it is embedded

NOTE 1 A larger "grey" dirt speck has the same visual impact as a smaller "black" one when viewed on the same sheet and under the same conditions.

NOTE 2 The Equivalent Black Area (EBA) of a dirt speck determined visually is generally less than its physical area. The EBA approaches the physical area only as the speck becomes large.

## 4 Principle

The test pieces to be examined are inspected on both sides with reflected light. The number and area of all contraries larger than a specified value and showing contrast, with respect to the surrounding area of the sheet, are estimated. The total EBA of the contraries is calculated and the total number and the total EBA of dirt and shives are reported as the number of contraries per square metre, and as square millimetre per square metre (number of contraries/$m^2$ and $mm^2/m^2$).

## 5 Apparatus

**5.1 Illumination device**, a suitable light source or a viewer for the investigation of sheets in reflected light. Lighting arrangements shall give about 1 700 cd/$m^2$ of white light or daylight on the surface of the test piece. Because the light affects equally the appearance of both the contraries and the comparison spots on the charts, the intensity of illumination is not critical.

NOTE The luminance can be measured by a luminance meter.

For grooved pulp sheets, care should be taken to position the light source so that the pulp ridges do not cast shadows.

The results can be significantly different on the same pulp sheet if the counting has been carried out with or without a magnifying glass or similar devices. Do not use a magnifying device for dirt size estimation.

**5.2 Comparison chart**, the actual chart is a photograph (approximately 89 mm × 127 mm) of a series of round black spots of various areas on a white background. The reflectance of the white background is (81,5 ± 1,0) % and that of the black spot is (2,4 ± 0,4) %. In accordance with Graff's findings (see Reference [1]), all the round spots on the present chart, except those listed, are correct to within 10 % or 0,005 $mm^2$, whichever is the larger. For special accuracy, these designated areas should be changed to those given in parentheses: 1,00 (1,08); 0,80 (0,76); 0,60 (0,58); 0,40 (0,42); 0,30 (0,31); 0,25 (0,26); 0,20 (0,21); 0,15 (0,16); 0,10 (0,11); 0,09 (0,10). The chart is included in normative Annex A.

Only the round spots are used for the analysis.

This Comparison chart is identical to the one used in TAPPI T 213 om-01. These charts are available from TAPPI (http://www.tappi.org).

Plastic-covered cards, transparencies, photocopies, or printed charts will not give equivalent results and shall not be used in this method.

Do not use the chart in ISO 5350-1 and ISO 5350-2, as that chart is intended for examination by transmitted light.

## 6 Sampling and preparation of test piece

### 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 specimens so that they are representative of the whole sample.

### 6.2 Pulp sheets

From each test unit, select 10 or more sheets (preferably 20), each sheet having an exposed area on each side of at least 0,15 $m^2$. Sheets taken from the usual pulp bale are suitable. Keep the specimen sheets clean between two extra outer sheets.

In thick pulp sheets, dirt specks may be embedded throughout the thickness of the sheet. When pulp is reformed into a new product, these embedded dirt specks may have a different impact.

### 6.3 Never-dried pulp

Take a sample and form it into specimen sheets in a carefully cleaned stainless-steel sheet-former in accordance with ISO 5269-1 or ISO 5269-2. Make a sufficient number of sheets so that they have a total exposed area (both sides) of at least 0,4 $m^2$. Dry the sheets under restraint on drying plates, taking care to avoid contamination and wrinkling.

## 7 Procedure

Examine the areas selected for counting. Use the comparison chart (Annex A) to estimate the Equivalent Black Area of each speck. Record the estimated area of each speck.

During the count, if any odd speck of dirt is encountered, which appears unusual, e.g., a crushed insect or a blotch of dirt which is definitely determined as not being representative of the shipment (ascertained by looking over additional sheets), ignore it.

A shive can be defined here as a dirt speck having an aspect ratio of at least 3 to 1. Shives may be counted as dirt specks if they are visible when viewed at an angle normal to the general direction of the pulp sheet, or they may be recorded separately if this information is needed.

### 7.1 Pulp with a low dirt content

Examine both sides of the specimens in a dust-free place, preferably on a bench top covered with a large sheet of clean paper and after making sure that the hands are clean. View the pulp sheets at right angles to its general surface direction.

NOTE The right angle is particularly important for grooved pulp sheets, since the sheet area is calculated by simple geometry and ignores the increased area of the sheets caused by the grooves. If the sheet and its contraries are viewed from an angle normal to the general surface direction of the sheet, the effect of the grooves tends to be cancelled.

Carefully brush away any loose dirt specks on the surface. Check each remaining dirt speck that has an EBA of 0,04 $mm^2$ or larger. Record the EBA of each dirt speck in square millimetres. When estimating the EBA of a coloured speck or a black speck on a white or coloured sheet, proceed to select from the Comparison chart, with its white background, an appropriate black spot that is equally noticeable. If they have the same noticeability or EBA, both the speck and the then selected spot become indistinguishable at the same distance when moved away from the eyes.

### 7.2 Pulp with a high dirt content

If the pulp is dirty and a variety of dirt specks are visible on the sheets, the specks may be too numerous to render tedious the examination of the required area of the sample. In such a case, select a particular reference spot on the Comparison Chart that has an EBA such that there will be on the average at least one such sized speck, or larger, to be found on each 500 $cm^2$ of the exposed surface of the specimens. (The size of reference spots selected might vary from 0,08 $mm^2$ for fairly clean pulp to 0,25 $mm^2$ or more for a dirty pulp.) Make a mask for a sheet of the pulp approximately the colour and size of the specimen sheets, having an opening at its centre, or a corner cut away, of one-fifth of its area.

Examine both sides of the specimens in a dust-free place. View the pulp sheet at right angles to its general surface direction (see the Note in 7.1).

Without using the mask, carefully brush away loose surface dirt. Then check each remaining dirt speck that has an EBA equal to or greater than that of the reference spot selected. Record the EBA of each speck in square millimetres.

Using the mask, check each dirt speck on the exposed pulp surface that is smaller than the reference spot and equal to or greater that 0,04 $mm^2$. Record the EBA of each dirt speck in square millimetres.

## 8 Expression of results

### 8.1 Calculation

For all contraries (or separately as dirt and shives, if required), calculate the total number and the total area of contraries.

#### 8.1.1 Pulp with a low dirt content

Using simple geometry, measure the total area of both sides of the specimen sheets and record it in square metres. Ignore the increased sheet area caused by grooves. For all contraries, calculate the total equivalent black area (EBA) on both sides and record it in square millimetres. Calculate the total square millimetres of contraries per square metre of surface examined ($mm^2/m^2$) and the total number of contraries per square metre of surface examined (number/$m^2$).

### 8.1.2 Pulp with a high dirt content

Using simple geometry, measure the total area of both sides of the specimen sheets and record it in square metres. Calculate the total EBA on both sides, by totalling the EBA of the larger specks on the entire area examined and adding 5 times the EBA of the smaller specks observed in 7.2. Calculate the total square millimetres of contraries per square metre of surface examined ($mm^2/m^2$) and the total number of contraries per square metre of surface examined (number/$m^2$).

### 8.1.3 Counting uncertainty

The size distribution of naturally occurring dirt particles is log-normal and is approximated by a Poisson-like distribution, where the counting uncertainty is calculated according to Equation (1). This is described in Reference [4] in the Bibliography.

$$P = \frac{\sqrt{n}}{n} \times 100 \tag{1}$$

where

$P$ is the counting uncertainty, expressed in percentage (%);

$n$ is the total number of contraries detected in the tested area.

This implies that the precision of the count is dependent on the number of specks counted.

## 8.2 Results

Report the total number of contraries per area of pulp to the nearest integer.

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

Report the counting uncertainty to one decimal place.

## 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. The method rapidly loses precision as the dirt count increases.

Precision statements for this part of ISO 5350 are based on TAPPI T 213 om-01.

### 8.3.1 Repeatability

Three lots of pulp that had dirt levels ranging between 1 and 5 $mm^2/m^2$ were analysed in one laboratory and the repeatability was 15 %.

### 8.3.2 Reproducibility

Three lots of pulp that had dirt levels ranging between 1 and 5 $mm^2/m^2$ were analysed in four different laboratories and the reproducibility was 90 %.

## 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 for a complete identification of the sample;

d) the results, expressed in number of contraries per square metre of pulp;

e) the results, expressed in square millimetres of contraries per square metre of pulp;

f) the counting uncertainty, expressed as a percentage;

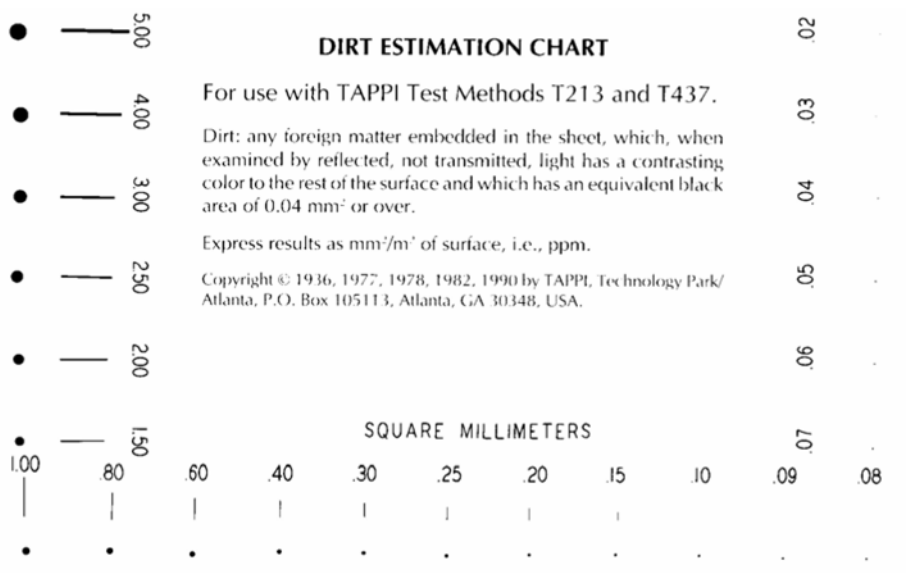
g) any optional points observed in the course of the test;

h) 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

The comparison chart used in this method (Figure A.1) is the same as described in TAPPI Test Method T 213 om-01 and is available from that organization (http://www.tappi.org).




| DIRT ESTIMATION CHART | TABLEAU D'ESTIMATION DES IMPURETÉS |
|---|---|
| For use with TAPPI test method T213 and T437 | À utiliser avec les méthodes d'essai TAPPI T213 et T437 |
| Dirt: any foreign matter embedded in the sheet, which, when examined by reflected, not transmitted, light, has a contrasting colour to the rest of the surface and which has an equivalent black area of 0,04 $mm^2$ or over. | Impureté: tout corps étranger logé dans la feuille qui, lorsqu'il est examiné sous lumière réfléchie, non transmise, a une couleur contrastant avec le reste de la surface et qui a une surface noire équivalente de 0,04 $mm^2$ ou plus. |
| Express results as $mm^2/m^2$ of surface, i.e. ppm. | Les résultats sont exprimés en $mm^2/m^2$ de surface, c'est-à-dire en parties par million (ppm). |
| SQUARE MILLIMETERS | MILLIMÈTRES CARRÉS |

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

Do not use the copy of the chart as depicted in this part of ISO 5350, and do not use any photocopy of the chart in any inspection, because reproduction may change the sizes and contrasts of the spots.

# Bibliography

[1] GRAFF, J.H. and NIHLEN, E.K., *A Chart for the Estimation of Dirt in Pulp and Paper*, Tech. Assoc. Papers **25**:331 (1942); Paper Trade J. **114** (21): 61 (1942)

[2] KLUNGNESS, J.H., FERNANDEZ, L.E. and PLANTINGA, P.L., *Image analysis for measuring adhesive contaminants in pulp.* TAPPI Journal, 72:1 (1989), pp. 89-93

[3] TAPPI Test Method T 213 om-01, *Dirt in pulp*

[4] TAPPI Test Method T 437 om-03, *Dirt in paper and paperboard*

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