INTERNATIONAL STANDARD

ISO 2470-1

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Paper, board and pulps — Measurement of diffuse blue reflectance factor —

Part 1: Indoor daylight conditions (ISO brightness)

Papier, carton et pâtes — Mesurage du facteur de réflectance diffuse dans le bleu —
Partie 1: Conditions d'éclairage intérieur de jour (degré de blancheur ISO)

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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 2470-1 was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*.

This first edition cancels and replaces ISO 2470:1999, which has been technically revised.

ISO 2470 consists of the following parts, under the general title *Paper, board and pulps — Measurement of diffuse blue reflectance factor*:

— *Part 1: Indoor daylight conditions (ISO brightness)*

— *Part 2: Outdoor daylight conditions (D65 brightness)*

Introduction

The reflectance factor (radiance factor) depends on the conditions of measurement, particularly the spectral and geometric characteristics of the instrument used. This part of ISO 2470 should therefore be read in conjunction with ISO 2469 which defines the geometric characteristics of the instrument and also defines the photometric calibration procedure to be adopted.

The definition of ISO brightness is historically linked to the Zeiss Elrepho instrument having, as a light source, an incandescent lamp which excites fluorescence to only a limited extent. It is specified here that, in instruments of the abridged spectrophotometer or filter colorimeter type, the UV content of the illumination be adjusted to conform to the CIE illuminant C as defined by a fluorescent reference standard having an assigned value of ISO brightness as described in Annex B. Only if this is done may the property measured on a fluorescent material be called ISO brightness.

Paper, board and pulps — Measurement of diffuse blue reflectance factor —

Part 1: Indoor daylight conditions (ISO brightness)

1 Scope

This part of ISO 2470 specifies a method for measuring the diffuse blue reflectance factor (ISO brightness) of pulps, papers and boards.

This part of ISO 2470 is limited in its scope to white and near-white pulps, papers and boards. The measurement can only be made in an instrument in which the ultraviolet energy level of the illumination has been adjusted to correspond to the CIE illuminant C using a fluorescent reference standard.

NOTE The property called D65 brightness is measured with an instrument adjusted to a much higher UV content than that specified in this part of ISO 2470. The measurement of D65 brightness is described in ISO 2470-2.

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 186, *Paper and board — Sampling to determine average quality*

ISO 2469:2007, *Paper, board and pulps — Measurement of diffuse radiance factor*

ISO 3688, *Pulps — Preparation of laboratory sheets for the measurement of diffuse blue reflectance factor (ISO brightness)*

ISO 4094, *Paper, board and pulps — International calibration of testing apparatus — Nomination and acceptance of standardizing and authorized laboratories*

ISO 7213, *Pulps — Sampling for testing*

3 Terms and definitions

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

3.1
radiance factor
β
ratio of the radiance of a surface element of a body in the direction delimited by a given cone with its apex at the surface element to that of the perfect reflecting diffuser under the same conditions of illumination

NOTE For fluorescent (luminescent) materials, the total radiance factor, β, is the sum of two portions, the reflected radiance factor, β_S, and the luminescent radiance factor, β_L, so that:

$$\beta = \beta_S + \beta_L$$

For non-fluorescent materials, the reflected radiance factor, β_S, is numerically equal to the reflectance factor R.

3.2
diffuse radiance [reflectance] factor
R
ratio of the radiation reflected and emitted from a body to that reflected from the perfect reflecting diffuser under the same conditions of diffuse illumination and normal detection

NOTE 1 The ratio is often expressed as a percentage.

NOTE 2 The diffuse radiance [reflectance] factor is influenced by the backing if the body is translucent.

NOTE 3 This part of ISO 2470 prescribes diffuse illumination and normal detection in an instrument calibrated in accordance with the provisions of this part of ISO 2470.

3.3
intrinsic radiance [reflectance] factor
R_∞
diffuse radiance [reflectance] factor of a layer or pad of material thick enough to be opaque, i.e. such that increasing the thickness of the pad by doubling the number of sheets results in no change in the measured radiance [reflectance] factor

NOTE The radiance [reflectance] factor of a single non-opaque sheet is dependent on the background and is not a material property.

3.4
ISO brightness
R_{457}
intrinsic radiance [reflectance] factor measured with a reflectometer having the characteristics described in ISO 2469, equipped with a filter or corresponding function having an effective wavelength of 457 nm and a half bandwidth of 44 nm, and adjusted so that the UV content of the irradiation incident upon the test piece corresponds to that of the CIE illuminant C

NOTE The filter function is described more fully by the weighting function factors given in Annex A and Table A.1.

4 Principle

A test piece is illuminated diffusely in a standard instrument and the light reflected normal to the surface is either allowed to pass through a defined optical filter and then measured by a photodetector or measured by an array of photosensitive diodes, where each diode responds to a different effective wavelength. The brightness is then determined directly from the output from the photodetector or by calculation from the photosensitive diode outputs using the appropriate weighting function.

5 Apparatus

5.1 Reflectometer

5.1.1 Reflectometer having the geometric, spectral and photometric characteristics described in ISO 2469 and calibrated in accordance with the provisions of ISO 2469, and equipped for the measurement of blue reflectance factor as defined in Annex A.

5.1.2 In the case of a filter reflectometer, the radiation falling upon the test piece shall have a UV content corresponding to that of the CIE illuminant C.

5.1.3 In the case of an abridged spectrophotometer, the instrument shall have an adjustable filter with a cut-off wavelength of 395 nm or some other system for adjustment and control, and this filter shall be adjusted or the system shall be calibrated with the help of the fluorescence reference standard (5.2.3), so that the UV content of the illumination falling upon the sample corresponds to that of the CIE illuminant C.

5.2 Reference standards for calibration of the instrument and the working standards

5.2.1 Use reference standards sufficiently frequently to ensure satisfactory calibration and UV adjustment.

NOTE This frequency interval can be fixed according to a defined schedule or control limits (e.g. from drift analysis of the measuring instrument).

5.2.2 Non-fluorescent reference standard for photometric calibration, issued by an ISO/TC 6 authorized laboratory in accordance with the provisions of ISO 2469.

5.2.3 Fluorescent reference standard for use in adjusting the UV content of the radiation incident upon the sample, having an ISO-brightness value assigned by an ISO/TC 6 authorized laboratory as prescribed in Annex B.

5.3 Working standards

5.3.1 Two plates of flat opal glass, ceramic or other suitable non-fluorescent material, cleaned and calibrated as described in ISO 2469.

NOTE In some instruments, the function of the primary working standard may be taken over by a built-in internal standard.

5.3.2 Stable plastic or other tablet, incorporating a fluorescent whitening agent.

5.3.3 Black cavity, having a reflectance factor which does not differ from its nominal value by more than 0,2 %, at all wavelengths. The black cavity should be stored upside down in a dust-free environment or with a protective cover.

NOTE The condition of the black cavity can be checked by reference to the instrument maker.

6 Sampling and conditioning

If the tests are being made to evaluate a lot of paper or board, the sample shall be selected in accordance with ISO 186. If a lot of pulps is to be evaluated, the sample shall be selected in accordance with ISO 7213. If the tests are made on another type of sample, make sure that the test pieces taken are representative of the sample received.

Conditioning according to ISO 187 is recommended but not required, but preconditioning with elevated temperatures should not be applied since it might change the optical properties.

7 Preparation of test pieces

Regarding pulp samples, prepare laboratory sheets in accordance with ISO 3688.

Avoiding watermarks, dirt and obvious defects, cut rectangular test pieces approximately 75 mm × 150 mm. Assemble at least ten of the test pieces in a pad with their top sides uppermost; the number should be such that doubling the number of test pieces does not alter the radiance factor. Protect the pad by placing an additional sheet on both the top and bottom of the pad; avoid contamination and unnecessary exposure to light or heat.

Mark the top test piece in one corner to identify the sample and its top side.

If the top side can be distinguished from the wire side, it shall be uppermost; if not, as may be the case for papers manufactured on double wire machines, ensure that the same side of the sheet is uppermost.