INTERNATIONAL STANDARD 2470

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Paper and board — Measurement of diffuse blue reflectance factor (ISO brightness)

Papier et carton — Mesurage du facteur de réflectance diffuse dans le bleu (degré de blancheur ISO)

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2470 was developed by Technical Committee ISO/TC 6, *Paper, board and pulps*, and circulated to the member bodies in September 1971.

It has been approved by the member bodies of the following countries :

Australia	India	South Africa, Rep. of
Austria	Iran	Spain
Belgium	Ireland	Sweden
Bulgaria	Israel	Switzerland
Canada	Italy	Thailand
Czechoslovakia	Netherlands	Turkey
Egypt, Arab Rep. of	New Zealand	United Kingdom
Finland	Norway	U.S.A.
France	Poland	U.S.S.R.
Germany	Portugal	
Hungary	Romania	

No member body expressed disapproval of the document.

This second edition, incorporating an annex which was submitted directly to the ISO Council in accordance with clause 6.12.1 of the Directives for the technical work of ISO, cancels and replaces the first edition (ISO 2470-1973).

Printed in Switzerland

Paper and board – Measurement of diffuse blue reflectance factor (ISO brightness)

0 INTRODUCTION

The reflectance factor depends on the conditions of measurement, particularly the spectral and geometric characteristics of the instrument used. This International Standard should be read in conjunction with ISO 2469, *Paper, board and pulps – Measurement of diffuse reflectance factor*.

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method for measuring the diffuse blue reflectance factor (ISO brightness) of paper and board.

This International Standard is confined in its scope to white and near-white papers and boards. Paper or board that has been treated with a fluorescent dyestuff or exhibits significant fluorescence may be measured, but the agreement between values obtained with different instruments may be unsatisfactory and there may be difficulty in assessing the meaning of results.

NOTE – Two reflectometers of different makes may both have spectral characteristics giving an effective wavelength of 457 nm although the spectral power distributions of the radiation incident are different. If this difference occurs in the spectral region that excites fluorescent radiation and if this fluorescent radiation is emitted in the spectral region of the measurements (near 450 nm), then different values of brightness can be obtained. Hence, measurements can only be made satisfactorily on samples exhibiting fluorescence if the spectral power distribution of the irradiation in the long wave ultra-violet region is standardized.

2 DEFINITIONS

For the purpose of this International Standard the following definitions apply :

2.1 reflectance factor, R : The ratio, expressed as a percentage, of the radiation reflected by a body to that reflected by a perfect reflecting diffuser under the same conditions.

2.2 intrinsic reflectance factor, R_∞ : The reflectance factor of a layer or pad of the material thick enough to be opaque.

2.3 diffuse blue reflectance factor (ISO brightness) : The intrinsic reflectance factor measured at an effective wavelength of 457 nm with a reflectometer having specified characteristics as given in ISO 2469.

3 APPARATUS

3.1 Reflectometer, in calibration with the reference instrument described in ISO 2469, and equipped for the measurement of blue reflectance factor.

3.2 Filter that in conjunction with the spectral characteristics of the basic instrument gives an overall effective wavelength of 457 ± 0,5 nm and a bandwidth at half-height of 44 nm.

3.3 Two working standards calibrated against ISO reference standards of level 3 supplied by the authorized laboratory for blue reflectance factor standardization purposes.

Details of the calibration of the working standards together with cleaning precautions and use are given in ISO 2469. Calibrate the working standards by using ISO reference standards of level 3. In each case recently calibrated reference standards intended for the calibration of the instrument for diffuse blue reflectance factor (ISO brightness) of paper and board measurements shall be used at suitable intervals to ensure agreement with the reference instrument.

4 SAMPLING

The sampling procedure will differ according to the purposes for which the measurement is required. It shall be agreed between the parties concerned.

5 PREPARATION OF TEST PIECES

Avoiding watermarks, dirt and obvious defects of the paper, cut rectangular test pieces about 75 mm × 150 mm. Assemble not less than ten test pieces top side upwards in a pad using, if necessary, a number greater than ten so that the blue reflectance factor remains unchanged if the number is increased. Protect the pad by placing an additional test piece on both top and bottom; avoid contamination and unnecessary exposure to light or heat.

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

6 PROCEDURE

Check that the correct filters are in the light beams. Remove the protecting sheets from the test piece pad. Without touching the test area, use the procedure appropriate to the instrument, and the working standard, to measure the intrinsic reflectance factor of the top side of the test piece pad. Read and record the value to the nearest 0,1 % reflectance factor. Move the uppermost test piece to the bottom of the pad and determine the blue reflectance factor for the next and similarly for the following test pieces until a total of not less than ten readings has been made.

Turn the pad upside down and repeat the procedure for the other side.

7 EXPRESSION OF RESULTS

Report the mean intrinsic reflectance factor, separately for both sides, as the diffuse blue reflectance factor (ISO brightness) of the paper or board in per cent to the nearest 0,5 % reflectance factor.

8 TEST REPORT

The test report shall include the following details :

a) precise identification of the sample;

b) a reference to this International Standard;

c) the results and the form in which they are expressed;

d) any particular points observed in the course of the test;

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

ANNEX

GENERAL INFORMATION ON ISO BRIGHTNESS AND REFLECTANCE FACTOR STANDARDS FOR PAPERS, BOARDS AND PULPS

(Not part of the standard)

In ISO 2469, ISO 2470, ISO 2471 and ISO 3688, which deal with measurements of diffuse reflectance factors, ISO brightness and opacity and opacity (paper backing), a sequence of reference standards of three different levels is mentioned in which, for diffuse reflectance factor measurements, the ultimate reference standard (the ISO standard of level 1) is the "perfect reflecting diffuser". The use of this ideal uniform diffuser, with a reflectance equal to 1,0, constitutes a deviation from the older practice of using smoked magnesium oxide as ultimate reference. However, the use of the perfect reflecting diffuser as ultimate reference is in full agreement with a recommendation made by the prime authority on optical properties, the Commission Internationale de l'Éclairage (CIE) which replaced smoked magnesium oxide by the perfect reflecting diffuser in 1969.

It appears that with this change a reference standard which is difficult to produce (magnesium oxide) is now replaced by a reference standard which probably can never be physically materialized. However, there are good reasons for this regulation. The preparation of a smoked magnesium oxide surface is a slow and tedious process which produces reference standards of low precision. A survey of the literature shows that the reflectances of magnesium oxide surfaces prepared in different laboratories vary by about 2 %. Such uncertainty in the ultimate reference cannot be tolerated if instruments are available which can measure relative reflectance factors with a precision of the order of 0,1 %. Reference to the perfect reflecting diffuser is equivalent to absolute measurements of reflectance factors and the techniques of such measurements have been improved in recent years to an accuracy which is of the order of ± 0,3 % and better[1]. Consequently it is possible to calibrate material standards in such absolute reflectometers to an accuracy which is far superior to the accuracy of smoked magnesium oxide standards[2].

For the implementation of this ultimate reference standard or "ISO reference standard of level 1" = IR 1 and the reference standards of levels 2 and 3, ISO proposes the following procedure.

Certain laboratories, which are equipped for absolute reflectance factor measurements, are appointed by ISO/TC 6 as "standardizing laboratories". These laboratories issue "ISO reference standards of level 2" = IR 2 to certain "authorized laboratories" for calibrating their "reference instruments"[1]. These authorized laboratories, which are also appointed by ISO/TC 6, then issue "ISO reference standards of level 3" = IR 3 on demand to industrial laboratories which are advised to use the IR 3 only for the purpose of calibrating their working standards periodically.*

The standardizing laboratories are requested to exchange samples from time to time so that agreement between their measurements is maintained. The same holds for the authorized laboratories. It is expected that this procedure, which is specified in certain ISO documents, will achieve those accuracies which are suggested in the "Expression of results" clause in the above-mentioned International Standards.

It should be mentioned that barium sulphate powders for pressing tablets are commercially available for which the absolute spectral reflectance factors are given on the container. These values are determined with care but they are valid only if the procedure of pressing the tablets is very close to that of the laboratory which determined these values.

One consequence of this conversion in the ultimate reference is that diffuse reflectance factors, for example the ISO brightness, when referred to the perfect reflecting diffuser, are lower by about 1,0 to 1,5 % than those referred to smoked magnesium oxide. It is very important that this fact be borne in mind, not only in commercial transactions, but in general whenever various measurements on one sample are to be compared. Measurements according to the above International Standards are always referred to the perfect reflecting diffuser. Consequently, "ISO brightness" can only be an absolute value, never relative to smoked magnesium oxide. However, if reflectance factors are given without the ISO prefix, it is advisable to mention the reference by a qualifying "absolute" or "MgO = 100".

Opacity measurements are, of course, almost unaffected by the change in the ultimate reference.

Two aspects of these International Standards must be kept in mind :

1) The term "diffuse" refers to a diffuse illumination on the sample which is achieved by means of an integrating sphere. It is important to recognize that other specifications, such as TAPPI 452, use a different geometry and that, in general, another geometry will yield different values.

2) The instruments described in these International Standards are equipped with a "gloss trap" so that the specularly reflected component is excluded. It is important to observe this condition because, for samples exhibiting gloss, the introduction of the gloss trap may cause an additional decrease of the value of the reflectance factor by up to 1 %.

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1) The up-to-date lists of standardizing and authorized laboratories are available from the Secretariat of ISO/TC 6 (AFNOR) or from the ISO Central Secretariat.

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