

Australian/New Zealand Standard™

Methods of test for pulp and paper

**Method 510: Measurement of diffuse
radiance factor (diffuse reflectance
factor)**



AS/NZS 1301.510:2016

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Appita
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Method 510: Measurement of diffuse radiance factor (diffuse reflectance factor)

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee PK-019, Methods of Test for Pulp and Paper, to supersede AS/NZS 1301.436:2014, *Methods of test for pulp and paper*, Method 436: *Measurement of diffuse reflectance factor*, and AS/NZS 1301.464s:2005, *Methods of test for pulp and paper*, Method 464s: *Equipment for measurement of diffuse reflectance factor*.

The objective of this Standard is to provide a method for determining diffuse radiance factor (formerly 'diffuse reflectance factor') of paper, board and pulps. This change of terminology is an acknowledgement of the fact that many grades of paper now contain added fluorescent whitening agents.

This Standard is identical with, and has been reproduced from ISO 2469:2014, *Paper, board and pulps—Measurement of diffuse radiance factor (diffuse reflectance factor)*.

None of the normative references in the source document have been adopted as Australian or Australian/New Zealand Standards.

As this Standard is reproduced from an International Standard, the following applies:

- (a) In the source text 'this International Standard' should read 'this Australian/New Zealand Standard'.
- (b) A full point substitutes for a comma when referring to a decimal marker.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the annex to which they apply. A 'normative' annex is an integral part of a Standard, whereas an 'informative' annex is only for information and guidance.

CONTENTS

1	Scope	1
2	Normative references	1
3	Terms and definitions	1
4	Principle	4
5	Apparatus	4
6	Photometric calibration of the instrument and its working standards	4
6.1	Calibration of the instrument	4
6.2	Calibration of the working standards for its intended use	5
6.3	Use of working standards	5
6.4	Cleaning the working standards	5
7	Sampling	6
8	Preparation of the test pieces	6
9	Procedure	6
9.1	Verification of calibration	6
9.2	Measurement	6
10	Calculation and expression of results	7
11	Precision	7
12	Test report	7
	Annex A (normative) Instruments for the measurement of radiance factor	8
	Annex B (normative) Calibration service — Photometric calibration	11
	Annex C (normative) Calibration service — UV-adjustment	13
	Annex D (informative) Measurement uncertainty	15
	Annex E (informative) Radiance and reflectance	18
	Bibliography	19

INTRODUCTION

The radiance factor depends on the conditions of measurement, particularly the spectral and geometric characteristics of the instrument used. The diffuse radiance factor as defined by this International Standard is determined using instruments having the characteristics given in [Annex A](#) and calibrated according to the procedure specified in [Annex B](#).

The diffuse radiance factor is the sum of the reflected radiance factor and the luminescent radiance factor, and the luminescent radiance factor of a luminescent (fluorescent) object is dependent on the spectral power distribution of the illumination. If adequately accurate measurements are to be carried out on fluorescent objects, the UV-content of the instrument illumination must therefore be adjusted to produce the same amount of fluorescence for a fluorescent reference standard as the selected CIE illuminant. The preparation of fluorescent reference standards to enable this adjustment to be made is described in [Annex C](#). The use of these fluorescent reference standards is described in detail in the International Standards describing the measurement of the properties of the materials containing fluorescent whitening agents.

The spectral diffuse radiance factor or the weighted diffuse radiance factor applicable to one or several specified wavelength bands is often used to characterize the properties of pulp, paper and board. Examples of diffuse radiance factors associated with specified wavelength bands are the ISO brightness (diffuse blue radiance factor) and the luminance factor.

The diffuse radiance factor or diffuse reflectance factor is also used as the basis for calculating optical properties, such as opacity, colour, whiteness and the Kubelka-Munk scattering and absorption coefficients. These various properties are described in detail in specific International Standards, and for all of these, ISO 2469 is the primary normative reference.

AUSTRALIAN/NEW ZEALAND STANDARD

Methods of test for pulp and paper

Method 510:

Measurement of diffuse radiance factor (diffuse reflectance factor)

1 Scope

This International Standard describes the general procedure for measuring the diffuse radiance factor of all types of pulp, paper and board. More particularly, it specifies in detail in [Annex A](#) the characteristics of the equipment to be used for such measurements, and in [Annex B](#) the procedures to be used for calibrating that equipment.

This International Standard may be used to measure the diffuse radiance factors and related properties of materials containing fluorescent whitening agents, provided that the UV-content of the instrument illumination has been adjusted to give the same level of fluorescence as a fluorescent reference standard for a selected CIE illuminant, in accordance with the specific International Standard describing the measurement of the property in question.

This International Standard describes in [Annex C](#) the preparation of fluorescent reference standards, although the procedures for using these standards are not included, since their use is described in detail in the specific International Standards describing the measurement of the properties of materials containing fluorescent whitening agents.

2 Normative references

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

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

ASTM E308-06, *Standard Practice for Computing the Colors of Objects by Using the CIE System*

3 Terms and definitions

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

NOTE It is intended that these terms and definitions and their symbols be included in ISO/TR 10688, in order to have a single and common reference document for International Standards for measurement of optical properties of paper, board and pulps.

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 1 to entry: For luminescent (fluorescent) 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 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 to entry: The ratio is often expressed as a percentage.

Note 2 to entry: This International Standard prescribes diffuse illumination and normal detection in an instrument constructed and calibrated in accordance with the provisions of this standard. The term “diffuse radiance factor” is used here both for bidirectional and sphere geometries.

3.3 intrinsic diffuse radiance factor

R_{∞}

diffuse radiance 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 factor

Note 1 to entry: The radiance factor of a single non-opaque sheet is dependent on the background and is not a material property.

3.4 reflectance factor

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

Note 1 to entry: The ratio is often expressed as a percentage.

Note 2 to entry: This term may be used only when it is known that the test material exhibits no luminescence (fluorescence).

3.5 diffuse reflectance factor

R

ratio of the reflection from a body to that from the perfect reflecting diffuser under the same conditions of diffuse illumination and normal detection

Note 1 to entry: The ratio is often expressed as a percentage.

Note 2 to entry: This International Standard specifies diffuse illumination and normal detection in an instrument constructed and calibrated in accordance with the provisions of this standard.

3.6 intrinsic diffuse reflectance factor

R_{∞}

diffuse 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 reflectance factor

Note 1 to entry: The reflectance factor of a single non-opaque sheet is dependent on the background and is not a material property.

3.7 international reference standard of level 1 IR1

perfect reflecting diffuser (see CIE publication 17.4, No 845.04.54), ideal spectrally uniform isotropic Lambertian diffuser with a reflectance equal to 1 at all wavelengths

Note 1 to entry: Reflectance is defined as the ratio of the reflected to the incident radiation, see [Annex E](#).

3.8 international reference standard of level 2 IR2

standard whose radiance (reflectance) factors have been determined by a standardizing laboratory in relation to the IR1 as defined by ISO 4094

Note 1 to entry: This International Standard refers to two types of IR2:

A non-fluorescent IR2 whose spectral reflectance factors have been determined by a standardizing laboratory in relation to the IR1. A non-fluorescent IR2 is used to calibrate the photometric scale of an authorized laboratory's reference instrument.

A white fluorescent IR2 whose spectral radiance factors corresponding to a specified CIE illuminant have been determined by a standardizing laboratory. A fluorescent IR2 standard is used to adjust the UV level of an authorized laboratory's reference instrument.

3.9 international reference standard of level 3 IR3 reference standard

standard whose radiance factors have been determined by an authorized laboratory in relation to an IR2, as defined by ISO 4094

Note 1 to entry: This International Standard refers to two types of IR3:

A non-fluorescent IR3 whose spectral reflectance factors have been determined by an authorized laboratory in relation to the IR2. A non-fluorescent IR3 is used to calibrate the photometric scale of a testing laboratory's reference instrument.

A white fluorescent IR3 whose calibration values have been determined by an authorized laboratory in relation to the IR2. A testing laboratory uses a fluorescent IR3 to adjust the relative amount of UV radiation incident on the sample to a specified level.

3.10 working standard

physical standard whose radiance (reflectance) factors have been determined by calibration with a suitable international reference standard (IR3) for subsequent use on a single instrument that conforms to this International Standard

3.11 primary working standard

working standard which is used routinely to validate and calibrate a given measuring instrument for its intended use

Note 1 to entry: The calibrated radiance (reflectance) factors of the primary working standard may not be transferred to a different instrument, even of the same type (see [3.10](#)). However, it is possible to use a primary working standard for validation purposes only on instruments of the same type.

3.12 control plate

secondary working standard which is used on an infrequent basis to monitor and validate the performance of a given primary working standard

Note 1 to entry: When one or more control plates give anomalous results on a given instrument, it may be necessary to re-calibrate the primary working standard used with that instrument with an appropriate international reference standard (IR3).