

Australian/New Zealand Standard™

**Methods of test for pulp and paper**

**Method 545: Determination of light scattering and absorption coefficients (using Kubelka-Munk theory) (ISO 9416:2017, MOD)**



AS/NZS 1301.545:2018

This Joint Australian/New Zealand Standard™ was prepared by Joint Technical Committee PK-019, Methods of Test for Pulp and Paper. It was approved on behalf of the Council of Standards Australia on 18 June 2018 and by the New Zealand Standards Approval Board on 2 August 2018.

This Standard was published on 22 October 2018.

The following are represented on Committee PK-019:

- Appita
- Australian Forest Products Association
- Australian Institute of Packaging
- Monash University
- New Zealand Paper Forum
- Scion

This Standard was issued in draft form for comment as DR AS/NZS 1301.545:2018.

### **Keeping Standards up-to-date**

Ensure you have the latest versions of our publications and keep up-to-date about Amendments, Rulings, Withdrawals, and new projects by visiting:

[www.standards.org.au](http://www.standards.org.au)

[www.standards.govt.nz](http://www.standards.govt.nz)

[www.saiglobal.com](http://www.saiglobal.com) (sales and distribution)

ISBN 978 1 76072 176 3

Australian/New Zealand Standard™

**Methods of test for pulp and paper**

**Method 545: Determination of light scattering and absorption coefficients (using Kubelka-Munk theory) (ISO 9416:2017, MOD)**

First published as AS/NZS 1301.545:2018.

**COPYRIGHT**

© ISO 2018 — All rights reserved

© Standards Australia Limited/the Crown in right of New Zealand, administered by the New Zealand Standards Executive 2018

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher, unless otherwise permitted under the Copyright Act 1968 (Cth) or the Copyright Act 1994 (New Zealand).

Jointly published by SAI Global Limited under licence from Standards Australia Limited, GPO Box 476, Sydney, NSW 2001 and by Standards New Zealand, PO Box 1473, Wellington 6140.

## Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee PK-019, Methods of Test for Pulp and Paper.

The objective of this Standard is to specify a method for the calculation of light-scattering and light-absorption coefficients based upon diffuse reflectance measurements made under the conditions specified in AS/NZS 1301.510:2016 using the Kubelka-Munk theory.

This Standard is an adoption with national modifications with, and has been reproduced from, ISO 9416:2017, *Paper — Determination of light scattering and absorption coefficients (using Kubelka-Munk theory)*.

Variations between ISO 9416:2017 and this Standard, for application in Australia and New Zealand, are set out in Appendix ZZ.

As this document has been reproduced from an International Standard, a full point substitutes for a comma when referring to a decimal marker.

Australian or Australian/New Zealand Standards that are identical adoptions of international normative references may be used interchangeably. Refer to the online catalogue for information on specific Standards.

The terms 'normative' and 'informative' are used in Standards to define the application of the appendices or annexes to which they apply. A 'normative' appendix or annex is an integral part of a Standard, whereas an 'informative' appendix or annex is only for information and guidance.

# Contents

Preface .....	ii
Foreword .....	iv
Introduction .....	v
<b>1 Scope .....</b>	<b>1</b>
<b>2 Normative references .....</b>	<b>1</b>
<b>3 Terms and definitions .....</b>	<b>1</b>
<b>4 Principle .....</b>	<b>3</b>
<b>5 Apparatus .....</b>	<b>3</b>
<b>6 Sampling and conditioning .....</b>	<b>4</b>
<b>7 Preparation of test pieces .....</b>	<b>4</b>
<b>8 Procedure .....</b>	<b>4</b>
<b>9 Calculation of results .....</b>	<b>5</b>
<b>10 Test report .....</b>	<b>5</b>
<b>Annex A (informative) Spectral characteristics of reflectometers for measuring luminance factor .....</b>	<b>6</b>
<b>Annex B (informative) Precision .....</b>	<b>10</b>
<b>Bibliography .....</b>	<b>11</b>
<b>Appendix ZZ (normative) Variations to ISO 9416:2017 for Australia and New Zealand .....</b>	<b>12</b>

## 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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*.

This third edition cancels and replaces the second edition (ISO 9416:2009), which has been technically revised, to allow for calculations to use ASTM E308 for instruments that have bandpass correction and still maintain the procedure for instruments without bandpass correction.

## Introduction

The opacity of a paper is dependent on its grammage, but it is also intrinsically dependent on the light-absorption and light-scattering coefficients of the material. These coefficients are calculated from the values of the reflectance factor over a black backing, the intrinsic reflectance factor and the grammage of the sheet.

The calculation of these coefficients requires luminance factor data obtained by measurement under specified conditions. Apart from the optical properties of the sample, the luminance factor depends on the conditions of measurement and particularly on the spectral and geometric characteristics of the instrument used for its determination. This document is therefore intended to be read in conjunction with ISO 2469 and ISO 2471.

**NOTE** This method is based on a theory developed by Kubelka and Munk. This theory describes scattering and absorption processes with certain approximations and simplifications and can therefore yield questionable results in extreme cases. However, the Kubelka-Munk theory offers a simple method for determining these coefficients with the instrument used for the determination of optical properties of paper and pulps. Moreover, the method based on this theory has been successfully used in practical applications.

## NOTES

# Australian/New Zealand Standard

## Methods of test for pulp and paper

### Method 545: Determination of light scattering and absorption coefficients (using Kubelka-Munk theory) (ISO 9416:2017, MOD)

#### 1 Scope

This document specifies a method for the calculation of light-scattering and light-absorption coefficients based upon diffuse reflectance measurements made under the conditions specified in ISO 2469 using the colour matching function  $\bar{y}(\lambda)$  and CIE illuminant C.

It is emphasized that the strict evaluation of the light-scattering and light-absorption coefficients requires conditions which cannot be achieved with the instrumentation specified here. The values obtained by application of this document are dependent on the application of the Kubelka-Munk equations, not to full reflectance data but to reflectance factor data obtained using the specified  $d/0^\circ$  geometry and a gloss trap.

The use of the method is restricted to white and near-white uncoated papers with an opacity less than about 95 %. Paper that has been treated with a fluorescent dyestuff or that exhibits significant fluorescence can only be dealt with if a filter with a cut-off wavelength of 420 nm is used to eliminate all the fluorescence effect in the UVex(420) mode.

NOTE 1 The residual UV-level in the instrument may depend on whether the instrument is adjusted to UV(C) or UV(D65) conditions prior to switching to the UVex(420) mode, but it is considered that this uncertainty in the residual level can be ignored in the application of this document.

NOTE 2 Although this method is restricted to paper, it can be applied to pulp sheets, although this is not in accordance with this document. In general, when pulps are tested, the light-absorption coefficient at 457 nm corresponding to the ISO brightness value or the spectral absorption coefficients are of greater interest than the weighted value standardized in this document.

#### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 187, *Paper, board and pulps — Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples*

ISO 536, *Paper and board — Determination of grammage*

ISO 2469, *Paper, board and pulps — Measurement of diffuse radiance factor (diffuse reflectance factor)*

#### 3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <http://www.iso.org/obp>

— IEC Electropedia: available at <http://www.electropedia.org/>