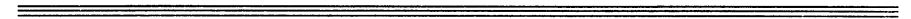


INTERNATIONAL STANDARD

**ISO
5651**

Second edition
1989-02-01



Paper, board and pulps — Units for expressing properties

Papiers, cartons et pâtes — Unités pour l'expression des propriétés

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Reference number
ISO 5651 : 1989 (E)

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.

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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 5651 was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*.

This second edition cancels and replaces the first edition (ISO 5651 : 1978), of which it constitutes a technical revision.

Annexes A and B to this International Standard are for information only.

Introduction

This International Standard deals with the application of the International System of Units (abbreviated to SI) within the field of paper, board and pulps.

The SI system of units has been adopted by ISO for use in its International Standards, and details of the SI system are given in various parts of ISO 31 and in ISO 1000. Implementation of this policy is not always easy. For instance, some quantities can be expressed in different units, all within the SI system, and various multiples can also be used. Such variations can lead to confusion in reporting test results and quoting values for properties.

In order to overcome such problems within its own area of activity, ISO/TC 6 has agreed on the units recommended for use in that area and its decisions are given in this International Standard.

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Paper, board and pulps – Units for expressing properties

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1 Scope

This International Standard specifies the units recommended for use in expressing properties of paper, board and pulps but excludes fibre building boards.

Table 1 gives recommended units for use in connection with test methods which are already the subject of International Standards and table 2 gives recommended units for use in connection with test methods which are not at present the subject of International Standards but are widely referred to in international technical exchanges.

NOTE – The list of properties in table 1 and table 2 cannot be regarded as comprehensive, and it may be possible to determine the appropriate units for describing other properties by analogy with the units given in this International Standard.

2 Recommended units

The units recommended to express properties which form the subject of International Standards are given in table 1. The

names of properties and quantities listed are given in an abbreviated form where this is easily understood.

The units recommended for the expression of properties which are not the subject of an International Standard are listed in table 2. This table also includes certain other units commonly encountered in test methods for paper, board and pulps and widely referred to in international technical exchanges in that field.

Wherever practicable, SI units are used. In a few instances where there is no satisfactory SI unit, units outside the SI system are quoted instead, though units permitted by ISO 1000 are used whenever possible.

In the majority of instances, a single unit is recommended to express a given property. However, for certain properties that show a wide range in numerical values, such as stiffness where a range in numerical value exceeding 10⁶:1 can be encountered, more than one recommended unit is given.

In combined units based upon special derived units, i.e. units for which special names exist, the units are not simplified where to do so might lead to confusion or unnecessarily obscure the principle of the test.

Table 1 — Recommended units for properties forming the subject of an International Standard

Number	Property	Recommended unit or method of expression	Relevant International Standard
1.1	General properties		
1.1.1	Grammage	g/m ²	ISO 536, ISO 3039
1.1.2	Thickness	µm, mm	ISO 534, ISO 3034
1.1.3	Apparent bulk density	g/cm ³	ISO 534
1.1.4	Apparent sheet density	g/cm ³	ISO 534
1.1.5	Bulking thickness	µm	ISO 534
1.1.6	Swelling after water immersion	%	ISO 5637
1.1.7	Hygroexpansivity	%	ISO 8226
1.1.8	Drainability of pulp — "CSF" and Schopper-Riegler	numerical value	ISO 5267
1.1.9	Dirt and shives in pulps	10 ² (number of specks)/kg	ISO 5350
1.1.10	Stock concentration	%	ISO 4119
1.2	Strength properties		
1.2.1	Tensile strength	kN/m	ISO 1924, ISO 3781
1.2.2	Tensile index	N · m/g	ISO 1924
1.2.3	Breaking length	km	ISO 1924
1.2.4	Stretch at break	%	ISO 1924
1.2.5	Tensile energy absorption	J/m ²	ISO 1924
1.2.6	Tensile energy absorption index	mJ/g	ISO 1924
1.2.7	Bursting strength	kPa	ISO 2758, ISO 2759, ISO 3689
1.2.8	Burst index	kPa · m ² /g	ISO 2758, ISO 2759
1.2.9	Tearing strength	mN, N	ISO 1974
1.2.10	Tear index	mN · m ² /g	ISO 1974
1.2.11	Puncture resistance	J, kJ	ISO 3036
1.3	Folding, bending and compression properties		
1.3.1	Static bending force	mN, N	ISO 2493
1.3.2	Bending stiffness	µN · m, mN · m, N · m	ISO 5629
1.3.3	Flat crush resistance (corrugated board)	kPa	ISO 3035
1.3.4	Flat crush resistance of laboratory fluted corrugating medium (CMT method)	N(CMT) ¹⁾	ISO 7263
1.3.5	Edgewise crush resistance	kN/m	ISO 3037
1.3.6	Folding endurance	log ₁₀ (number of folds)	ISO 5626
1.4	Surface properties		
1.4.1	Roughness, Bendtsen ²⁾	ml/min	ISO 2494, ISO 8791
1.4.2	Roughness, Sheffield ²⁾	ml/min	ISO 8791
1.4.3	Roughness, Print-surf	µm	ISO 8791
1.4.4	Smoothness, Bekk ²⁾	s	ISO 5627
1.4.5	Picking velocity, IGT	mm/s, m/s	ISO 3782, ISO 3783
1.5	Permeability and absorption properties		
1.5.1	Water vapour transmission rate	g/(m ² · d)	ISO 2528
1.5.2	Water absorbency		
	— area basis	g/m ²	ISO 535
	— mass basis	%	ISO 5637
	— capillary rise	mm	ISO 8787
1.5.3	Air permeance	µm/(Pa · s)	ISO 5636
1.5.4	Air resistance (Gurley) ²⁾	s	ISO 3687, ISO 5636-5
1.5.5	Resistance to water penetration	min, h, d	ISO 5633
1.5.6	Dimensional change after immersion in water	%	ISO 5635
1.5.7	Resistance to grease penetration	min, h, d	ISO 5634
1.6	Optical properties		
1.6.1	Reflectance factor	%	ISO 2469, ISO 2470, ISO 3688
1.6.2	Opacity	%	ISO 2471

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Table 1 (concluded)

Number	Property	Recommended unit or method of expression	Relevant International Standard
1.7	Electrical properties		
1.7.1	Conductivity of extracts	mS/m	ISO 6587
1.8	Composition		
1.8.1	Moisture content (or dry matter content)	% (m/m)	ISO 287, ISO 638
1.8.2	Ash	% (m/m)	ISO 1762, ISO 2144
1.8.3	Other major constituents	% (m/m)	ISO 624, ISO 692, ISO 699, ISO 3260
1.8.4	Other minor constituents	mg/kg	ISO 776, ISO 777, ISO 778, ISO 779, ISO 1830
1.8.5	Saleable mass	kg	ISO 801
1.8.6	Degree of delignification		
	– Kappa number	numerical value	ISO 302
	– chlorine consumption	% (m/m)	ISO 3260
1.9	Other properties		
1.9.1	pH value	numerical value	ISO 6588
1.9.2	Limiting viscosity number	ml/g	ISO 5351

1) CMT stands for Corrugated Medium Test.

2) Properties so designated are measured using tests which give results in units different from those of the property itself. It is therefore necessary to give the method of measurement when reporting test results.

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Table 2 — Recommended units for other properties

Number	Property	Recommended unit or method of expression	Relevant International Standard						
2.1	Strength properties								
2.1.1	Adhesion strength of glue bonds of corrugated fibreboard	kN/m							
2.1.2	z-direction strength properties	<table style="display: inline-table; vertical-align: middle;"> <tr> <td style="padding-right: 5px;">kPa</td> <td rowspan="4" style="font-size: 2em; vertical-align: middle;">}</td> <td rowspan="4" style="padding-left: 5px;">as appropriate</td> </tr> <tr> <td>kN/m</td> </tr> <tr> <td>J/m²</td> </tr> <tr> <td></td> </tr> </table>	kPa	}	as appropriate	kN/m	J/m ²		
kPa	}	as appropriate							
kN/m									
J/m ²									
2.2	Folding, bending and compression properties								
2.2.1	Fold number, double fold	numerical value							
2.2.2	Ring crush	kN/m							
2.3	Permeability and absorption properties								
2.3.1	Ink absorbency "K and N"	"K and N" units							
2.4	Optical properties								
2.4.1	Reflection (optical) density	numerical value							
2.4.2	Transmission (optical) density	numerical value							
2.4.3	Light absorbing power	numerical value							
2.4.4	Light scattering power	numerical value							
2.4.5	Light absorption coefficient	m ² /kg							
2.4.6	Light scattering coefficient	m ² /kg							
2.4.7	Gloss	% or numerical value							
2.5	Electrical properties								
2.5.1	Surface resistivity	Ω							
2.5.2	Volume resistivity	$\Omega \cdot m$							
2.5.3	Electric strength	kV/mm							
2.6	Composition								
2.6.1	Constituents other than moisture or ash	g/m ² , mg/kg, g/kg, % (m/m)							
2.7	Other quantities								
2.7.1	Linear dimensions	nm, μ m, mm, m, km							
2.7.2	Wavelength (optical)	nm							
2.7.3	Mass	μ g, mg, g, kg, t							
2.7.4	Time	μ s, ms, s, min, h, d	ISO 5263, ISO 5264						
2.7.5	Area	mm ² , cm ² , m ²							
2.7.6	Volume	mm ³ , cm ³ , dm ³ , m ³							
2.7.7	Volume of fluids	as for 2.7.6 above or μ l, ml, l							
2.7.8	Dynamic viscosity	mPa · s, Pa · s							
2.7.9	Surface tension	mN/m							
2.7.10	Pressure and stress	Pa, kPa, MPa							
2.7.11	Frequency	Hz							
2.7.12	Rotational frequency	s ⁻¹ , r/s	ISO 5263						
2.7.13	Plane angle	° (with decimal sub-divisions)							
2.7.14	Linear load	kN/m							
2.7.15	Temperature	°C, K							
2.7.16	Colour temperature	K							
2.7.17	Force	N							
2.8	Surface properties								
2.8.1	Roughness, Sheffield	Sheffield units							

Annex A

(informative)

Conversion factors

Although this International Standard specifies the units recommended for paper, board and pulp testing, it is accepted that non-recommended, e.g. non-SI, units are still in use. It is therefore recognized that there is a need to convert from one system to another and a useful source of conversion factors is to be found in TAPPI Technical Information Sheet TIS 018-4.

This information is given for the assistance of users of this International Standard and not as endorsement of the use of non-recommended units, a practice which is deprecated.

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