INTERNATIONAL STANDARD

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Pulps — Determination of zero-span tensile strength, wet or dry

Pâtes — Détermination de la résistance à la traction à mâchoires jointives, à l'état humide ou sec

Reference number
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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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 15361 was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*, Subcommittee SC 5, *Test methods and quality specifications for pulp*.

Annex A forms a normative part of this International Standard.

Introduction

Tensile strength data at a span length of zero may be used to assess the retention of fibre strength through the entire fibre-processing chain, providing opportunities to optimize fibre characteristics and utilization in various paper grades. Tensile strength values determined at a span length of zero contribute to our understanding of finished sheet strength and are of increasing importance in measuring the impact of new pulping, bleaching and papermaking processes on fibre characteristics.

The zero-span tensile test may be used to determine the strength of pulp fibres when beaten under laboratory conditions, regardless of the laboratory beating procedure used. Measurement of zero-span tensile strength, in conjunction with tensile strength as well as other physical properties, is useful in optimizing new fibre-processing techniques and maximizing utilization of new fibre sources such as recycled fibres. Papers referenced in the bibliography give further information on the use of zero-span tensile measurements.

The clamping pressure utilized in zero-span testing ensures a maximum clamping effect but cannot totally prevent micro-slippage, whereby the tensile load transmitted in the clamped fibres is dissipated by frictional shear into the clamping jaws. This micro-slippage means that the ends of some fibres will slip out from beneath the clamping jaw, thereby diminishing the number of fibres carrying the load at tensile failure. In addition, if kinks in fibres are not removed in the beating process, test results may be diminished. For these reasons, careful interpretation of the zero-span tensile strength value should be exercised in order to separate effects due to the relative number of fibres which are carrying the load at failure, and the effects due to the tensile strength of the individual fibres present in the aggregate.

The zero-span strength values may be different if the samples are tested dry and conditioned, rewetted or wet (never dried).

Pulps — Determination of zero-span tensile strength, wet or dry

1 Scope

This International Standard specifies the procedure for determining the tensile strength of laboratory sheets at a test span which is initially zero. It is applicable to all kinds of fibres, including recycled fibres. The laboratory sheets can be tested either dry, rewetted, or never dried.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 187, *Paper, board and pulps — Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples.*

ISO 287, *Paper and board — Determination of moisture content — Oven-drying method.*

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

ISO 1924-2, *Paper and board — Determination of tensile properties — Part 2: Constant rate of elongation method.*

ISO 5263, *Pulps — Laboratory wet disintegration.*

ISO 5264-1, *Pulps — Laboratory beating — Part 1: Valley beater method.*

ISO 5264-2, *Pulps — Laboratory beating — Part 2: PFI mill method.*

ISO 5269-1, *Pulps — Preparation of laboratory sheets for physical testing — Part 1: Conventional sheet-former method.*

ISO 5269-2, *Pulps — Preparation of laboratory sheets for physical testing — Part 2: Rapid-Köthen method.*

ISO 7213, *Pulps — Sampling for testing.*

3 Terms and definitions

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

3.1
tensile strength
maximum force per unit width that a test piece of the sample will withstand before breaking under the conditions defined in ISO 1924-2

3.2
zero-span
shortest possible span between the clamps that hold the sample; when clamps are adjusted to zero-span, a beam of light aimed between the two clamps is completely interrupted

3.3
zero-span tensile strength
tensile strength value measured using an appropriate instrument, with the clamps adjusted to zero-span, under conditions specified in this International Standard

3.4
zero-span tensile index
zero-span tensile strength divided by the grammage

NOTE Either conditioned or oven-dry grammage may be used in the calculation, and should be reported.

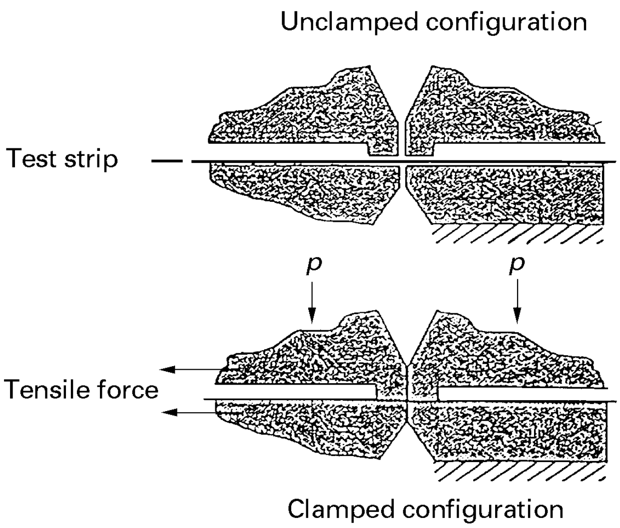
4 Principle

From a pulp suspension, laboratory sheets or wet test pieces are formed. They can be tested wet (i.e. never dried), dried (as conditioned) or rewetted. The test pieces are clamped in a tensile-testing instrument where the clamps are adjusted to zero-span and the test pieces are strained to break. The maximum force at rupture is measured and the zero-span tensile strength is calculated.

5 Apparatus

5.1 Tensile strength tester, complying with the following requirements.

5.1.1 Clamping device, incorporating two clamps with jaws for holding the test piece (see Figure 1). In each clamp, the lower jaw is planar, and is sometimes referred to as the anvil. The upper jaw is similar to the lower jaw, except that it includes a tip extending across the entire front width of the jaw and having a minimum dimension perpendicular to the width of at least 0,6 mm. The width of the jaws shall be between 15 mm and 25 mm, however, the exact width used is not critical, but shall be known to a certainty of ± 0,01 mm. The jaws shall be of identical width to ± 0,01 mm (see Figure 2).



p is the pressure applied to the test piece by the clamps in the pressurized state.

Figure 1 — Essential elements for any zero-span tensile tester

Dimensions in millimetres

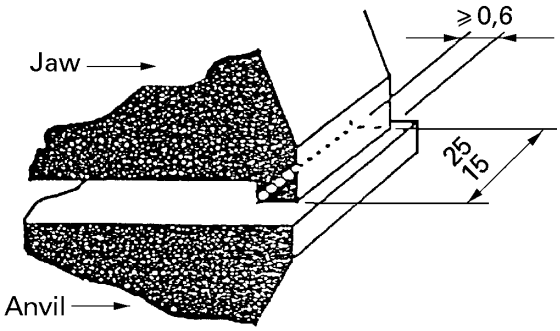


Figure 2 — Suitable arrangement for the clamps

There shall be a means for applying a clamping pressure by the clamps on the test piece. The clamping pressure shall be uniform to 0,1 % across the width of the jaw. The clamping pressure shall be variable between 250 kPa and 1 000 kPa.

The clamps shall be in alignment in both the horizontal direction, A, and vertical direction, B (see Figure 3). When the clamps are in the closed position with no test piece in place, a beam of light aimed to pass between the clamps, is completely interrupted. The alignment of the clamps is generally set by the manufacturer, and is not user-adjustable. In use, however, adherence of one or more fibres to one of the jaws is possible, in which case a light beam may not be completely interrupted. This matter shall be dealt with as described in 8.1.2.

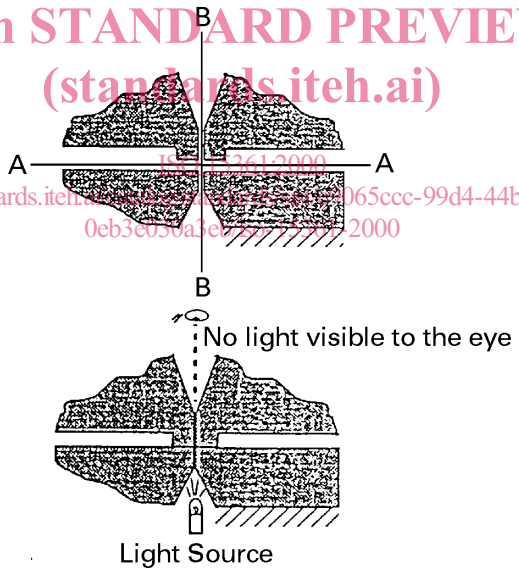


Figure 3 — Spatial alignment of the two clamps

5.1.2 Means of applying an in-plane tensile force within the fibre aggregate in the free span between the clamps, and of measuring the force at failure, complying with the following requirements.

The force shall be applied by tending to cause one clamp to move away from the other in such a way that the rate of increase of the force is (25 ± 2) N/s per 10 mm of jaw width. The accuracy of the means used to measure the applied force shall be ± 0,5 % of the measuring range of the tensile strength tester.

5.2 Laboratory sheet former, capable of producing homogeneous isotropic sheets with an oven-dry grammage of 60 g/m^2 ± 3 g/m^2.

5.3 Blotters, couch weight and plane press, for use in production of laboratory sheets and test pieces, as required in the standard for the sheet former used. (See ISO 5269.)