# GB

NATIONAL STANDARD OF THE

PEOPLE'S REPUBLIC OF CHINA

ICS 85.010

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# GB/T 12914-2018

Replacing GB/T 12914-2008

# Paper and Board - Determination of Tensile Properties - Constant Rate of Elongation Method (20 mm/min)

纸和纸板 抗张强度的测定 恒速拉伸法（20 mm/min）

[ISO 1924-2:2008, Paper and Board - Determination of Tensile Properties - Part 2: Constant Rate of Elongation Method (20 mm/min), MOD]

**Issued on: December 28, 2018** **Implemented on: July 1, 2019**

**Issued by: State Administration for Market Regulation;**

**Standardization Administration of the People's Republic of China.**

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# Foreword

This Standard was drafted in accordance with the rules in GB/T 1.1-2009.

This Standard serves as a replacement of GB/T 12914-2008 *Paper and Board - Determination of Tensile Properties*. In comparison with GB/T 12914-2008, the main technical changes are as follows:

---The title of the Standard is modified;

---The Scope is modified (see Chapter 1; Chapter 1 of Version 2008);

---A statement of differences between this Standard of GB/T 22898-2008 [ISO 1924-3:2005, MOD] is added (see NOTE of Chapter 1);

---The terms and definitions are modified (see Chapter 3): the definitions of elongation (see 3.3) and strain (see 3.4) are added;

---Relevant content of constant-rate loading method is deleted (see Chapter 4 of Version 2008); standard chapters are re-arranged;

---Strain measurement accuracy is modified into elongation measurement accuracy (see 5.1; 5.2.1.1 of Version 2008); supplementary statement of elongation measurement accuracy is added (see Note 2 of 5.1);

---The calculation formula of breaking length is added (see 9.5);

---The calculation formula of modulus of elasticity is modified (see 9.8; 10.8 of Version 2008);

---Relevant data of precision is added (see Table 2 and Table 3 of 10.3).

This Standard adopts the re-drafting method to modify and adopt ISO 1924-2:2008 *Paper and Board - Determination of Tensile Properties - Part 2: Constant Rate of Elongation Method (20 mm/min)*.

In comparison with ISO 1924-2:2008, the main technical differences and their causes are as follows:

---In terms of Normative References, this Standard adjusts the technical differences, so as to adapt to the technical conditions in China. The adjustments are intensively reflected in Chapter 2 “Normative References”. See the specific adjustments below:

- GB/T 450, which modifies and adopts international standard, is used to replace ISO 186;

# Paper and Board - Determination of Tensile Properties - Constant Rate of Elongation Method (20 mm/min)

## 1 Scope

This Standard stipulates the method of using test instrument with a constant rate of elongation (20 mm/min) to determine tensile strength, strain at break, breaking length and tensile energy absorption of paper and board. It also stipulates the calculation formulas of tensile index, tensile energy absorption and index and modulus of elasticity.

This Standard is applicable to all papers and boards, except corrugated paperboards.

**NOTE:** GB/T 22898-2008 *Paper and Board - Determination of Tensile Properties - Constant Rate of Elongation Method (100 mm/min)* (ISO 1924-3:2005, MOD) stipulates another form of constant rate elongation method: using 100 mm/min constant rate of elongation and 100 mm test length. For different samples, the rate of elongation has different effects on tensile strength, strain at break, tensile energy absorption and modulus of elasticity. Under most circumstances, when the rate of elongation increases from 20 mm/min (180 mm test length) to 100 mm/min (100 test length), tensile strength increases 5% ~ 15%. The test results obtained through the two methods should not be compared with each other.

## 2 Normative References

The following documents are indispensable to the application of this document. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

GB/T 450 *Paper and Board - Sampling for Testing and Identification of Machine and Cross Direction, Wire Side and Felt Side* (GB/T 450-2008, ISO 186:2002, MOD)

GB/T 451.2 *Paper and Board - Determination of Grammage* (GB/T 451.2-2002, eqv ISO 536:1995)

GB/T 451.3 *Paper and Board - Determination of* Thickness (GB/T 451.3-2002, idt ISO 534:1988)

GB/T 10739 *Paper, Board and Pulps - Standard Atmosphere for Conditioning and Testing* (GB/T 10739-2002, eqv ISO 187:1990)

### 3.9 Modulus of Elasticity

Modulus of elasticity refers to the maximum slope of the tensile force - elongation curve multiplied by the initial test length, and then, divided by the product of the width and thickness of the sample.

**NOTE:** refer to Figure 2.

## 4 Principle

Use a tensile tester, at a constant rate of elongation, stretch a sample of the specified size to break; record its tensile force. If necessary, record its elongation. If the tensile force and elongation can be continuously recorded, then, strain at break, tensile energy absorption and modulus of elasticity can be determined. Through the recorded data and known quantification of samples, tensile index and tensile energy absorption index can be calculated.

## 5 Instruments

### 5.1 Tensile Tester

**5.1.1** Tensile tester shall be able to stretch a sample of the specified size at a constant rate of elongation (20 mm/min), determine its tensile force, and if necessary, determine its elongation.

**5.1.2** The maximum allowable error of the tensile tester's tensile force determination and display device is ± 1%. If necessary, the maximum allowable error of its elongation determination and display device is ± 0.1%. Tensile force may be recorded as a function of elongation on electronic integrator or other equivalent devices.

**NOTE 1:** the measurement accuracy of elongation is of great importance. In order to accurately determine the actual elongation, it is recommended to install an appropriate extensometer directly on the sample, so as to avoid false elongation of the sample due to the imperceptible slippage of the sample in the chuck and the tightening of the connecting part of the instrument. The latter depends on the applied load. In terms of instruments that have been used for a period of time, due to the wear of the connecting parts, the error will increase. The additional load caused by the installation of the extensometer on the sample should be controlled within the required allowable error limit of tensile force.

**NOTE 2:** if the determination result of elongation is merely used for the calculation of strain at break and tensile energy absorption, then, the elongation determination accuracy of ± 0.1 mm is acceptable.

**5.1.3** Tensile tester includes two chucks, which are used to clamp samples of the

energy absorption needs to be determined, this device shall be used.

**NOTE:** some tensile testers are equipped with the function of calculating tensile energy absorption without external connection with the above-mentioned devices.

### 5.4 Device for Drawing a Tensile Force - Elongation Curve and Measuring the Maximum Slope of the Curve

It is only needed when the modulus of elasticity needs to be determined.

**NOTE:** some tensile testers are equipped with the function of drawing the tensile force-elongation curve and calculating the modulus of elasticity without external connection with the above-mentioned devices.

## 6 Adjustment and Calibration of Tester

**6.1** Install the instrument in accordance with the instruction manual. If necessary, in accordance with Appendix A, calibrate the tensile force determination device and elongation determination device of the instrument.

**6.2** Adjust the position of the chucks, so that the test length (the distance between the two clamping lines) is (180 ± 1) mm.

**NOTE:** under certain circumstances, for example, high-strain papers or length-limited samples, a smaller test length may be used. Under this circumstance, it is recommended to adjust the rate of elongation to (10 ± 2.5) % of the initial test length; indicate the adopted test length and rate of elongation in the rest report.

**6.3** In the chuck, clamp a thin aluminum foil; measure the distance between the two clamping indentations; check whether the test length is accurate.

**6.4** Adjust the chuck separation rate (sample elongation rate) to (20 ± 5) mm/min.

**6.5** Adjust the clamping pressure, so that the sample has no slippage or damage.

**NOTE:** in terms of some papers and paperboards, the sample might quickly break (within 5 s) or take a long time (for example, more than 30 s) to break. Under this circumstance, different rates of elongation may be used; indicate the rates of elongation in the test report.

## 7 Sample Preparation and Processing

### 7.1 Sampling

In accordance with GB/T 450, take samples.

### 7.2 Temperature and Humidity Treatment

In accordance with the stipulations of GB/T 10739, conduct temperature and humidity treatment on the sample. In addition, under such atmospheric conditions, prepare samples for the tests.

### 7.3 Sample Preparation

**7.3.1** From non-damaged paper and paperboard samples, cut sample strips with a width of (15 ± 0.1) mm and a length sufficient to be clamped between two chucks. Avoid using bare hands to touch the part of the sample between the two chucks. The test area must be free of watermarks, creases and wrinkles. If watermark must be included, it shall be indicated in the test report. The two long sides of the sample shall be flat and straight. Within the entire clamping length, the parallelism error shall not exceed ± 0.1 mm. The incision of the sample shall be neat and damage-free. Cut a sufficient number of sample strips, so as to ensure that there are 10 valid determination results in each direction (longitudinal or transverse).

**NOTE:** some papers are difficult to be evenly cut, two or three layers of paper may be sandwiched in a harder paper (for example, bond paper) to form a stack, then cut the samples.

**7.3.2** If tensile index or tensile energy absorption index needs to be determined, then, in accordance with the stipulations of GB/T 451.2, determine the quantification of the samples.

**7.3.3** If the modulus of elasticity needs to be determined, then, in accordance with the stipulations of GB/T 451.3, determine the sample thickness.

## 8 Test Procedures

**8.1** Check the zero position of the tester and the recorder (if necessary).

**8.2** Adjust the chuck distance to the specified initial test length; clamp the sample on the chucks. Pay attention not to use your hands to touch the test area between the two clamping lines. It is recommended to wear disposable gloves or lightweight cotton gloves when handling the samples. Straighten and firmly clamp the sample without leaving any perceptible loosening or obvious strain. Make sure that the sample is parallel to the direction of the applied tension (see Figure 1).

**NOTE 1:** when the instrument clamps the sample in the vertical direction, in order to prevent the sample from loosening, a small weight may be attached to the lower end of the sample, for example, a 10 g weight may be attached to a low-quantitative paper. This method is not suitable for high-strain papers.

**NOTE 2:** for certain types of paper, it is difficult to distinguish “perceptible loosening”

# Appendix A

**(normative)**

**Calibration of Tensile Tester**

In accordance with the frequency of use, regularly calibrate the instrument. It is recommended to calibrate at least once a month.

Use a weight with already-known mass and a maximum allowable error of ± 0.1% to calibrate the instrument's force-measuring device and recording device (if necessary). In accordance with the mass of the weight and the acceleration of gravity, calculate the applied force. In addition, calibration devices, for example, a pre-calibrated elastic calibration body, may also be used.

Under the loaded state, within the required elongation measurement range, use a Vernier caliper or block gauge to calibrate the elongation-measuring device and recording device (if necessary) of the tensile tester.

Some tensile testers' tensile force measuring devices may stretch after being stressed. At different points within the effective operating range of the instrument, simultaneously calibrate the tensile force and elongation measuring device, so as to ensure that the measurement results are not affected.

If the integrator is used to measure and determine tensile energy absorption, then, within the corresponding measuring range of tensile force and elongation, in accordance with the instruction manual, calibrate the integrator.

Check whether the chucks comply with the requirements of 5.1.3 and 5.1.4.

Check the drawing device used for the determination of the modulus of elasticity.

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