

# International Standard



# 5082

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## Textiles — Woven fabrics — Determination of breaking strength — Grab method

*Textiles — Tissus — Détermination de la force de rupture — Méthode d'arrachement*

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## Foreword

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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.

International Standard ISO 5082 was developed by Technical Committee ISO/TC 38, *Textiles*, and was circulated to the member bodies in September 1981.

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# Textiles — Woven fabrics — Determination of breaking strength — Grab method

## 1 Scope and field of application

1.1 This International Standard specifies a method, known as the "grab" method, for the determination of the breaking strength of woven textile fabrics.

NOTE — The determination of breaking strength using the "strip" method is given in ISO 5081.<sup>1)</sup> There is no simple relationship between results given by grab tests and those given by strip tests because the amount of assistance provided by the adjacent yarns depends on the type of weave, construction, mobility of yarns, and other factors.

1.2 The method is applicable to unimpregnated fabrics and to fabrics that have been impregnated with sizing or stiffening materials, but not to fabrics coated with rubber or plastics.<sup>2)</sup>

1.3 The method provides for the determination of the breaking strength of specimens in equilibrium with the standard atmosphere for testing and of specimens in the wet state.

1.4 The method authorizes the use of the following types of testing machine in common use for measuring the breaking strength of fabrics :

- a) constant-rate-of-specimen-extension (CRE) (see clause 5 and annex A, clause A.1);
- b) constant-rate-of-traverse (CRT) (see clause 5 and annex A, clause A.2);
- c) constant-rate-of-load (CRL) (see clause 5 and annex A, clause A.3).

The three types of testing machine do not necessarily give the same results for the same fabric. The type of tester to be used must, therefore, be agreed upon by all parties interested in the test results, and must be reported. As it has been found that the breaking strengths obtained on different types of tester agree best when the time-to-break is the same, the method provides for testing at a specific time-to-break (see 4.2) and rates of extension, traverse, or loading are not specified.

NOTE — When the time-to-break has been the same, excellent experimental agreement has been reported between results obtained with CRE and CRT testers, but results given by CRL testers have in some cases been reported to differ somewhat from the other results.

## 2 References

ISO 139, *Textiles — Standard atmospheres for conditioning and testing*.

ISO 2602, *Statistical interpretation of test results — Estimation of the mean — Confidence interval*.

## 3 Definitions

For the purpose of this International Standard, the following definitions apply.

**3.1 breaking strength** : The maximum tensile force observed during a test in which the specimen is stretched until it breaks.

**3.2 grab test** : A breaking strength test in which only the centre part of the width of the specimen is gripped in the jaws.

**3.3 nominal gauge length** : The length of a specimen under specified pre-tension, measured from nip to nip of the jaws of the holding clamps in their starting position.

**3.4 time-to-break** : The interval, measured in suitable units such as seconds, during which the specimen is under a (generally increasing) tension, i.e. absorbing the energy supplied before the breaking force is reached.

NOTE — Time-to-break does not include the time required to remove slack from the specimen. On machines supplied with an autographic recorder, the time-to-break is indicated by the time elapsing after the pen registers the initial force sustained by the specimen until the pen registers the maximum force.

## 4 Principle

### 4.1 Breaking strength

An increasing force is applied (until break occurs) by a suitable mechanical means that indicates the maximum force up to break. The testing machine is operated at such a rate that the average time-to-break of a group of specimens falls within specified time limits.

1) ISO 5081, *Textiles — Woven fabrics — Determination of breaking strength and elongation (Strip method)*.

2) The determination of breaking strength and elongation at break of fabrics coated with rubber or plastics is dealt with in ISO 1421, *Determination of breaking strength and elongation at break of fabrics coated with rubber or plastics*.

## 4.2 Time-to-break

Unless otherwise agreed upon by the parties interested in the test results, the specified period for the average time-to-break shall be either  $20 \pm 3$  s or  $30 \pm 5$  s.

## 5 Apparatus

**5.1 Tensile testing machine** meeting the following requirements :

### 5.1.1 Type

The type of machine shall be one of those described in annex A, as mutually agreed upon by the parties interested in the test results.

### 5.1.2 Machine requirements

The tensile testing machine shall include a pair of clamps suitable for gripping the specimen, and a force-indicating mechanism which will indicate (or record) continuously the force applied to the specimen.

### 5.1.3 Accuracy of recorder

The dynamic response rate of the recorder shall be sufficiently rapid to ensure that the maximum error of the indicated force at any point in the range in which the machine is used does not exceed 1 %. Before use, verify the accuracy of the graduated scale of the apparatus dynamically.

### 5.1.4 Gauge length

The testing machine shall be capable of testing specimens that have a nominal gauge length of 75 mm.

### 5.1.5 Jaws

The central points of the two jaws of the machine shall be in the line of pull, the front edges shall be at right angles to the line of pull, and their clamping faces shall be so aligned as to maintain specimens in a plane. The jaws of the clamps shall be capable of holding the specimens without slippage and without causing apparent damage.

The size of one jaw of each clamp shall be 25 mm × 25 mm; the other jaw of each clamp shall be at least as large as its mate. The gripping faces of the jaws shall, preferably, be smooth and flat, but when the specimens under test cannot be satisfactorily held with unlined flat faced jaws, jaws with lined or engraved faces may be used. (Suitable lining materials include paper, felt, leather, plastics, and sheet rubber.)

### 5.1.6 Rates of operation

All testing machines shall include facilities for producing such different constant rates of operation as will allow specimens to be broken in the applicable average time-to-break, i.e. unless otherwise agreed (see 4.2)  $20 \pm 3$  s or  $30 \pm 5$  s. Different

rates can be obtained most readily by means of a continuously variable drive, but satisfactory results can be obtained by means of a series of steps, provided that the latter are small enough. The ratio between the rates produced by consecutive steps should not exceed 125 : 100.

**5.2 Equipment in which specimens can be immersed in water preparatory to wet testing** (see 8.4).

**5.3 Equipment for cutting specimens.**

**5.4 Stop-watch or interval-timer.**

**5.5 Distilled or de-ionized water for wetting out specimens.**

**5.6 Wetting agent or surfactant, non-ionic.**

## 6 Atmospheres for testing

### 6.1 Standard atmosphere for testing

The standard temperate atmosphere for testing has a relative humidity (RH) of  $65 \pm 2$  % at a temperature of  $20 \pm 2$  °C. The standard tropical atmosphere for testing has the same relative humidity and a temperature of  $27 \pm 2$  °C (see ISO 139).

### 6.2 Pre-conditioning atmosphere

Suitable atmospheres and procedures for pre-conditioning are specified in ISO 139.

NOTE — Air at 20 °C and 65 % RH has a water vapour pressure of 1 515 Pa\* and when heated to  $47 \pm 2$  °C will produce an atmosphere having an RH of 12,3 % to 16,7 %. Air at the maximum permissible limits of 22 °C and 67 % RH has a vapour pressure of 1 700 Pa, and when heated to 50 °C has an RH in the range of 14,3 % to 19,4 %. If it is desired to keep the RH below 10 % and not to exceed a temperature of 50 °C, the original air must have a water vapour pressure below 1 230 Pa (equivalent to 53 % RH at 20 °C or 30 % RH at 27 °C).

## 7 Samples

**7.1 Both bulk samples and laboratory samples shall be taken in one of the following ways, as appropriate :**

- a) according to the directions given in the relevant material specification;
- b) if directions for sampling are not included in the material specification, according to the procedures approved by ISO for textile products;
- c) if neither a) nor b) is applicable, according to the method given in annex B.

\* 1 Pa = 1 N/m<sup>2</sup>

**7.2** Laboratory samples shall be conditioned as follows :

**7.2.1** Except in the case of heat-sensitive materials, the laboratory samples from which specimens are to be taken shall be pre-conditioned by exposing them for at least 12 h to freely moving air in the special atmosphere for pre-conditioning as given in 6.2.

**7.2.2** After pre-conditioning (when relevant), the samples shall be brought to moisture equilibrium for testing by exposing them for at least 24 h (48 h in the case of samples of tightly woven material) to the appropriate standard atmosphere for testing as given in 6.1.

## 8 Specimens

### 8.1 General

From each laboratory sample, two sets of test specimens shall be cut, one set in the warp direction and the other in the weft direction. Unless otherwise agreed by the parties interested in the test results, each set shall consist of at least five specimens, except that if a higher degree of precision is required, more specimens shall be tested.<sup>1)</sup> The specimens shall be as representative of the sample as possible. No two specimens shall contain the same longitudinal threads, and no warp direction specimen shall be cut from nearer either selvedge than one-tenth of the width of the test sample. An example of cutting specimens to meet the above conditions is given in the figure, annex C. Additional specimens shall be used for adjusting the time-to-break of the testing machine. All specimens shall be cut and tested in the standard atmosphere for testing.

### 8.2 Dimensions

The width of each specimen shall be  $100 \pm 2$  mm and its length shall be at least 150 mm.

### 8.3 Preparation

On each specimen, lines shall be drawn at a distance of 38 mm from each edge, parallel to either the warp or weft threads, as relevant, and running the full length of the specimen.

### 8.4 Wet test specimens

**8.4.1** When the wet breaking strength of the fabric is required in addition to the dry breaking strength, specimens of width  $100 \pm 2$  mm and at least twice as long as the specimens required for a dry test shall be cut. Each end of each specimen shall be numbered and then each specimen shall be cut crosswise into two parts, one for determining the dry breaking strength and the other for determining the wet breaking strength. (This ensures that each pair of specimens contains the same longitudinal yarns.) For fabrics which shrink excessively when wet, the initial length of test specimens for the determination of wet breaking strength must be greater than that of specimens for dry breaking strength tests.

**8.4.2** The wet test specimens shall be laid on the surface of distilled or de-ionized water at a temperature between 17 and 30 °C, until they sink under their own weight, but if this period exceeds 2 h, they shall be forcibly immersed in the water for at least a further 1 h.

When complete wetting of specimens that are normally resistant to wetting is essential, an aqueous solution containing not more than 1 g of non-ionic wetting agent per litre may be used instead of the water.

## 9 Procedure

### 9.1 Checking of apparatus

Check the testing machine to ensure that the distance between the clamps is equal (to within 1 mm) to the nominal gauge length (see 5.1.4). Check also that the clamps are properly aligned and parallel (to ensure that the subsequent application of force to the specimen will not cause any angular deflection of either clamp). Ensure that the appropriate standard atmosphere for testing prevails (see 6.1), and that the recording mechanism is operating properly.

### 9.2 Mounting of specimens

Mount a specimen centrally in the testing machine so that the longitudinal axis of the specimen is at right angles to the edges of the clamps after pre-tensioning (see 9.3) and the lines drawn on the specimens coincide with the corresponding side edge of the two clamps. In the case of tests on wet specimens, mount them immediately after removal from the water.

### 9.3 Pre-tensioning

**9.3.1** Unless the use of a lower tension is necessary (see 9.3.2), apply either of the following tensions :

- a tension equal to  $1 \pm 0,25$  % of the probable breaking strength;
- the tension given in table 1 appropriate to the mass per unit area of the fabric under test.

**Table 1 — Pre-tensioning of specimens**

Mass, g/m <sup>2</sup>	Force, N
Up to and including 150	2
Over 150 to and including 500	5
Over 500	10

**9.3.2** If the tension chosen in terms of 9.3.1 elongates the specimen by more than 0,5 %, use a lower tension that is acceptable to the parties interested in the test results.

NOTE — If, owing to the construction of the testing machine or for other reasons, no pre-tension is applied, this shall be stated in the test report [11 g].

1) The parties interested in the test results are referred to ISO 2602.

**9.4 Preliminary test**

Use an additional specimen (see 8.1) and, after pre-tensioning (if relevant), set the moving clamp in motion at a rate estimated to result in an average time-to-break as specified. In the case of tests on wet specimens, ensure that the test is completed within 120 s of removal of the specimen from the water.

After the specimen has been broken, note

- a) the maximum force recorded;
- b) the time-to-break.

Return the moving clamp to its zero position, remove the ends of the broken specimen, and repeat the above procedure on two additional specimens.

If the average time-to-break of the first three preliminary tests does not fall within the applicable limits, i.e. unless otherwise agreed (see 4.2),  $20 \pm 3$  s or  $30 \pm 5$  s, discard the results and, using a suitably different rate of traverse of the moving clamp, repeat the procedure described above. Continue in this way until the average time-to-break is within the applicable limits.

**9.5 Final tests**

**9.5.1** Using the final rate of operation established in accordance with 9.4, test the required number of specimens (see 8.1). For each specimen note the maximum force recorded.

**9.5.2** Discard the result on any specimen that slips in the clamp or breaks in the clamp or within 5 mm of the edge of the clamp, if there is reason to believe that the machine has operated in a faulty manner. Otherwise accept the result provided that it is not lower than the lowest result obtained on specimens from the same sample which break in a normal manner. When a result is discarded, repeat the test on a replacement test specimen taken (if practicable) from the same part of the test sample as the discarded specimen.

**10 Expression of results**

**10.1 Units**

Express the breaking strength in newtons.

**10.2 Calculation of mean breaking strength**

For each set of warp and weft direction specimens, calculate (separately) the mean breaking strength as follows :

$$\bar{F} = \frac{\sum F_i}{n}$$

where

$\bar{F}$  is the mean breaking strength, in newtons;

$\sum F_i$  is the sum of the observed values of breaking strength, in newtons;

$n$  is the number of observations (see 9.5).

Express the mean breaking strength to a precision of 1 %.

**11 Test report**

The test report shall state that the tests were performed in accordance with this International Standard and shall also include the following particulars :

- a) the date of the test;
- b) the observed values of breaking strength of each specimen and the average breaking strength of each laboratory sample, in newtons (warp and weft directions separately);
- c) the results of tests that have been repeated and the reasons for which they have not been retained;
- d) the time-to-break (either  $20 \pm 3$  s or  $30 \pm 5$  s);
- e) the sampling scheme used;
- f) the number of specimens tested of each laboratory sample;
- g) the type (whether CRT, CRE or CRL) and capacity of the testing machines used;
- h) details of any deviation from the specified test procedure;
- j) state of specimens (conditioned or wet).

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## Annex A

### Types of testing machine

(Forms part of the Standard.)

#### A.1 Constant-rate-of-specimen-extension type of testing machine

##### A.1.1 Principle

The specimen is elongated at a predetermined constant rate which is such that the average time-to-break will fall within the specified limits.

##### A.1.2 Testing machine

A constant-rate-of-extension testing machine shall comply with the requirements given in clause 5. After the first 2 s of the operation, the rate of increase in the distance between the clamps shall be uniform to within 5 %. The testing machine shall be capable of operating at such different constant rates of elongation that, regardless of the extent of elongation, the specimen is elongated to breaking point within the applicable time limits.

#### A.2 Constant-rate-of-traverse type of testing machine (Pendulum or spring weighing mechanism)

##### A.2.1 Principle

The specimen is subjected to an increasing force by the moving clamp traversing at a constant rate which is such that the average time-to-break will fall within the specified limits.

#### A.2.2 Testing machine

A constant-rate-of-traverse testing machine with a pendulum or a spring type weighing mechanism shall comply with the requirements given in clause 5. The machine shall be capable of operating at such different constant rates of traverse that, regardless of the strength of the specimen, the breaking point is reached within the applicable time limits.

#### A.3 Constant-rate-of-load type of testing machine

##### A.3.1 Principle

The specimen is subjected to a force that increases at a predetermined constant rate which is such that the average time-to-break will fall within the specified limits.

##### A.3.2 Testing machine

A constant-rate-of-load tensile testing machine shall comply with the requirements given in clause 5. After the first 2 s of the operation, the rate of increase of force per unit time shall be uniform to within 10 %. The machine shall be capable of applying a range of constant rates of loading such that, regardless of the strength of the specimen, the breaking force (maximum force) required can be applied within the applicable time limits.

## Annex B

### Suggested procedure for sampling

(Forms part of the Standard.)

#### B.1 Bulk sample (number of pieces from a shipment or lot)

Take at random from the shipment or lot the appropriate number of pieces shown in table 2. Ensure that no piece that shows signs of damage or dampness incurred during transit is included in the sample.

#### B.2 Number of laboratory samples

From each piece in the bulk sample, cut (from a position taken at random but at least 3 m from an end of the piece) a laboratory sample of length at least 1 m and of full width. Ensure that areas that are creased or that have visible faults are not included in a sample, and roll each sample on a tube.

Table 2 — Bulk sample

Number of pieces in shipment or lot	Number of pieces in bulk sample, minimum
3 or less	1
4 to 10	2
11 to 30	3
31 to 75	4
76 or more	5

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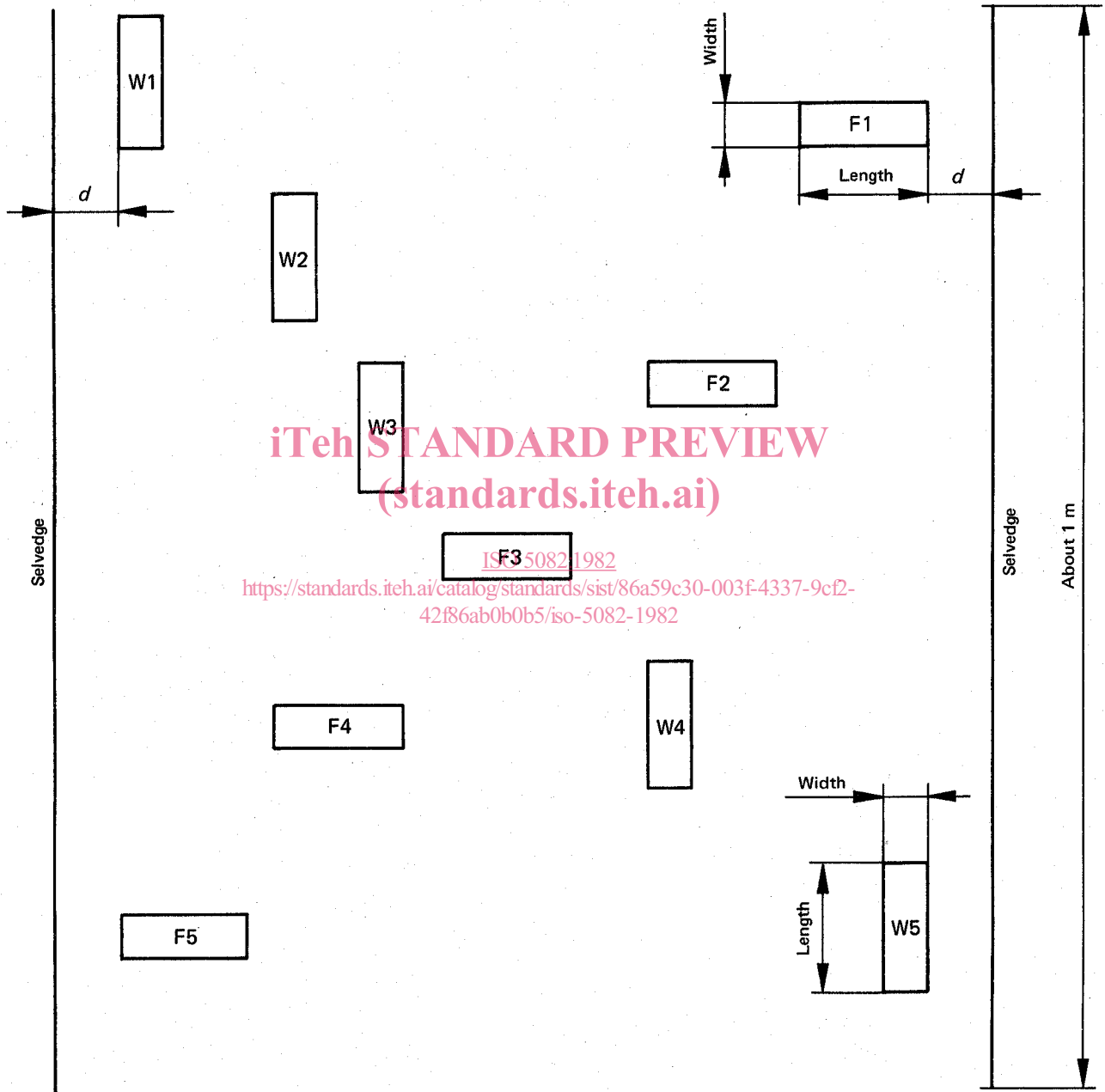
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## Annex C

### Example of cutting specimens

(Forms part of the Standard.)



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$d$  = at least one-tenth of width of sample

F : weft direction      W : warp direction

Figure — Example of cutting specimens