

STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard
METHODS OF TEST FOR TEXTILES

PART 2—PHYSICAL TESTS

AS 2001.2.7
DETERMINATION OF BREAKING FORCE AND
EXTENSION OF YARNS

PREFACE

This edition of this standard was prepared by the Association's Committee on Testing of Textiles. It supersedes AS L54—1970.

This standard is based on ISO 2062-1972, Textiles—Yarn from packages—Method for determination of breaking load and elongation at the breaking load of single strands—(CRL, CRE and CRT testers).

The principal changes in this edition are:

- (a) Precludes the use of testing machines not based on the constant rate of extension principle.
- (b) Provides for a testing machine capable of operating at a rate of jaw separation of 200 ± 10 mm/min, and the use of 500 ± 1 mm gauge length. Alternative gauge lengths may be used as agreed by the interested parties.
- (c) Includes sampling from bulk consignment.
- (d) Mentions the use of automatic testing machines for product control testing from packages.
- (e) Includes additional points relating to the use of automatic testing machines as an option to manual testing.

METHOD

1 SCOPE. This standard sets out a method for determining the breaking force and breaking extension of various types of yarn. It is designed primarily for yarn taken from skeins or packages, but can be used for yarns extracted from a fabric. The method uses a tensile machine based on the constant rate of extension principle.

2 APPLICATION. This method is applicable to monofilament, multifilament and spun yarns, either single, plied or cabled with the exception of yarns which stretch more than 0.5 percent when the tension is increased from 0.5 to 1.0 centinewton per unit of linear density (cN/tex).

The method is not applicable to yarns having a linear density greater than 2000 tex.

3 REFERENCED DOCUMENTS. The following standards are referred to in this standard:

- AS 1010 Method for the Determination of Linear Density of Textile Yarn from Packages.
- AS 2001 Methods of Test for Textiles
AS 2001.1 Conditioning Procedures
- AS 2193 Methods of Calibration and Grading of Force Measuring Systems of Testing Machines

4 DEFINITIONS. For the purpose of this standard, the following definitions apply:

4.1 Breaking force—the maximum force applied to a specimen in a tensile test carried to rupture. It is expressed in N, cN or mN.

4.2 Extension at break—the increase in length at rupture of a specimen during a tensile test expressed as a percentage of the original length.

4.3 Tenacity—the tensile stress expressed as the ratio of the breaking force to the linear density of the unstrained specimen.

4.4 Gauge length—the length of a specimen under specified pretension measured from nip to nip of the jaws of the holding clamps in their starting position at the beginning of the test, and including any portion of the specimen in contact with bollard or snubbing surfaces.

4.5 Yarn package—a length or lengths of yarn in a form suitable for use, handling, storing or shipping. Packages may be unsupported, such as balls, skeins or cakes or supported such as bobbins, cops, cones, pirns, spools, tubes or beams.

4.6 Yarn—a product of substantial length and relatively small cross-section consisting of fibres or filaments or both, with or without twist.

5 PRINCIPLE. A specimen is gripped in a tensile testing machine of suitable capacity and extended until it breaks. The tenacity may be calculated if required.

6 APPARATUS.

6.1 Conditioning facility. Means of providing and maintaining a standard atmosphere as described in AS 2001.1.

6.2 Tensile testing machine. A constant rate of extension (CRE) testing machine complying with the following requirements:

- The machine shall comply with the requirements of Grade B machines specified in AS 2193, except that error in measurement of length shall not exceed 1.0 mm.
- The machine shall provide means for indicating the maximum force applied in breaking the specimen; the force shall be indicated clearly to an accuracy of 1 percent on a dial, scale or chart. The machine shall provide means for indicating or recording the extension at the breaking point.
- The machine capacity or measuring range selected shall be such that the value of the breaking force of the yarns under test shall not be less than 20 percent of the selected range of the machine.
- The machine shall be capable of operating at a constant rate of 200 ± 10 mm/min.
- The force measuring mechanism of the machine shall allow little or no movement of the fixed jaws in the direction of the applied load.
- The fixed and moving jaws of the machine shall be in the same plane, parallel to one another and at right angles to the direction of the force.
- The jaws of the clamps shall be smooth, flat, and capable of holding the specimens without slippage and without apparent damage. When specimens cannot be suitably held with unlined flat-faced jaws, lined jaws or, if necessary, bollard clamps, or some other type of snubbing device which is satisfactory to all interested parties may be used. Such use shall be noted in the report and attention shall be drawn to the fact that the specimen length is not determined precisely. Consequently the

indicated extension should not be compared with that obtained with unlined flat jaws.

- The machine shall be capable of testing specimens with a nominal gauge length of 500 ± 1 mm, or as agreed upon by the interested parties.
- Means of applying the pretension force of 0.5 ± 0.1 cN/tex.

7 SAMPLE AND TEST SPECIMENS. Care should be taken to ensure that the operator's hands are dry. Excessive handling of the sample and test specimens should be avoided.

7.1 Sample. The sample shall be selected in one of the following ways:

- According to the directions given in the relevant material specification.
- According to the procedure agreed upon by the interested parties, if such directions are not included in the material specification.
- According to the procedures approved by SAA for textile products*, if directions on sampling are not included in the material specification.
- Yarn from packages.*
 - Bulk sample.* Take a bulk sample of one or more cases, as representative of the lot to be tested, according to Table 1.

TABLE
RELATIONSHIP BETWEEN BULK SAMPLE
AND MINIMUM NUMBER OF CASES
TO BE SELECTED

Number of cases in shipment or lot	Minimum number of cases to be selected at random
3 or less	1
4 to 10	2
11 to 30	3
31 to 75	4
76 or more	5

Take care that none of the cases selected for sampling shows signs of damage or dampness incurred during transit.

- Number of laboratory sample packages.* In the absence of a material specification, select 10 yarn packages from the bulk sample, taking as nearly as possible the same number of packages from each case and choosing packages at random from the top, middle and bottom layers in the cases and from the middle and sides of the layers. Take, as nearly as possible, the same number of specimens from each package of the laboratory sample.

In cases where the bulk sample contains less than 10 yarn packages, all available packages shall form the laboratory sample.

If woven or knitted fabrics need to be sampled the sample shall be large enough to furnish a sufficient number of test specimens. The test specimens shall be taken in such a manner that the twist of the yarns is not changed during sampling. When yarns in a woven fabric are to be tested, warp specimens shall be taken from different ends, and weft yarns shall be

* In course of preparation.

taken so as to represent as many cops or pirns as practicable. The specific sampling procedure shall be reported.

- (iii) *Laboratory sample skeins.* These may be prepared as a source of specimens from bulk sample packages to accelerate conditioning. In reeling the skein, take the yarn from the end of the package if this is the normal method of use, otherwise take the yarn using the least tension practicable. Skeins shall be reeled under conditions which avoid tension above that needed to lay the yarn smoothly on the reel. The skeins shall be of the length required for the number of tests to be made (see Clause 7.3).

NOTE: Testing from a sample skein is preferred to testing from a tightly wound package because of the ease of conditioning the yarn in skeins. However, the outer layers of a tight package reach approximate equilibrium in a reasonable length of time (48 h), and, where only a few metres are to be used for testing and extreme accuracy is not required (as, for example, in production control work), it may be more convenient to condition and test the yarn in package form using automatic single end, multi-package testing machines. The results obtained from yarn taken from a relaxed skein may differ from those obtained for yarn taken directly from a tight package.

7.2 Conditioning. Samples shall be conditioned according to procedures specified in AS 2001.1. Preparation of test specimens and subsequent testing is to be conducted without removal from the standard atmosphere.

7.3 Test specimens.

7.3.1 Length. Individual specimens shall have a minimum length of 600 mm of yarn; a length of 1000 mm facilitates handling and preservation of twist.

7.3.2 Number of specimens. The number of specimens shall be determined as follows:

- Test the number of specimens required in the material specification, when applicable.
- In the absence of material specification, all interested parties shall agree upon—
 - the acceptable level of probability of the test results;
 - the desired precision of the test result;
 - representative values for the coefficient of variation, or the standard deviation of the type of yarn to be tested.

The number of tests shall then be calculated according to accepted statistical methods, (see Appendix A). If, for any reason it is not possible to make the indicated number of tests, it will be necessary to revise the specified precision or probability or both.

- When the directions given in (a) and (b) do not apply or are inoperable, choose a number of specimens which will give a precision (maximum permissible error of the mean) of ± 4 percent at a probability level of 90 percent. The number of specimens can be calculated as $0.17 V^2$, where V is the coefficient of variation of the individual breaks. V should preferably be based on long past experience with yarns of a type similar to that being tested.

- If V is not known, test the number of specimens given in Table 2 below. The coefficients of variation, V , on which these numbers of tests are based are also indicated.

TABLE 2
NUMBER OF TESTS TO OBTAIN A
PRECISION OF ± 4 PERCENT AT A
PROBABILITY LEVEL OF 90 PERCENT

Type of yarn	Number of tests	V%
Single spun	60	18.5
Plied spun	30	13
Single multifilament		
Plied multifilament		
Cabled spun yarns	20	11

NOTE: The values of V assumed in Table 2 are somewhat higher than will be found in practice in most cases. By knowing the value of V which actually applies to the yarn under test, it will usually be possible to make fewer tests than specified in Table 2.

- Take, as nearly as possible, the same number of specimens from each of the packages, of which there should be no fewer than 10 (see Clause 7.1(d)(ii)).

7.3.3 Selection. Test specimens shall be selected as follows:

- Depending on the purpose of the test and the equipment to be used, specimens may be taken from either—
 - laboratory sample skeins; or
 - laboratory sample packages.
 The selected alternative shall be agreeable to all interested parties. In either case, the specimens shall be selected at random.
- If more than one specimen is to be taken from a laboratory sample skein, cut the skein and secure the ends with clamps to prevent loss of twist. Withdraw test specimens at random.
- If more than one test specimen is taken from an individual package, select them at random in such a manner as to minimize the effect of cyclic variations introduced during the manufacturing process, for example, at intervals of at least 1 m between successive specimens along the yarn. If more than 5 specimens are taken from an individual package, groups of specimens, not more than 5 to a group, shall be taken at intervals of several metres. When taking individual specimens or reeling laboratory sample skeins, discard the few metres of yarn at the beginning and end of the package in order to avoid damaged sections.
- Take precautions to avoid any loss of twist in the individual specimen before it has been secured in the clamps of the testing machine. Take the yarn from the package as directed in Clause 7.1(d)(iii).

8 PROCEDURE. The procedure for each test specimen shall be as follows:

- Testing shall be conducted in the standard atmosphere (6.1).
- Adjust the machine to allow for a gauge length of 500 ± 1 mm.

NOTE: By agreement, the nominal gauge length of 100 ± 1 mm or 200 ± 1 mm may be used for yarns with high extensibility. However, under these conditions slightly higher results are likely to be obtained. It is recommended that the 500 mm gauge length should be used for yarns with an extensibility of less than 50 percent, and 100 mm gauge length for yarns with an extensibility of greater than 50 percent.