Standard Procedure SP 0012-1:2005

Methods of testing strengths of materials - Part 1: Comparing the tensile strength of sheet materials

1 Scope

This procedure is adapted from BS 903-A1:1995 Physical testing of rubber – Method for determination of tensile stress-strain properties.

It can be used to compare the tensile strength of sheets of materials, such as plastics, paper and card, or metal foils. The test also gives an indication of the test material's ductility.

A similar procedure can be used to compare wires and fibres (natural or plastic), though this requires measurement of the diameter.

2 Definitions

tensile strength
the tensile stress required to break the specimen. It is calculated as the force per unit area of the original cross-section of the test piece.

comparative tensile strength
a value which allows the strength of different specimens to be compared without the need to determine cross-sectional area

3 Principle

A test specimen is stretched by applying a tensile load, which is gradually increased until the test specimen breaks. A comparative value for tensile strength can be determined by dividing the force required to break the material by the width of the test specimen. The value can be used to compare with other materials of the same thickness, tested using this method. Different thicknesses of the same material may also be compared.
The method in BS 903-A1 includes measuring the thickness of the specimen. This allows the actual tensile strength to be determined, not just a comparative value.

4 Apparatus

- large pair of scissors, or surgical knife for cutting test pieces
- clear sticky tape
- metre rule
- clamp and stand
- wooden blocks
- strong thread
- dowel with a pin or pointer attached to one end
- 100 g mass hanger
- 100 g masses
- 10 g masses
- box of crumpled paper

5 Test Specimens

Test specimens should be 10 mm wide and of uniform thickness. The length should be sufficient to set up the apparatus with 300 mm of test material between the clamps.

Note: Results for test specimens of different thickness are not comparable. Thus, samples of card or board of similar thickness may be compared with each other, but not with samples of paper or thin plastic film.

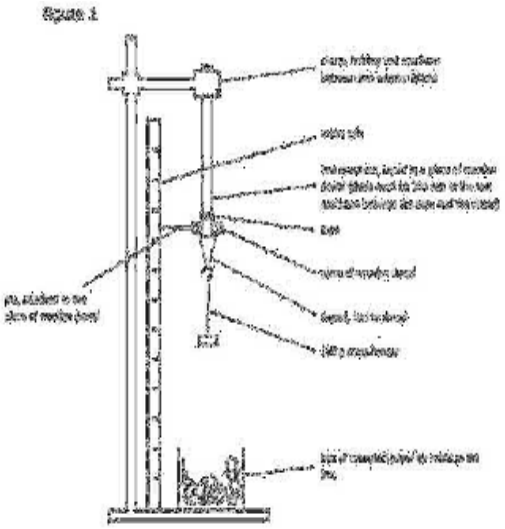
If test specimens break very easily (in other words, under only a small load), increase the width. Similarly, if they do not break under laboratory test conditions, decrease the width.

At least three test specimens of each material should be tested.

6 Procedure

- Set up the apparatus as shown in figure 1. Record the position of the pin on the ruler scale.
- Add a 100 g mass to the mass holder. Record the mass and the position of the pin.
- Keep adding 100 g masses until the test specimen breaks. Record the position of the pin every time you add a new mass.
- Record the mass, in kilograms, required to break the test specimen
(NOTE: 1 kg = 1000 g).

- If the test specimen breaks after only a few hundred grams, repeat the procedure using 10g masses instead of 100g.



7 Expression of Results

Calculate the force F required to break the test specimen using the equation:

$F = m \times 9.8$

where

F is the force required, in newtons;

m is the mass required, in kilograms;

9.8 is the acceleration due to gravity.

Calculate a comparative value for the tensile strength S_t of the test specimen using the equation:

$S_t = F/w$

where

S_t is the strength, in newtons per millimetre ($N\ mm^{-1}$);

w is the width of the test specimen, in millimetres.

Plot a graph of the distance the pin moves (in millimetres) on the y-axis against mass (in kilograms) on the x-axis.

The shape of the graph gives an indication of the material's ductility. The steeper the graph, the more ductile the material.

8 Test Report

Your test report should include:

(a) reference to this Standard Procedure;

(b) the identity and comparative tensile strength of each test specimen;

(c) the average tensile strength of test specimens of the same material;

(Calculate this by adding the tensile strengths of all test specimens of this material, and dividing the total by the number of specimens tested.)

(d) A general description of how ductile the test specimen was.

Note: Values determined by this method can only be used to compare tensile strengths of different materials if the test specimens had the same thickness. The value of S_t is not the true tensile strength, which is measured in newtons per square millimetre (or per square metre), taking thickness into account.