SRI LANKA STANDARD 477:1979
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METHOD FOR
TESTING OF BOARD FOR PUNCTURE RESISTANCE

BUREAU OF CEYLON STANDARDS

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SLS 477 : 1979

Gr. 3

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Sri Lanka.

Sri Lanka Standards are subject to periodical revision in order to accommodate the progress made by industry. Suggestions for improvement will be recorded and brought to the notice of the Committees to which the revisions are entrusted.

This Standard does not purport to include all the necessary provisions of a contract.

SRI LANKA STANDARD

METHOD FOR TESTING OF BOARD FOR PUNCTURE RESISTANCE

FOREWORD

This Sri Lanka Standard was adopted from the relevant International Standard on Board on the recommendations made by the Drafting Committee of the Bureau of Ceylon Standards on Packaging. It was approved by the Civil Engineering Divisional Committee of the Bureau and was authorised for adoption and publication by the Council of the Bureau on 1979-12-21.

This standard is technically identical to ISO 3036 - 1975(E) - Board - Determination of Puncture Resistance. This is part of a series of standards on Paper and Board, the others in the series being:

a) SLS 338 Method of test for the determination of substances of paper and paper board.

b) SLS 473 Method for testing of paper and board for water absorption - Cobb method.

c) SLS 474 Method for testing of paper and board for tensile strength.

d) SLS 475 Method for testing of paper and board for stiffness - static bending method.

e) SLS 476 Method for testing of paper and board for bursting strength after immersion in water for a specified period.

f) SLS 478 Method for testing of corrugated fibreboard for thickness.

g) SLS 479 Method for testing of single-faced and single wall corrugated fibreboard for flat crush resistance.

h) SLS ... Method for testing of board for bursting strength (Under preparation).

j) SLS ... Method for testing of paper for bursting strength (Under preparation).

This method of determining puncture resistance is applicable to all types of heavy board including corrugated fibre board; specially those used in the manufacture of packing cases.

1 SCOPE

This standard specifies a method for determining the puncture resistance of board.

2 PRINCIPLE

Subjection of a test piece from a representative sample of board to puncture by a triangular pyramid puncture head attached to a pendulum.

Measurement of the energy required to force the puncture head completely through the test piece, that is: to make the initial puncture and to tear and bend open the board.

3 APPARATUS

3.1 Description of apparatus

The apparatus used in a puncture tester, which produces an impact by means of pendulum. The bed plate of the frame of the instrument shall be firmly attached to a strong base to prevent energy losses. The instrument shall be accurately levelled, and shall not vibrate during the test.

NOTE - The instrument shall be so designed that the energy contained in the pendulum in each of the measuring ranges corresponds to the respective scale.

The instrument consists of the following elements:

3.1.1 *Pendulum and puncture head*

The pendulum is fitted with an arm, having the shape of a 90° circular arc to which the puncture head is attached. Both pendulum and arm shall be strong enough to minimize deformation and vibration when the test is carried out.

The puncture head shall be a right-angled triangular pyramid, 25 ± 0.7 mm high, with edges between sides honed to a radius between 1.0 mm and 1.6 mm.

One of the edges of the base of the pyramid shall be parallel to the axis of rotation of the pendulum, and the opposite corner of the base shall point towards the axis of rotation.

The axis of symmetry through the effective point of the puncture head shall be vertical when it is half-way through the horizontal plane through the axis of the pendulum*

**To allow the use of existing instruments, a tolerance of ± 12.5 mm is acceptable on the distance between the mid-point and the horizontal plane.*

At the release point, the pendulum shall be in the horizontal position, which is determined by measuring through an angle of 90° from the pendulum with its centre of gravity at rest.

3.1.2 *Interchangeable weights*

By the use of interchangeable weights that can be attached to the pendulum, several ranges of energy are provided.

The range selected shall be such that the test result will be between 20 per cent and 80 per cent of the maximum value of the corresponding scale.

3.1.3 *Release mechanism*

A safety catch shall be provided to prevent accidental release of the pendulum. The release mechanism shall not impart any acceleration or deceleration to the pendulum.

3.1.4 *Collar*

The neck of the puncture head shall be fitted with a close-fitting collar designed so as to slip off its seating and to keep open the aperture in the test piece after the puncture head has passed through. This is to prevent the corrugated fibreboard from springing back on the arm and breaking the pendulum, thus altering the test result.

The loss of energy due to friction when the collar is forced off its seating shall be measurable and shall not exceed 0.25 J. This loss of energy shall be compensated for in the reported test results.

3.1.5 *Clamping device*

To hold the test piece, two horizontal clamping plates are provided, the upper plate being fixed. The lower face of the upper clamping plate, which contacts the

test piece, shall be on the horizontal plane through the axis of the pendulum, or up to 7 mm above it.

Both clamping plates shall be sufficiently rigid to withstand the clamping forces employed, without deformation.

The effective clamping dimensions of the clamping plates shall be not less than 175 mm x 175 mm.

The upper clamping plate shall have an opening in the centre in the form of an equilateral triangle with sides 100 ± 2 mm in length. The aperture in the lower plate should preferably be identical and coincident with that in the upper plate; however, a centrally positioned circular aperture, with a diameter 90 ± 2 mm may be used*.

The force holding the test piece between the clamping plates shall be at least 250 N and not more than 1000 N. If the instrument has no device for measuring the clamping force, the force applied shall in any case be sufficient to ensure that the test piece does not slip when the test is carried out.

3.1.6 *Measurement indicator*

The test result shall be indicated by a friction-loaded pointer operating over a dial on which the several scales corresponding to the energy ranges are engraved. The scale divisions shall be calibrated in joules**.

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*To allow the use of certain existing types of instrument the lower plate may have a centrally positioned circular aperture with a diameter up to 100 mm.

**Many existing instruments are calibrated in GE units and kgf. cm:

1 GE unit = 0.0298 J

1 kgf. cm = 0.098 J

The friction mounting of the pointer shall be just sufficient to ensure smooth operation without over-run.

3.2 Adjustment of the instrument

For all measuring ranges, the affective point of the puncture head shall be within ± 5 mm of the horizontal plane through the axis of rotation of the pendulum, when the centre of gravity of the pendulum is at its lowest point.

3.3 Instrument checks

No compensation for loss of energy due to friction shall be made in the calibration of the measuring scales.

Energy loss due to friction in the bearings of the pendulum and to air resistance shall not exceed one per cent of the measuring scale.

To measure energy loss due to collar friction, a slip-off device shall be provided which catches the collar when the pendulum is allowed to swing freely from the release point.

Energy losses due to pointer friction shall be determined by twice allowing the pendulum to make a free swing from the release position. The first swing shall carry the pointer close to the scale zero. The second free swing made without resetting the pointer, shall carry the pointer nearer to the zero reading. The difference between the two readings represents the energy loss due to pointer friction.

When making re-adjustments to the settings of the measuring scales, the following checks shall be made:

Allow the pendulum to come to rest, with its centre of gravity at the lowest point, then move the pointer towards the maximum scale value. When the drive pin just touches the pointer, the latter shall indicate the

maximum scale value. Carry out an analogous check with the pendulum in the horizontal position, 180° from the release point, when the pointer shall indicate zero.

4 SAMPLING

Sampling shall be carried out in accordance with SLS...*

3 PREPARATION OF TEST PIECES

Prepare test pieces with minimum dimensions 175 mm x 175 mm from the sample selected in accordance with 4. These test pieces shall be free from conversion machine marks, irregularities and damage. In no instance shall the puncture area be less than 60 mm from the edge of the test piece or from any crease, score, or printed area. If for some reason a printed area is used for the test, this fact shall be clearly stated in the test report.

6 CONDITIONING

The test pieces shall be conditioned in accordance with SLS 374**.

7 PROCEDURE

Carry out the tests in the standard atmosphere specified in **6**.

Place the test piece between the clamping plates and clamp it with a constant force. If the instrument is equipped with a clamping force measuring device, record the force.

**SLS ... Method of sampling paper and board for testing (under preparation).*

***SLS ... Atmospheric conditions for conditioning and testing.*

Adjust the pendulum mass, using the supplementary weights as necessary, to operate over the energy range that will contain the expected test result within 20 per cent and 80 per cent of its maximum value.

With the pendulum held by the release mechanism, slide the collar over its seating on the neck of the puncture head, and set the indicating pointer to the maximum scale value.

Then operate the release mechanism so that the puncture head completely pierces and passes through the test piece. Read the amount of energy used, representing the work in puncturing the test piece and overcoming the friction in the instrument, from the appropriate scale. Scale readings shall be taken to the nearest 0.1 J for measuring ranges up to 12 J and to the nearest 0.2 J for measuring ranges above 12 J.

Compensate the test result for predetermined energy losses caused by friction in the apparatus if the friction is greater than or equal to one per cent.

Unless otherwise agreed between the interested parties, make ten replicate tests from each side of the material, five tests from each side with the cross direction or the flutes parallel with the axis of rotation of the pendulum, and five tests from each side with the cross direction or the flutes perpendicular to the axis of rotation of the pendulum.

8 EXPRESSION OF RESULTS

Calculate the arithmetic mean puncture resistance in joules; report the results to the nearest 0.1 J for values up to 12 J and to the nearest 0.2 J for values above 12 J.

If the mean puncture resistance for the two sides of the test piece differs by more than 10 per cent of the

highest value, report the values separately; otherwise, report the mean.

9 TEST REPORT

The test report shall include the following particulars:

a) a reference to this Sri Lanka Standard;

b) the date and place of testing;

c) the make and type of test instrument used;

d) a description and identification of the material tested;

e) the conditioning atmosphere used;

f) the number of replicate tests carried out;

g) the arithmetic mean of all the replicate test results, in joules;

h) if required, the separate arithmetic mean and range of the results for each configuration, that is: the results of the tests made from each direction and from each side;

j) the clamping force, in newtons;

k) details of any deviation from this test method; and

l) any other information which may assist in the interpretation of the test results.

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