SRI LANKA STANDARD 9 : PART 1 : 2001
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SPECIFICATION FOR
ASBESTOS-CEMENT PRODUCTS
PART 1 : FLAT SHEETS
(SECOND REVISION)

SRI LANKA STANDARDS INSTITUTION

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SLS 9 : Part 1 : 2001

Gr. 10

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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
SPECIFICATION FOR ASBESTOS-CEMENT PRODUCTS
PART 1 : FLAT SHEETS
(SECOND REVISION)

FOREWORD

This standard was approved by the Sectoral Committee on Building and Construction Materials and was authorized for adoption and publication as a Sri Lanka Standard by the Council of the Sri Lanka Standards Institution on 2001-11-22.

This part of the standard specifies the flat sheets; Part 2 of this standard specifies the corrugated sheets.

This Standard was first published in 1969 and subsequently revised in 1988. This is the second revision. This revision includes the following:

a) Amosite (brown asbestos) is not permitted; and
b) Scale of sampling has been revised.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or an analysis shall be rounded off in accordance with **CS 102**. The number of significant figures to be retained in the rounded off values shall be the same as that of the specified value in this standard.

In the preparation of this standard the assistance derived from the publications of the International Organization for Standardization ,the British Standards Institution and the Bureau of Indian Standard are gratefully acknowledged.

1 SCOPE

This part of the standard specifies the requirements, methods of sampling and test for asbestos-cement flat sheets intended for both interior and exterior uses in building construction.

2 REFERENCES

CS 102 Presentation of numerical values
SLS 107 Ordinary portland cement
SLS 428 Random sampling methods

3 REQUIREMENTS

3.1 Composition

Asbestos-Cement Flat Sheet shall consist, essentially of, ordinary portland cement conforming to **SLS 107** reinforced mainly with clean chrysotile (generally referred to as white asbestos) asbestos fibers. Other inorganic fibers, inert filers, pigments and chemical additives may be added but shall exclude any materials liable to cause ultimate deterioration in the quality of flat sheet. **All asbestos cement product shall be free form crocidolite (blue asbestos) and amosite (brown asbestos).**

3.2 General appearance and finish

The sheets shall be flat, rectangular in shape and free from visible defects which may impair its appearance and strength. The surface of sheets shall be of uniform texture and shall have at least one smooth surface. The edges shall be trimmed, straight and corners cut square, subject to the tolerances specified in **3.3.3.**

3.3 Geometrical characteristics

3.3.1 *Dimensions*

3.3.1.1 Length and width

The nominal length and width of the sheet shall be as specified in Table **1** subject to tolerance given in **3.3.2.1.**

TABLE 1 - Dimensions of flat sheets

Unit – metres

(1)	(2)	(3)	(4)	(5)
Length	1.2	1.8	2.4	3.0
Width	1.2	1.2	1.2	1.2

3.3.1.2 Thickness

Thickness of sheets shall be 4.5 mm, 6 mm, 9 mm or 12 mm subject to the tolerances given in **3.3.2.2.**

NOTE
Other dimensions may be supplied by mutual agreement between the purchaser and the manufacturer.

3.3.2 *Tolerance on dimensions*

3.3.2.1 Length and width

The sheets shall not vary from the nominal dimensions for length and width specified in Table **1** by + 5 mm or -5 mm when measured by the method given in Appendix **A.**

3.3.2.2 Thickness

The actual thickness measured on the sheet shall not vary from the nominal thickness specified in **3.3.1.2** by +20 per cent or -10 per cent. The maximum difference between extreme values of the thickness measurements within a sheet shall not exceed 10 per cent of the maximum measured value. The method of measurement shall be as given in Appendix **A.**

3.3.3 *Tolerance on shape*

3.3.3.1 Straightness of edges

The tolerance on the straightness of edges shall be 3 mm per meter length for the relevant dimensions (length or width). The method of measurement shall be as given in Appendix **A.**

3.3.3.2 Tolerance on squareness

The tolerance on squareness of the edges shall be 5 mm per metre length. The method of measurements shall be given in Appendix **A.**

3.4 Mechanical, physical and chemical characteristics

3.4.1 *Bending strength*

When tested as described in Appendix **B**, the bending strength shall be not less than:

a) 13 Mpa (N/mm^2) for loading parallel to asbestos fibres of the sheet; and
b) 16 Mpa (N/mm^2) for loading perpendicular to asbestos fibres of the sheet.

3.4.2 *Density*

When tested as described in Appendix **C**, the density of a sheet shell be not less than 1200 kg/m^3 .

3.4.3 *Water absorption*

When tested described in Appendix **D**, the amount of water absorbed shall not exceed 28 per cent of the dry mass.

3.4.4 *Resistance to acidified water*

When tested as described in Appendix **E**, the amount of acetic acid used by the test specimens shall not exceed 1.15 kg/ m^2 .

4 MARKING

4.1 Each sheet shall be stamped or indelibly marked by any suitable method with the following information:

a) The name or registered trade mark of the manufacturer or both ; and
b) The date of manufacture, batch or code number.

NOTE

Attention is drawn to certification facilities offered by SLSI, see the inside back cover of this standard.

5 METHOD OF TEST

Tests shall be carried out as described in the appropriate appendices.

6 SAMPLING AND CRITERIA FOR CONFORMITY

6.1 Definitions

6.1.1 *Lot*

In any consignment all flat sheets of same nominal length and belonging to one batch of manufacture shall be grouped to form a lot.

6.1.2 *Defective sheets*

Any sheet, which does not conform to any one or more of the requirements given in 3.2 and 3.3, shall be considered as a defective sheet.

6.2 Scale of sampling

6.2.1 The conformity of a lot to the requirements of this specification shall be ascertained on the basis of tests carried out on the sheets selected from the lot.

6.2.2 Samples of flat sheets shall be taken from stocks aged not less than 4 weeks from the date of manufacture or from stocks, which the manufacturer guarantees to be of sufficient maturity.

6.2.3 The number of flat sheets to be selected from the lot shall be in accordance with Columns **1** and **2** of Table **2**.

TABLE 2 - Scale of sampling

(1) Number of sheets	(2) Number of sheets to be selected	(3) Acceptance Number	(4) Sub sample size
Up to 500	08	1	3
501 to 1000	12	1	3
1001 to 3000	16	2	5
3001 to 8000	20	2	5
8001 and above	32	3	8

6.2.4 The sheets shall be selected at random. In order to ensure randomness of selection, methods given in **SLS 428** shall be followed.

6.2.5 All the sheets selected as in **6.2** shall be examined for requirements given in **3.2** and **3.3.**

6.2.6 A sub sample of size as given in Column **4** of Table **2** shall be drawn at random and each sheet selected shall be individually tested for all the characteristics given in **3.4.**

6.3 Test specimen

From one sheet of the sample, one test specimen shall be cut for particular test, but for different tests, the necessary test specimens may be out from the same sheet of the sample.

6.4 Criteria for conformity

The lot shall be declared as conforming to the requirements of this specification if the following conditions are satisfied.

6.4.1 The number of defective sheets in the sample when examined as in **6.2.5** is less than or equal to the corresponding acceptance number given in Column **3** of Table **3**.

6.4.2 The sheets of the sub sample when tested as in **6.2.6** satisfy the criteria for conformity given in Table **3**.

TABLE 3 - Criteria for conformity

Characteristic (1)	Average (2)	Range (3)	Criteria for conformity (4)
Bending strength loading parallel to asbestos fibre	x_1	R_1	$x_1 - 0.4R_1$ shall be greater than or equal to 13 Mpa (N/mm^2) (see **3.4.1 - a**)
Bending strength loading perpendicular to asbestos fibre	x_2	R_2	$x_2 - 0.4R_2$ shall be greater than or equal to 16 mpa (N/mm^2) (see **3.4.1 - b**)
Density	x_3	R_2	$x_3 - 0.4R_3$ shall be greater than or equal to 1200 kg/m^3 (see **3.4.2**)
Water absorption	x_4	R_4	$x_4 + 0.4R_4$ shall be less than or equal to 28 per cent of the dry mass (see **3.4.8**)
Resistance to acidified water	x_5	R_5	$x_5 + 0.4R_5$ shall be less than or equal to 1.15 kg/m^2 (see **3.4.4**)

NOTE

Average x and the range R are computed from the results of tests carried out on the relevant sub sample.

Average, x = $\frac{\text{Sum of the values of the observations}}{\text{Number of observations}}$

Range, R = *The difference between the largest and the smallest observation in a sample.*

APPENDIX A
DIMENSIONAL MEASUREMENT

A.1APPARATUS

A.1.1 Smooth, flat inspection surface, large enough to place the sheet. The steel reference rulers larger than the dimensions of the sheet may be fixed at right angles along the edges of the inspection surface.

A.1.2 The tolerance on straightness of each steel reference rule shall be 0.3 mm per metre length and the tolerance on the right angle between the two steel reference rulers shall be 0.001 radians.

Alternatively, a portable square may be used. The same requirements for straightness and angularity shall apply.

A.1.3 Steel rulers, capable of being read to 0.5 mm.

A..1.4 Micrometer, reading at least to 0.05 mm with flat measuring surfaces at least 10 mm in diameter,

A.2OVERALL DIMENSIONS (LENGTH AND WIDTH)

For each dimension, three measurements are taken after smoothing the protruding fibres and avoiding any locations with local deformations. Each reading shall be made to the nearest 0.5 mm. Each value shall correspond to the nominal width or length and tolerances specified in **3.3.1** and **3.3.2**.

A.3THICKNESS

Using the micrometer, measurements shall be taken at least at four random points out of which three measurements shall be as indicated in Fig. **1**. The mean value shall correspond to the nominal thickness and the tolerances, specified in **3.3.1.2** and **3.3.2.2.**

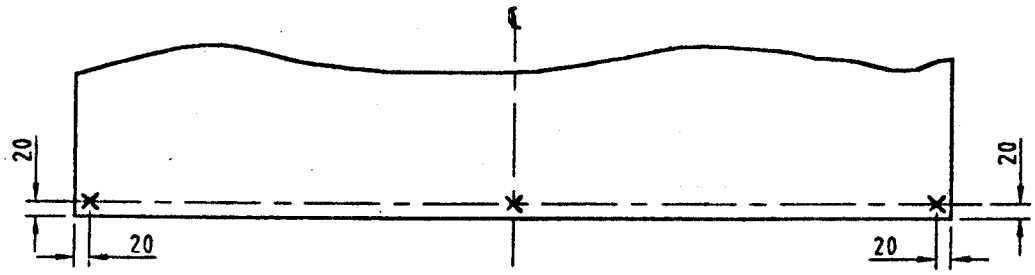

FIGURE 1 - Location of thickness measurement

A.4STRAIGHTNESS OF EDGES

After smoothing out all protrusions, each edge of the sheet is placed in succession against the long arm of the square or the reference ruler. By means of the steel ruler described in **A.1.3,** measure to the nearest 0.5 mm the greatest separation between the edge of the sheet and the long arm of the square or the reference ruler as the case may be. The separation shall be within the tolerance specified in **3.3.3.1** for any edge of the sheet.

A.5OUT OF SQUARENESS

After smoothing out all protrusions, along the edges, each of the four corners of the sheet is placed in succession between the arms of the square (or the two steel reference rulers kept at right angles). The sheet is kept with the longer side against the longer arm and with one corner of the shorter side of the sheet touching the shorter arm (See Figure **2**).

In this position the shortest distance between the short arm of the square (or the reference rule) and the corner not in contact with it, is measured using the rule described in **A.1.3 .** The squares (d/L), in millimetre per metre corresponding to each measurement shall be within the tolerance specified in **3.3.3.2.**

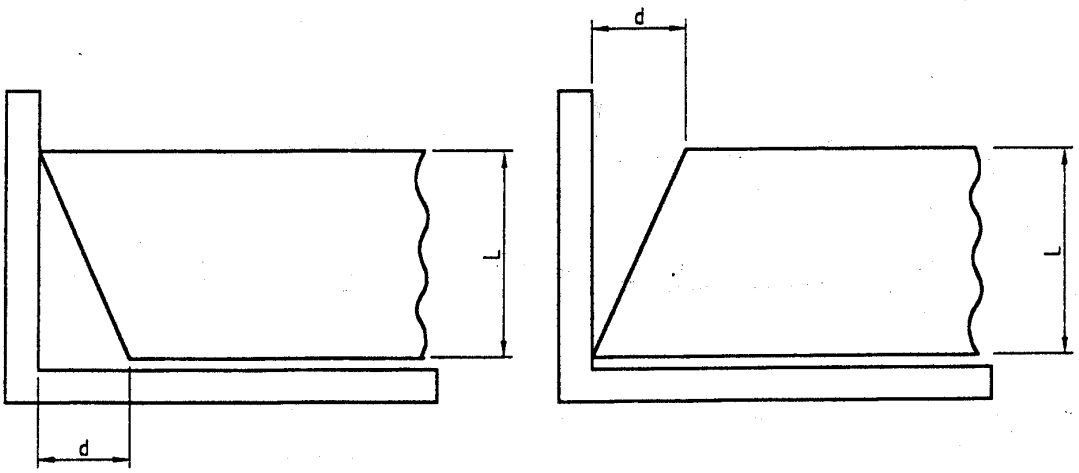

FIGURE 2 - Measurements of out of squareness

APPENDIX B
TEST FOR BENDING STRENGTH

B.1 APPARATUS

B.1.1 Testing frame, comprising :

a) Two parallel supports situated in the same horizontal plane, their upper faces being rounded to a radium between 3 mm and 25 mm; and

(b) A loading bar of the same profile as the two supports, parallel to the support and equidistant from them.

B.1.2 Micrometer, equipped with flat measuring surfaces not less than 10 mm in diameter and accurate to 0.05 mm.

B.2 PREPARATION OF TEST SPECIMENS

Cut two square test specimens of side 250 mm from the material, as shown in Figure **3**. Immerse the test specimens in water at the ambient temperature for a period of 18 hours.

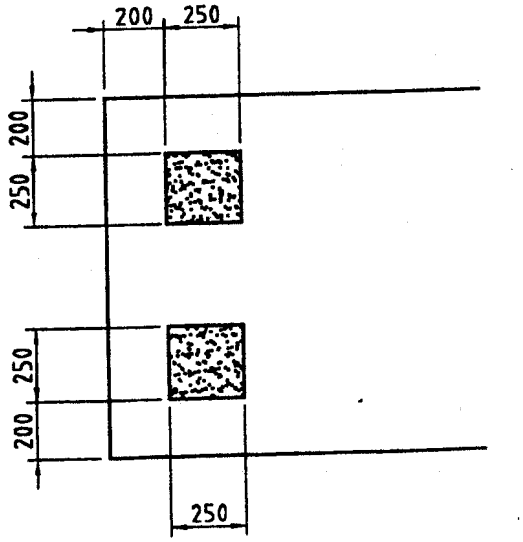

FIGURE 3 - Cutting test specimens for bending test

B.3 PROCEDURE

B.3.1 Adjust the distance between the supports of the testing frame **B.1.1** to 215 mm.

B.3.2 Arrange the specimen on the supports with its smooth side upper most and load the specimen at mid span, using the loading bar.

B.3.3 Increase the load at constant sped so that breaking occurs after not less than five seconds.

B.3.4 Measure the thickness of the specimen using the micrometer **B.1.2** at two points along the line of fracture, as shown in Figure **4(a).**

B.3.5 Reassemble the broken sections and submit the reconstituted specimen to a second bending test along an axis at right angles to that used in the first test.

B.3.6 Remeasure the thickness of the specimen at two points along the line of fracture, as shown in Figure 4(b).

NOTE

*It is convenient to preserve the broken pieces for re-use in density measurement as described in Appendix **C**.*

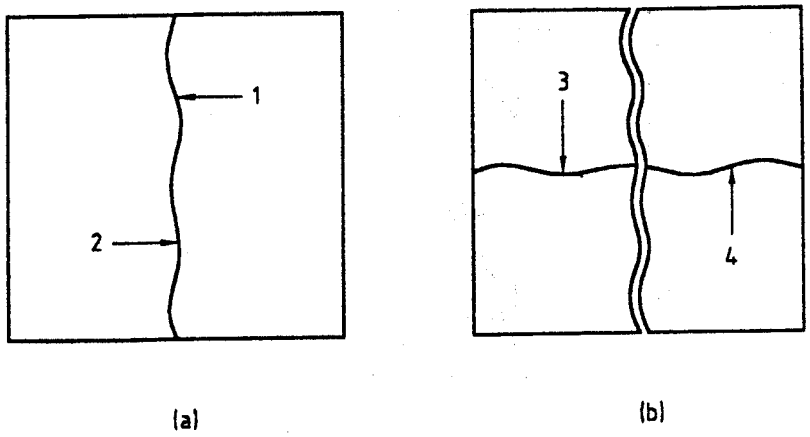

FIGURE 4 - Measurement of thickness for bending test

B.4 CALCULATION

Calculate the bending strength using the formula :

$$R_f = \frac{3P1}{2bc^2}$$

Where,

R_f = the bending strength in Mpa (N/mm^2) ;
P = the breaking load in N ;
l = the distance between supports in mm ;
b = the width of the specimen in mm ; and
c = the average thickness of the four measurements taken along the line of the fracture in mm.

APPENDIX C
TEST FOR DENSITY

C.1PREPARATION OF TEST SPECIMEN

C.1.1 Take an uncoated specimen approximately 40 mm x 60 mm from the material to be tested.

NOTE

It is convenient to use a piece from a specimen which has been subjected to a bending strength test.

C.2PROCEDURE

C.2.1 Determine the dry mass of the test specimen by drying out the test specimen in an oven at a temperature of 100 ^{0}C to 105 ^{0}C until the difference between two consecutive weightings made at an interval of not less than 2 hours is less than one per cent.

C.2.2 Determine the volume of the specimen by immersing it in water and measuring the volume of water displaced or by using any other method capable of giving a result accurate to within two per cent. If water is used, saturate the test specimen before determining the volume.

C.3CALCULATION

Calculate the density using the formula.

$$\rho = 1000 \times \frac{m}{V}$$

Where,

ρ = the density is kg/m^3 ;
m = the mass of the test specimen after drying in g ; and
v = the volume of the test specimen in cm^3.

APPENDIX D
TEST FOR WATER ABSORPTION

D.1PREPARATION OF TEST SPECIMEN

D.1.1 Cut an uncoated specimen measuring 175 x 75 mm from each of the flat sheets selected for bending strength test.

D.2PROCEDURE

D.2.1 Immerse completely the specimen in water at a temperature of 27 $\pm$ 3^0 C for a period of 18 hours.

D.2.2 Take out the specimen, remove surplus moisture with a damp cloth and weigh. Record the mass (m).

D.2.3 Place the specimen in a ventilated oven capable of being raised to a temperature of 150 ^{0} C. Commence heating with the oven ventilated wide open, raise the temperature to 150 ^{0} C and maintain it at that temperature for 4 hours.

NOTE

In carrying out the test, not more than 30 specimens shall be placed in an oven of 0.05 m^3 internal capacity or a proportionately larger or smaller number depending on the internal capacity. The specimens shall not be placed in contact with one another, but shall be distributed uniformity throughout the oven. Wet specimens shall be introduced into an oven in which drying of other specimens is in progress.

D.2.4 Remove the specimen, cool for 1 hour to 2 hours in a desiccator and weigh at room temperature. Record the mss (m_1).

D.3CALCULATION

Calculate the water absorption as follows :

$$\text{Absorption per cent} = \frac{m_0 - m_1}{m_1} \times 100$$

Where,
m_0 = mass, in g, of specimens after absorption ; and
m_1 = mass, in g, of specimen after drying

APPENDIX E
TEST FOR RESISTANCE TO ACIDIFIED WATER

E.1 REAGENTS

E.1.1 Acetic acid 5 per cent (m/m) solution.

E.1.2 Sodium hydroxide; 0.5 M standard volumetric solution.

NOTE

1 ml of this solution corresponds to 0.03 g of acetic acid.

E.1.3 Thymol blue solution; dissolve 0.04 g of thymol blue in 100 ml of 95 per cent (v/v) ethanol.

E.2 PREPARATION OF TEST SPECIMEN

Cut from each of the sheets selected for the bending strength test, two test specimens measuring 65 mm x 65 mm giving a total surface area, including edges, of approximately 10 000 mm^2 per specimen.

NOTES

1. The dimensions refer to actual edge length of the specimen.

2. This test is for untreated asbestos cement and not for any surface coating which may be applied to it. In the case of material provided with a protective or coloured surface coating, such coating shall be removed or protected. For materials coated on one side only the coated side shall be covered with a layer of paraffin wax applied hot and painted over the coating. Pairs of such specimens shall be placed in the test solution to maintain the exposed surface area of approximately 10 000 mm^2 .

*In the case of materials coated on both sides the coating shall be removed by abrasion from both sides and the specimen then tested as described in **E.3**.*

E.3 PROCEDURE

E.3.1 To determine the concentration of the acetic acid solution **(E.1.1)** take 10 ml of the solution, add 10 drops of the thymol blue solution **(E.1.3)** and dilute to 100 ml while stirring. Titrate with the sodium hydroxide solution **(E.1.2)** until the colour changes from yellow to blue, corresponding to a modification of the pH of 8.0 to 9.5. Record the volume V_1 , in ml, of the sodium hydroxide solution used for the titration.

E.3.2 Immerse the test specimens or the pair of test specimens (see **NOTE 2**) of (**E.2**) for a period of 24 hours, in 270 ml of 5 per cent acetic acid solution (**E.1.1**) at a temperature of 27 $\pm$ 3^0C contained in a vessel of such a size that the test specimen is completely immersed. Use separate vessels and solution for each test specimen or pair of test specimens.

E.3.3 After a period 24 hours remove the specimen from the solution. Mix the solution well, take 10 ml of the solution, add 10 drops of the thymol blue solution (**E.1.3**) and dilute to 100 ml while stirring. Titrate this solution as described (**E.3.1**). Record the volume V_2 in ml, of the sodium hydroxide solution used, ignoring the small amount of gelatinous precipitate which may be formed during the titration.

E.4 CALCULATION

E.4.1 The amount of acetic acid used per m^2 of area of the specimen, is given by :

$$\text{amount of acetic acid used in kg/m}^2 = \frac{0.030 \times 270 (V_1 - V_2)}{10^4 \times A}$$

Where,

V_1 = the volume, in ml. of 0.5 N sodium hydroxide used at the initial titiraitions;
V_2 = the volume, in ml. of 0.5 N sodium hydroxide used at the final titration;
A = area, in m^2 of unprotected asbestos-cement of the specimen.

E.4.2 Record the mean of the test results for the two specimens from the same sheets (or two pair of specimens from sheets coated on one side) as the test result for the sheet as a whole.

SRI LANKA STANDARDS INSTITUTION

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The principal objects of the Institution as set out in the Act are to prepare standards and promote their adoption, to provide facilities for examination and testing of products, to operate a Certification Marks Scheme, to certify the quality of products meant for local consumption or exports and to promote standardization and quality control by educational, consultancy and research activity.

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