SRI LANKA STANDARD 999 : 1993

UDC 677 . 752 : 677 . 554

# METHODS OF TEST FOR ELASTIC FABRICS

SRI LANKA STANDARDS INSTITUTION

# METHODS OF TEST FOR ELASTIC FABRICS

SLS 999 : 1993

Gr. 10



SRI LANKA STANDARDS INSTITUTION
53, Dharmapala Mawatha,
Colombo 3,
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
# METHODS OF TEST FOR ELASTIC FABRICS

**FOREWORD**

This standard was approved by the Sectoral Committee on Textiles and was authorized for adoption and publication as a Sri Lanka Standard by the Council of the Sri Lanka Standards Institution on 1993-06-17.

In this standard, methods of test for elastic fabrics for the following parameters are given :

i) Extension at a specified force;
ii) Modulus;
iii) Tension decay;
iv) Residual extension;
v) Fatigue set;
vi) Elastomeric thread breaks;and
vii) Runback.

In addition, methods for fatiguing and ageing of specimens are given.

In reporting the result of a test or an analysis made in accordance with this standard, if the final value, observed or calculated is to be rounded off, it shall be done in accordance with SLS 102.

In the preparation of this standard, the valuable assistance derived from the following publication is gratefully acknowledged:

BS 4952 : 1992 Methods of test for elastic fabrics.

## 1 SCOPE

This standard prescribes methods of test specific to both narrow and wide elastic fabrics. The test methods are applicable to woven and to warp knitted and weft knitted fabrics but certain tests are also applicable to stretch fabrics which are obtained by the use of elastomeric bulked yarns or by a process such as slack mercerization.

## 2 REFERNCES

SLS 16 Standard atmosphere for conditioning and testing textiles.
SLS 102 Presentation of numerical values.

## 3 DEFINITIONS

For the purposes of this standard the following definitions shall apply :

3.1 **elastic fabrics** : Fabrics which incorporate elastomeric threads.

3.2 **elastomer** : A macromolecular material which returns rapidly to approximately its initial dimensions and shape after substantial deformation by a weak stress and release of stress.

3.3 **modulus** : The tensile force in the test specimen required to produce a specified elongation.

## 4 APPARATUS

4.1 *Metal scale,* graduated in millimetres.

4.2 *Autographic constant rate-of-extension stress/strain apparatus,* (unless otherwise indicated in the particular test procedure), capable of cycling between zero extension and either a predetermined force or a predetermined extension and capable of maintaining a specimen either under a constant tension or at a constant elongation.

The apparatus shall be provided with means for recording the extension of the test specimen and the corresponding force. It shall be equipped with either line contact clamps for straight specimens (see **4.3.2**) or loop assembly clamps (see **4.3.3**).

### 4.3 Clamps

4.3.1 *General*

The central points of the two clamps shall be in the line of pull and the testing device shall be calibrated with the clamps in position.

The clamps shall be capable of allowing the specimens to be maintained either at a constant elongation or under a constant force as appropriate for the test to be performed.

4.3.2 *Line contact clamps*

Line contact clamps as shown in Figure 1 shall consist of two jaws, one being a flat steel plate, the other having a convex 3 mm radius. The line of contact of the jaws shall be at right angles to the line of pull, and their clamping faces shall be in the same plane. The jaws shall be capable of holding the test specimen without allowing it to slip, shall be designed so that they do not cut or otherwise weaken the specimen and shall be not less than the width of the specimen.

*Dimension in millimetres*

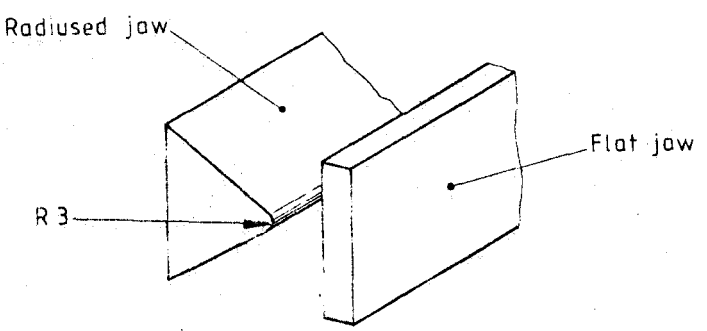



**FIGURE 1 - Line contact clamps**

4.3.3 *Loop assembly clamps*

Loop assembly clamps shall be as shown in Figure 2 and shall essentially comprise two removable steel bars of circular cross section and 4 mm in diameter, around which the specimen passess and by which it is extended as the bars move apart. The axes of the bars shall be at right angles to the line of pull and shall be in the same plane.

*Dimension in millimetres*

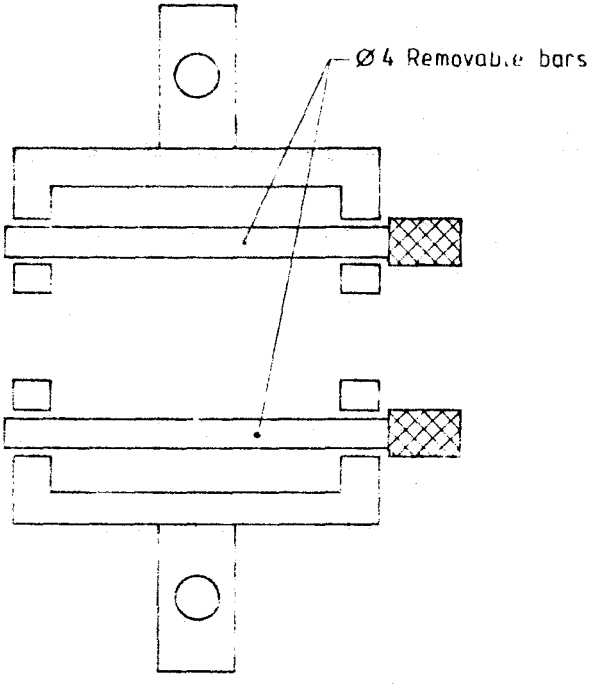



FIGURE 2 - Loop assembly clamps

4.3.4 *Gauge length and specimen length under extension*

In the case of line contact clamps, the gauge length and the length of the extended test specimen at any time is measured as the distance between the lines of contact of the two jaws.

Where specimen length is to be measured after removal of the specimen from the jaws, the gauge length marks shall be drawn on the specimen before it is inserted into the clamps.

*NOTE*

*The method of marking should be such as to prevent damage to the specimen.*

In the case of loop assembly jaws, the gauge length is measured as the circumference around the loop bars.

## 5 TEST SPECIMENS

### 5.1 General

Take samples of fabric from which test specimens will be cut to represent the fabric under test.

Prepare the specimens according to whether machine direction or cross direction stretch of the fabric is to be tested. Where possible test at least five specimens in each direction.

### 5.2 Preparation of specimens

4.2.1 *General*

Specimens shall be prepared in accordance with 5.2.2 to 5.2.5 as appropriate.

*NOTE*

*Straight specimens and looped specimens do not necessarily give the same results.*

5.2.2 *Straight specimens*

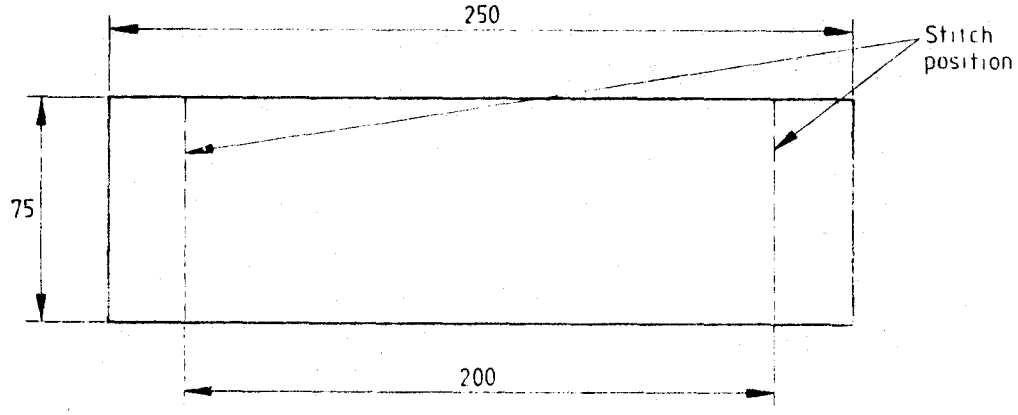
Fabrics 50 mm and below in width shall be tested full width in a lengthwise direction. For fabrics greater than 50 mm in width, specimens 50 mm wide, excluding any fringe, shall be prepared such that they are of sufficient length to provide a nominal gauge length of 100 mm.

5.2.3 *Looped specimens*

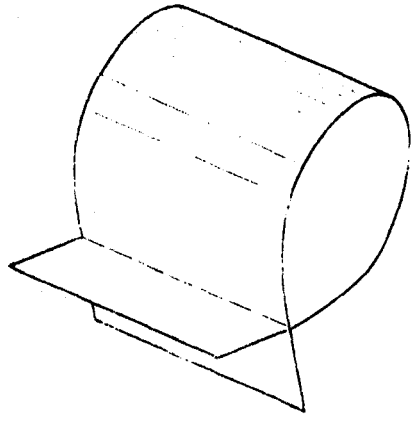
Fabrics 75 mm and below in width shall be tested full width in a lengthwise direction. For fabrics greater than 75 mm in width, specimens 75 mm wide, excluding any fringe shall be prepared of length 250 mm.

Mark a line 25 mm from each end, parallel to the short dimension (see Figure 3 a). Fold the specimen in half parallel to the short dimension and, starting in the centre of the line, sew along the line to form the strip into a loop, turning at the edge without breaking the threads, returning along the same line to the other edge and turning again to finish in the centre (see Figure 3 b ). The stitch, sewing thread and stitch density shall be such as to withstand the testing forces, i.e. to prevent the specimen opening on extending.

*All dimensions in millimetres*




**a) Looped specimens as cut from fabric**



**b) Looped specimens as prepared for testing**

FIGURE 3 - Looped specimen

5.2.4 *Specimens of woven fabric*

For fabrics liable to fray during testing , cut specimens 25 mm wider than the required testing width and fray them down by removing excess threads in approximately equal numbers from each of the longer edges of the cut strip until the width of the specimen is as specified in 5.2.2.

5.2.5 *Specimens of weft knitted fabrics*

Prevent the cut edges of weft knitted test specimens from laddering by a method which will neither restrict the extension and retraction of the fabric, nor alter its stress/strain characteristics to any significant extent.

*NOTE*

*In some cases it is possible to use an expandable seam, or alternatively the cut edges could be sealed with a light application of latex adhesives followed by dusting of talc when the latex is dry, to prevent sticking.*

## 6 CONDITIONING AND TESTING ATMOSPHERE

### 6.1 Atmosphere

The conditioning and testing shall be carried out in the standard atmosphere for testing textiles as defined in CS 16, i.e. a temperature of 27 $\pm$ 2 °C and a relative humidity of 65 $\pm$ 2 per cent.

### 6.2 Conditioning of samples

Condition the samples from which the test specimens are to be taken for a period of not less than 16 hours in a free, unrestrained state in the standard atmosphere for testing textiles (see 6.1).

In cases of dispute, precondition the test specimens for 4 hours at a relative humidity not exceeding 10 per cent at a temperature not greater than 52 °C. An oven at 52 °C under ordinary room conditions will give the required low humidity. Then expose the test specimens to the standard atmosphere for testing textiles (see 6.1) for at least 24 hours before testing.

## 7 TEST METHODS

### 7.1 Determination of extension at a specified force

7.1.1 *Apparatus* as described in 4.2 and 4.3.

7.1.2 *Procedure*

7.1.2.1 Straight specimens

Set the clamps of the tensile testing machine to 100 mm apart. Clamp a test specimen centrally in the stationary clamp so that its longitudinal axis passes through the centre points of the front edges of the jaws.
Either :
a) apply a pre-tension of 2 N; or
b) slack-mount the specimen, with any extension that occurs prior to the force reaching the pre-tension level (as indicated on an autographic recording) being considered as part of the slack, ultimately to be added to the gauge length.

Clamp the free end of the test specimen in the second clamp.

Set the rate of extension and retraction of the specimen to 500 mm/minute. Cycle the specimen twice between zero extension and the specified force. Record, from the force versus extension graph produced, the elongation at the specified force on the second cycle.

7.1.2.2 Looped specimens

Set the gauge length such that the circumference around the loop bars is 200 mm.
Slide the loop bars open, position the looped specimen around the bars so that the seam lies midway between the bars and close the bars.

Set the rate of extension and retraction of the specimen to 500 mm/minute. Cycle the specimen twice between zero extension and the specified force. Record, from the force versus extension graph produced, the elongation at the specified force on the second cycle.

7.1.3 *Test report*

The following shall be reported :

a) Specified force used;
b) Percentage elongation for each specimen and their arithmetic mean;
c) Direction of test of the fabric, i.e. either machine direction or cross direction;
d) Specimen type, i.e. whether straight or looped; and
e) Specimen width.

**7.2 Determination of modulus**

7.2.1 *Apparatus,* as described in 4.2 and 4.3.

7.2.2 *Procedure*

Read from the force versus extension curves as described in 7.1, the force on the extension and/or recovery curves on the second cycle, at intervals of elongation as arranged between the interested parties.

7.2.3 *Test report*

The following shall be reported :

a) Modulus, i.e. force (in N) at each value of elongation where readings have been taken, the value of each elongation at which modulus reading has been taken and whether these were from the extension or retraction portion of the cycle, and their arithmetic mean ;
b) Direction of test of the fabric, i.e. either machine direction or cross direction;
c) Specimen type, i.e. whether straight or looped; and
d) Specimen width.

## 7.3 Determination of tension decay

### 7.3.1 *Principle*

The test specimen is stretched to a specified elongation and the tension recorded. The elongation is maintained for 5 mintes during which the decay of tension over this period is determined.

7.3.2 *Apparatus,* as described in 4.2 and 4.3.2.

### 7.3.3 *Test specimens*

Straight specimens as described in 5.2.2 shall be used.

### 7.3.4 *Procedure*

The rate of extension and retraction shall be 500 mm/minute. Set the separation of the clamps to give a specimen gauge length of 100 mm ($L_1$). Mount the test specimen in such a way that it is straight and untensioned. Set the cycling controls to cycle between zero extension and a force of either 5.0 N/cm or 10.0 N/cm as agreed between interested parties. After cycling twice to this force, and without a pause, extend the specimen at the specified rate, to the specified elongation and record the maximum force. Maintain the specimen at this elongation for 5 minutes and record the force.

### 7.3.5 *Calculation*

$$\text{Tension decay as a per cent of the maximum force} = \frac{F_o - F_T}{F_o} \times 100$$

where

$F_o$ is the maximum force, in N, at the specific elongation; and
$F_t$ is the force, in N, after 5 minutes.

### 7.3.6 *Test report*

The following shall be reported :

a) Cycling force;
b) Specified elongation to which the specimens have been subjected and the resulting (maximum) force in the specimen;
c) Percentage tension decay for each specimen and their arithmetic mean;
d) Direction of test of the fabric, i.e. whether machine direction or cross direction; and
e) Specimen width.

## 7.4 Determination of residual extension

7.4.1 *Apparatus,* as described in 4.2 and 4.3.2.

7.4.2 *Test specimens*

Straight specimens as described in 5.4.2 shall be used.

7.4.3 *Procedure*

Carry out the test as described in 7.1, except on the second cycle maintain the specified force for 10 $\pm$ 2 s. Return the clamps to their original position such that the force is gradually reduced to zero within a period of 7.5 $\pm$ 2.5 s.

Remove the specimen from the clamps, immediately place it on a flat, smooth surface and after a period of 1 $\pm$ 0.1 minutes from the time when the clamps were returned to their original position measure the distance between the outside edges of the gauge marks ($L_2$) to the nearest 1 mm.

If the determination of residual extension after a longer period of relaxation is required, the distance between the gauge marks ($L_3$) shall be measured (to the nearest 1 mm) after total relaxation time of 30 $\pm$ 1 minutes.

*NOTE*

*When tests are made at right angles to the wale direction of weft knitted fabrics, the results are invalid if laddering occurs. When elastomeric threads are laid-in, precautions should be taken to prevent slippage of these threads through the fabric.*

7.4.4 *Calculation and expression of results*

7.4.4.1 Calculate the arithmetic mean values of $L_2$ and $L_3$ in each direction separately for the five specimens. These are denoted by $\bar{L}_2$ and $\bar{L}_3$ respectively.

7.4.4.2 Calculate the mean residual extension, expressed as a percentage, after 1 minute ($R_1$) for the fabric in each direction from the equation :

$$R_1 = \frac{\bar{L}_2 - L_1}{L_1} \times 100$$

where

$L_1$ is the initial gauge length, in mm.

7.4.4.3 If required, calculate the mean residual extension, expressed as a percentage, after 30 minutes ($R_{30}$) for the fabric in each direction from the equation :

$$R_{30} = \frac{\bar{L}_3 - L_1}{L_1} \times 100$$

7.4.4.4 The mean values of $R_1$ and $R_{30}$ shall be quoted to the nearest 1 per cent.

7.4.4.5 Calculate the arithmetic mean of the maximum values of the force applied in each direction separately for the five specimens.

7.4.5 *Test report*

The following shall be reported :

a) Mean value of the maximum force applied;
b) Value of the mean extension of the fabric in each direction;
c) Value of the mean residual extension of the fabric in each direction after 1 minute relaxation;
d) If required, value of the mean residual extension after 30 minutes relaxation;
e) Direction of test of the fabric, i.e. either machine direction or cross direction; and
f) Specimen width.

## 7.5 Method for fatiguing specimens

7.5.1 *Principle*

This method is designed to stardardize the procedure for fatiguing specimens of elastic fabric. Specimens are subjected to an agreed number of cycles of elongation and retraction, so that appropriate properties can be measured and compared with the corresponding properties of the unfatigued specimens. For certain properties, for example, elongation and modulus, appropriate gauge marks shall be made on the specimen to be fatigued and these same marks shall be used in subsequent testing irrespective of any change in length during the fatigue procedure.

7.5.2 *Apparatus*

7.5.2.1 Fatiguing apparatus, consisting of one or more pairs of clamps, with mechanical means for moving one clamp (reciprocating clamp) at a rate of 60 $\pm$ 1 cycles per minute with means for recording the number of cycles.

Each pair of clamps shall be set so that the specimens are alternately stretched and relaxed. The movement of the reciprocating clamp shall be adjustable between 50 mm and 250 mm. The position of the stationary clamp shall be adjustable to give 125 mm of effective length to be fatigued irrespective of amplitude of reciprocation.

7.5.3 *Test specimens*

Straight specimens as described in 5.2.2 shall be used except that specimens shall be cut parallel to the general direction of the elastomeric threads and that the length shall be such that the effective length to be fatigued is 125 mm. Make gauge marks centrally 100 mm apart on each specimen.

The number of specimens to be subjected to the fatigue test shall be appropriate to the tests subsequently intended to be applied.

7.5.4 *Procedure*

Adjust the reciprocating clamp to give a fatigue-cycle elongation equal to 80 per cent of the mean elongation as determined by using the procedure described in 7.1. Adjust the stationary clamp to give a length of 125 mm between the clamps . Mount each specimen so that it is at zero tension but not slack in the clamps. Fatigue each specimen at the specified rate. The number of fatiguing cycles shall be agreed between the interested parties.

*NOTE*

*It is recommended that the number of fatiguing cycles be in multiples of 5000.*

Remove the specimens from the apparatus and allow them to relax for 30 $\pm$ 1 minutes before remeasuring the relevant properties as required after fatiguing.

7.5.5 *Test report*

The following shall be reported :

a) Results of the relevant tests on fatigued specimens;
b) Number of fatiguing cycles used; and
c) Fatigue-cycle elongation.

## 7.6 Determination of fatigue set

7.6.1 *Apparatus* as described in 4.1 and 7.5.2.

7.6.2 *Test specimens* prepared as described in 7.5.3.

7.6.3 *Procedure*

Mount each test specimen with the guage marks positioned centrally between the clamps. Subject each specimen to the fatiguing procedure described in 7.5.4 for the agreed number of cycles. Remove the specimen from the clamps and lie it on a smooth flat surface. Allow it to relax for 30 $\pm$ 1 minutes. Measure the distance between the gauge marks to the nearest millimetre. Calculate the percentage increase in length to the nearest 1 per cent.

7.6.4 *Test report*

The following shall be reported :

a) Number of fatiguing cycles;
b) Number of specimens tested;
c) Fatigue extension;
d) Fatigue set, as the mean percentage increase in length; and
e) Specimen width where less than 50 mm.

## 7.7 Determination of elastomeric thread breaks

7.7.1 *Apparatus*, as described in 7.5.2.

7.7.2 *Test specimens*, prepareed as described in 7.5.3.

7.7.3 *Procedure*

Subject each specimen to the fatiguing procedure described in 7.5.4 for the agreed number of cycles. Remove the specimen from the clamps and count the number of elastomeric thread breaks, if any, within the area of fabric between the gauge marks.

7.7.4 *Test report*

The following shall be reported :

a) Number of breaks for each individual specimen;
b) Number of fatiguing cycles; and
c) Specimen width where less than 50 mm.

## 7.8 Determination of runback

7.8.1 *Apparatus*, as described in 7.5.2.

7.8.2 *Test specimens*

Prepare the test specimens as described in 7.5.3. At a position midway between the gauge marks, entirely cut through three elastomeric threads. With certain fabrics, it could be necessary to cut the associated covering and/or structural threads also. This is permissible provided that the cutting through of these threads does not result in laddering or fraying. The three elastomeric threads shall be uniformly spaced across the fabric at intervals of 12.5 mm.

*NOTE*

*For fabrics less than 50 mm in width, the number of elastomeric threads to be cut through in any one specimen will depend on the width of the fabric and the total number of elastomeric threads it contains. Not more than approximately 10 per cent of the elastomeric threads should be cut through.*

7.8.3 *Procedure*

Mount each specimen with the gauge marks centrally between the clamps. Subject each specimen to the fatiguing procedure described in 7.5.4 for 5000 cycles. Remove the specimens from the clamps and lay them on a smooth flat surface. Allow them to relax for 30 minutes. Measure the distance between the two cut ends of each elastomeric thread to the nearest millimetre. This is the runback distance.

7.8.4 *Test report*

The following shall be reported :

a) Mean runback distance, in millimetres;
b) Number of threads cut;
c) Number of specimens tested; and
d) Specimen width where less than 50 mm.

## 7.9 Method for ageing specimens

### 7.9.1 *Principle*

This ageing procedure is designed to accelerate theoxcidative deterioration of elastic fabrics which occurs with the passage of time. Specimens are aged by a prescribed heating treatment in air and are afterwards submitted to any of the preceding tests to determine the effect on their properties.

*NOTE*

*Accelerated ageing tests do not truly reproduce under all* all *circumstances, the changes produced by natural ageing.*

### 7.9.2 *Apparatus*

*Ventilated oven,* in which there is slow circulation of air providing 3 to 10 air changes per hour.
Also,

a) The incoming air shall be within $\pm$ 2 $^{o}$C of the temperature specified before coming into contact with the test specimens;
b) No copper or copper alloy shall be within the ageing chamber of the oven;
c) The total volume of the test specimens shall not exceed 10 per cent of the free air space of the oven;
d) Means shall be provided for suspending the test specimens within the oven such that they are not within 10 mm of each other nor within 50 mm of the inner surfaces of the oven;
e) Means shall be provided for maintaining an atmosphere within the oven at a temperature of 70 $\pm$ 1 $^{o}$C;
f) Any direct heat and/or light radiation on to the test specimens shall be avoided; and
g) Means shall be provided for the introduction of temperature-measuring instruments, at a suitable point, for measuring the operating conditions.

### 7.9.3 *Test specimens*

#### 7.9.3.1 Dimensions

The dimensions of the test specimens shall be chosen so that they are suitable for any subsequent tests to be conducted.

7.9.3.2 Quantity

The number of test specimens selected shall be as required by the particular physical test intended to be carried out after the ageing procedure.

*NOTE*

*It is recommended that in any event the number of test specimens chosen for post ageing comparsions should be not less than five.*

7.9.4 *Procedure*

Preheat the oven to the operating temperature of 70 ± 1 °C. Suspend the test specimens in the ageing chamber, ensuring that the volume of the specimens does not exceed 10 per cent of the air space of the oven and that the air circulates freely on both sides of each specimen.

Allow the specimens to remain under these conditions for a period agreed between the interested parties.

*NOTES*

1. *It is recommended that specimens be aged for 1,3,7 and 10 days and thereafter in multiples of 7 days from the start of the test.*

2. *The test period used should be such that deterioration of the test specimens will not be so great as to prevent determination of the final values of the relevant physical property after ageing.*

3. *The rate of change in physical characteristics of materials such as those considered in this standard has been found to approximately double with each 10 °C rise in temperature, for example 1 day at 70 °C is approximately equal to 32 days at 120 °C.*

After removing the test specimens from the oven, condition them as specified in 5 for not less than 16 hours or more than 24 hours.

7.9.5 *Test report*

The following shall be reported :

a) Results of the appropriate tests on aged specimens;and
b) The number of days the specimen have been aged.

- Blank Page -

## *SLS CERTIFICATION MARK*

*The Sri Lanka Standards Institution is the owner of the registered certification mark shown below. Beneath the mark, the number of the Sri Lanka Standard relevant to the product is indicated. This mark may be used only by those who have obtained permits under the SLS certification marks scheme. The presence of this mark on or in relation to a product conveys the assurance that they have been produced to comply with the requirements of the relevant Sri Lanka Standard under a well designed system of quality control inspection and testing operated by the manufacturer and supervised by the* SLSI *which includes surveillance inspection of the factory, testing of both factory and market samples.*

*Further particulars of the terms and conditions of the permit may be obtained from the* Sri *Lanka Standards Institution, 17, Victoria Place, Elvitigala Mawatha, Colombo 08.*


Printed at SLSI (Printing Unit)

## SRI LANKA STANDARDS INSTITUTION

The Sri Lanka Standards Institution (SLSI) is the National Standards Organization of Sri Lanka established under the Sri Lanka Standards Institution Act No. 6 of 1984 which repealed and replaced the Bureau of Ceylon Standards Act No. 38 of 1964. The Institution functions under the Ministry of Science & Technology.

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.

The Institution is financed by Government grants, and by the income from the sale of its publications and other services offered for Industry and Business Sector. Financial and administrative control is vested in a Council appointed in accordance with the provisions of the Act.

The development and formulation of National Standards is carried out by Technical Experts and representatives of other interest groups, assisted by the permanent officers of the Institution. These Technical Committees are appointed under the purview of the Sectoral Committees which in turn are appointed by the Council. The Sectoral Committees give the final Technical approval for the Draft National Standards prior to the approval by the Council of the SLSI.

All members of the Technical and Sectoral Committees render their services in an honorary capacity. In this process the Institution endeavours to ensure adequate representation of all view points.

In the International field the Institution represents Sri Lanka in the International Organization for Standardization (ISO), and participates in such fields of standardization as are of special interest to Sri Lanka.

Printed at the Sri Lanka Standards Institution, 17, Victoria Place, Elvitigala Mawatha, Colombo 08.