SRI LANKA STANDARD 856 : 1989

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SPECIFICATION FOR

AUTOMOTIVE BRAKE LININGS

SRI LANKA STANDARDS INSTITUTION

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SLS 856 : 1989

Gr. 11

SRI LANKA STANDARDS INSTITUTION
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DRAFTING COMMITTEE ON AUTOMOTIVE BRAKE LININGS

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

SRI LANKA STANDARD
SPECIFICATION FOR AUTOMOTIVE BRAKE LININGS

FOREWORD

This Sri Lanka Standard was authorised for adoption and publication by the Council of the Sri Lanka Standards Institution on 1989-07-25, after the draft finalized by the Drafting Committee on Automotive Brake Linings, had been approved by the Mechanical Engineering Divisional Committee.

Frictional brakes are used on all automotive vehicles where the braking effect is achieved by frictional resistance offered by brake shoes or pads on a rotating metallic drum or disc. The braking effect results in a rise in temperature of the system and also causes wear, mostly on the brake lining. For the safe operation of an automobile, it is therefore necessary that the braking effect is uniform and is not noticeably reduced by a rise in temperature or humidity.

The tests and coefficient of friction have been included in this standard with a view to establishing control over the quality. The purpose of this standard is to establish minimum coefficient of friction requirements for brake linings used on the service brake system of automotive vehicles. It should however, be noted that there may be variations depending on the type of brake design and application.

This standard is intended chiefly to cover the technical provisions relating to automotive brake linings, and it does not include all the necessary provisions of a contract.

All standard values given in this specification are in SI units.

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 **SLS 102**. The number of significant places retained in the rounded off value shall be the same as that of the specified value in this standard.

The assistance derived from the relevant publications of the International Organization for Standardization, the British Standards Institution, the Bureau of Indian Standards, the Japanese Standards Association and the Society of Automotive Engineers in United State of America in the preparation of this standard is gratefully acknowledged.

1 SCOPE

This standard covers terminology, dimensions and other general requirements for automotive brake linings. It also covers various tests and the coefficient of friction for different types and classes of brake linings dealt at clause 4.

2 REFERENCES

SLS 102		Presentation of numerical values.
SLS 145		Rockwell hardness test.
SLS 146		Brinell hardness test.
SLS 428		Random sampling methods.
SLS 783	Part 1	Method for measurement of compressibility of lining material.
SLS 783	Part 2	Method for measurement of internal shear strength of lining material.
SLS 783	Part 5	Method for determining resistance to water, saline solution, oil and brake fluid of the brake lining material.

3 DEFINITIONS

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

3.1 brake lining : A piece of friction material made to a specified shape.

3.2 flexible lining : Lining which is adoptable to brake drums of different diameters.

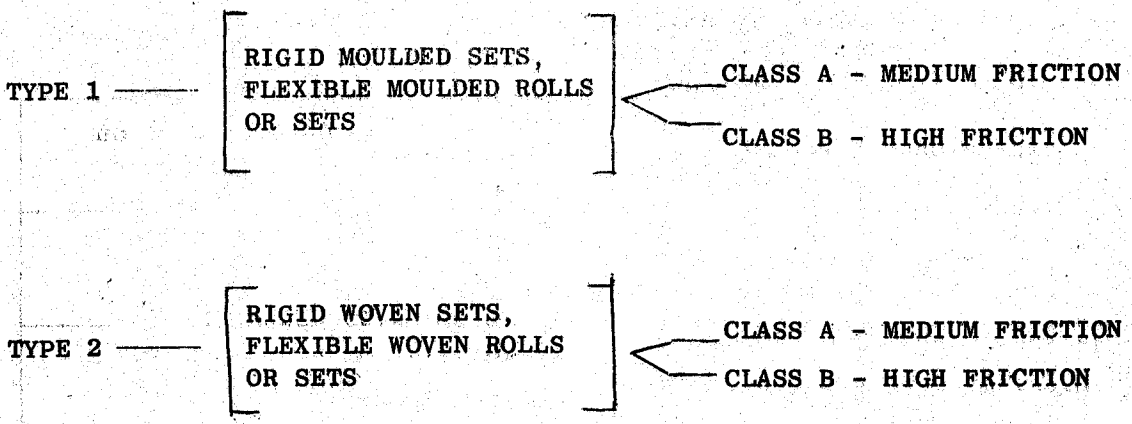
3.3 rigid lining : Lining which is formed to fit a specific drum diameter. It may be moulded or woven.

3.4 moulded lining : Lining which is made with asbestos/non-asbestos fibre mixed with suitable fillers and bonding agents and appropriately processed.

3.5 woven lining : Lining which is made with woven asbestos/non-asbestos fabric as a base with suitable filler and bonding agents. It may be rigid or flexible.

4 TYPES AND CLASSES

This standard specifies two types of brake linings, each classified into two classes as follow.



5 DESIGNATION

Brake linings shall be designated by type, class, width and thickness in millimetres.

EXAMPLE :

Automotive Brake Lining Type 1, Class B, 80 x 6.3, or

Automotive Brake Lining 1B 80 x 6.3

6 REQUIREMENTS

6.1 General

6.1.1 The frictional characteristics of the lining shall be uniform throughout the material and its life span.

6.1.2 The lining shall have sufficient mechanical strength to permit it to be assembled, either by reveting or other means on to the lining carrier and to prevent shearing, slipping or cracking during use.

6.1.3 The brake lining shall conform to the requirements of this standard even after one year of normal bin storage in tropical climate.

6.2 Finish

6.2.1 The finished brake lining shall be free from defects, such as cracks, scorings, indentations, unevenness or other defects affecting its life and serviceability.

6.3 Tolerance

6.3.1 The allowable tolerance on width and thickness shall be as in Table 1.

TABLE 1 - Allowable tolerances on width and thickness

Thickness (1)	Tolerance on width (2)	Tolerance on thickness (3)
Up to and including 5 mm	+ 0 - 0.8	+ 0 - 0,2
Over 5 mm	+ 0 - 0.8	+ 0 - 0.3

6.4 Properties

6.4.1 *Frictional*

The coefficient of friction shall be calculated by the following formula. Besides, "μ" is calculated from average frictional force for the latter half of overall frictional force recorded.

$$\mu = f/F$$

where,

μ is coefficient of friction ;
f is frictional force, in kgf; and
F is total press force on test specimen.

Coefficient of friction shall be as in Table 2.

TABLE 2 - Coefficient of friction

Type (1)	Class (2)	100°C (3)	150°C (4)	200°C (5)	250°C (6)	300°C (7)
1 and 2	A Medium friction	0,30-0.60	0.25-0.60	0.20-0.60	——	——
1 and 2	B High friction	0.30-0.60	0.25-0.60	0.20-0.60	0.20-0.60	0.15-0.60

The tolerance for designated coefficient of friction shall be as in Table 3.

TABLE 3 - Tolerance for designated coefficient of friction

Type (1)	Class (2)	100°C (3)	150°C (4)	200°C (5)	250°C (6)
1 and 2	A Medium friction	± 0.10	± 0.12	——	——
1 and 2	B High friction	± 0.08	± 0.10	± 0.12	± 0.12

6.4.2 *Wear rate*

The wear rate shall be calculated using the following formula,

$$V = 1.06\left(\frac{A}{N}\right)\left(\frac{d_1 - d_2}{f_m}\right)$$

where,

V is wear rate (wear volume per unit work-done) in cm^3/kgm;
N is total revolutions of disc during the wearing test;
A is total frictional area of test specimen in cm^2;
d_1 is average thickness of specimen before test in cm;
d_2 is average thickness of specimen after test in cm; and
f_m is total average frictional force during test in kg.

NOTE

1.06 is ≃ 1/2 R , and

R is distance from test specimen centre to rotor shaft centre (0.15 m).

6.4.2.1 Wear rate shall be as in Table 4.

Unit : $10^{-7} cm^3 / kgm$

TABLE 4 - Wear rate

Type (1)	Class (2)	100°C (3)	150°C (4)	200°C (5)	250°C (6)	300°C (7)
1 and 2	A Medium friction	10.0 <	15.0 <	20.0 max.	——	——
1 and 2	B High friction	5.0 <	7.5 <	10.0 <	20.0max.	35.0max.

7 MARKING

Brake lining shall be marked as follows :

(a) Manufacturer's name or trade mark;
(b) Date of manufacture;
(c) Type, class and size; and
(d) Asbestos or non-asbestos.

8 PACKING

The brake lining shall be packed in accordance with the best trade practice. A package shall contain a set of linings for one axle only.

9 TEST METHODS

9.1 From the sample selected, test specimens shall be cut for conducting the tests specified below :

9.1.1 *Friction test* (see Appendix A)

9.1.2 *Wear test* (see Appendix A)

9.1.3 *Wet friction test*

After the completion of the test described in Appendix A the test pieces shall be placed in water for two hours and then removed and the normal test carried out as in Appendix A.The average value of coefficient of friction for wet test shall be 90 per cent of the original value.

9.1.4 *Oven test*

The lining shall not show any evidence of blistering, swelling or distortion when heated in an oven for 2 hours at 200°C. The change in thickness shall not be more than 0.25 mm; when measured at this temperature.

9.2 The tests given below may be carried out as agreed between the purchaser and the manufacturer.

9.2.1 *Hardness test*

Hardness testing shall be in accordance with **SLS 145** or **SLS 146.**

9.2.2 *Compressibility test*

Test for compressibility of lining material shall be in accordance with **SLS 783 : Part 1.**

9.2.3 *Internal shear strength test*

Test for internal shear strength of lining material shall be in accordance with **SLS 783 : Part 2.**

9.2.4 *Resistance Test*

Test for resistance to water, saline solution, oil and brake fluid of brake lining material shall be in accordance with **SLS 783 : Part 5.**

10 SAMPLING

10.1 Lot

All brake linings of the same type, class, width, thickness and belonging to one batch of manufacture or supply shall constitute a lot.

10.2 Scale of sampling

10.2.1 Samples shall be tested from each lot for ascertaining conformity of the lot to the requirements of this specification.

10.2.2 The number of sets of brake linings to be selected from a lot shall be in accordance with Column **2** of Table **5**.

TABLE 5 - Scale of sampling

Number of sets of brake linings in a lot (1)	Number of sets of brake linings to be selected (2)	Number of sets of Brake lining to be select for sub sample (3)
Up to 25	2	1
26 to 50	3	1
51 to 100	4	1
101 to 150	5	2
151 and above	8	2

10.2.3 Sets of brake linings shall be selected at random. In order to ensure randomness of selection random number tables as given in **SLS 428** shall be used.

10.3 Number of tests

10.3.1 Each set of brake lining selected as in **10.2.2** shall be inspected for **marking.**

10.3.2 Each set of brake lining selected as in **10.2.2** shall be inspected for defects given in **6.2.1.**

10.3.3 A sub sample of size given in Column **3** of Table **5** shall be selected from the sample selected as in **10.2.2** and each set of brake lining of the sub sample shall be subjected to friction test, wear test, wet friction test and oven test.

NOTE

The test pieces shall be prepared in accordance with the relevant test method.

10.3.4 If the purchaser and manufacturer agreed another sub sample of size as given in column 3 of Table 5 shall be selected, and each set of brake lining of the sub sample shall be subjected to tests given in 9.2.

11 CRITERIA FOR CONFORMITY

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

11.1 Each set of brake lining inspected as in 10.3.1 satisfies the marking requirement.

11.2 Each set of brake lining inspected for defects as in 10.3.2 contains no defects.

11.3 Each set of brake lining tested as in 10.3.3 satisfies the relevant property requirements.

11.4 Each set of brake lining tested as in 10.3.4 satisfies the relevant property requirements.

APPENDIX A

TEST FOR ASSESSMENT OF FRICTION AND WEAR

A.1 PURPOSE

The purpose of this to obtain data on frictional and wear characteristic of brake linings for in-plant quality control by manufacturers and for the quality assessment of incoming shipments by the purchaser.

A.2 EQUIPMENT

The machine shown in Figs 1 and 2 shall be equipped with suitable means for

(a) Measuring the drum temperature;

(b) Heating the drum;

(c) Controlling the drum heating rate;

(d) Cooling the drum;

(e) Controlling the drum cooling rate;

(f) Measuring the friction force; and

(g) Measuring the drum rotational speed.

Means shall also be provided for measuring specimen thickness and mass.

The means for heating the drum shall be capable of ensuring that the 'free running' temperature rise of the drum follows the heating curve in Fig. 3 within ± 14 °C.

The means for cooling the drum shall be capable of ensuring that the maximum drum temperature of 93 °C specified in A.4.3 is not exceeded, and that the 'free running' cooling curve of the drum follows the cooling curve in Fig. 4 within ± 14 °C.

A.2.1 Condition of test specimens

The temperature measuring system shall have ± 2 per cent full scale accuracy. The friction force measuring system shall have ± 2 per cent full scale accuracy. The drum speed measuring system shall have ± 2 per cent full scale accuracy. The drum diameter shall be between the limits of 277.4 mm and 279.9 mm.

A.3 TEST CONDITIONS

Actual tests for performance shall be started when preliminary preparations and lining bedding given in A.4 have been completed.

All drum speeds, in rev/min, are based on a nominal 280 mm diameter drum with the specified loads applied to the specimen.

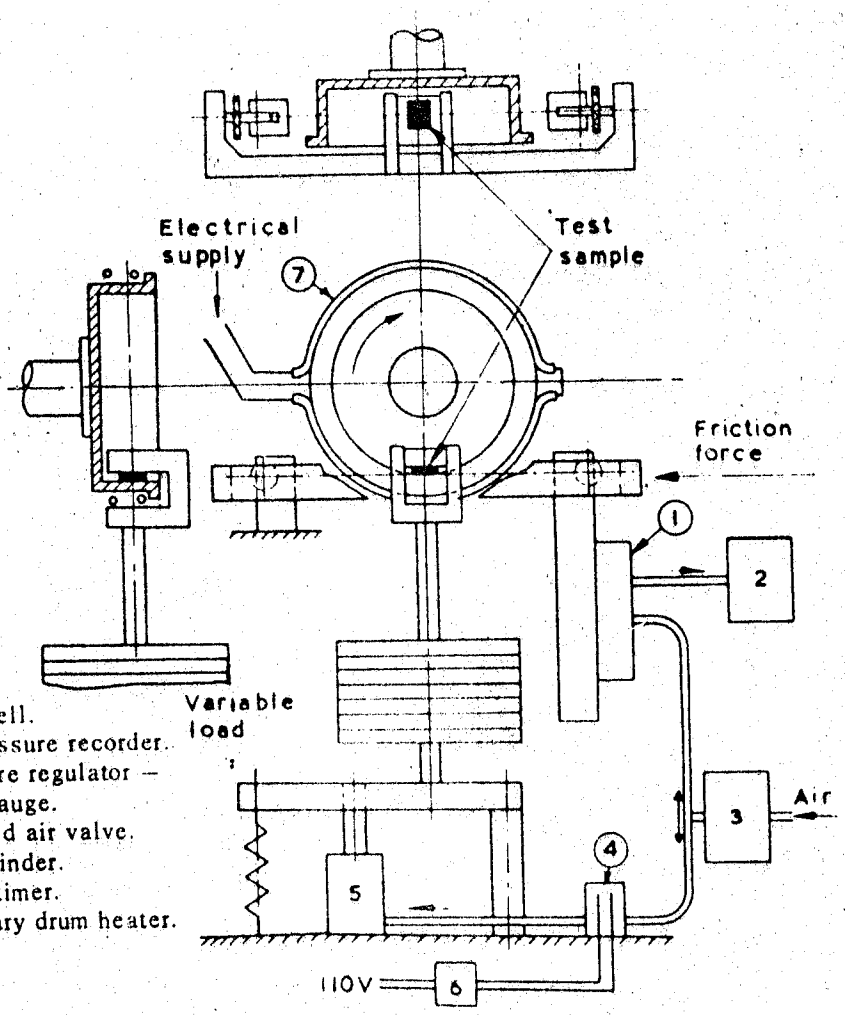
A.4 PROCEDURE

A.4.1 Preparation of test specimen

The tests specimen shall be taken from the centre of the selected lining segment equidistant from each end. (In case of rolls the segment may be the selected from one end of the roll)

The specimen shall be 25 mm square and flat on the bottom, the radius of the working surface shall conform to the radius of the test drum. Not less than 0.25 mm nor more than 0.50 mm shall be removed from the working surface of a curved specimen. The specimen thickness (or specimen plus shim) shall be approximately 6 mm measured in the centre of the specimen. Excess of material shall be removed from bottom side of the specimen cut from 6.3 mm or greater nominal thickness linings. In cases where nominal lining thickness is less than 5.3 mm remove a minimum amount of material from the bottom surface to produce flatness.

The working surface of the specimen should not be handled and should be kept free of foreign matter.



1. Load cell.
2. Air pressure recorder.
3. Pressure regulator – filter gauge.
4. Solenoid air valve.
5. Air cylinder.
6. Cycle timer.
7. Auxiliary drum heater.

Fig.1. Schematic diagram of typical friction materials test machine

A.4.2 **Preparation of test drum surface**

After grinding the drum surface of new or resurfaced drums (in position on the test machine), remove all grinder marks and finish with No. 320 grit (wet or dry) abrasive paper or cloth. Remove dust from the drum with clean dry air and/or wiping with a clean cheese cloth or equivalent.

Complete the surface preparation by running a reference specimen continuously at 7 kgf/cm^2, 417 rev/min (6 metres/second) and at not over 93 ^{o}C until the coefficient of friction has stabilized.

Prior to each test, finish the drum surface with No. 320 grit (wet or dry) abrasive paper or cloth. Remove dust from the drum with clean dry air and/or wipe it with clean cheese cloth or equivalent.

A.4.3 **Conditioning of test specimen**

The specimen is run-in at 7 kgf/cm^2, 312 rev/min (4.5 m/s) and at a maximum drum temperature of 93 ^{o}C, for 20 minutes. If the specimen does not show at least 95 per cent contact after 20 minutes, the specimen is to be discarded and another prepared.

A.4.4 **Measurements of initial thickness and mass**

Specimen thickness measurements shall taken in three places along the axis parallel to the drum axis (open centre and closed edges) and recorded. Weigh (in grames) to 0.001 mg and record. Reseat the specimen by running continuously for 5 min at 3.5 kgf.cm^2 and 208 rev/min (3 m/s). The initial clearance between the specimen and the drum should be 0.25 mm to 0.38 mm in the OFF position.

A.4.5 **Initial wear measurement**

With the drum stationary and at 93 ^{o}C, and with 10.5 kgf/cm^2 loading on the specimen, obtain an indicator reading of height of specimen holder, and record.

A.5 **TEST RUNS**

A.5.1 **Base line run**

Run for 10 seconds ON (load applied) and for 20 seconds OFF (load removed), at 10.5 kgf/cm^2 and 417 rev/min (6 m/s) for 20 applications. Start the run at a drum temperature of 93 $\pm$ 11 ^{o}C and maintain within these limits during this part of the test.

A.5.2 First fade run

With the heater voltage adjusted so that the 'free running' temperature rise curve of the drum follows the heating curve in Fig. 3 within ± 14 °C run under a continuous load of 10.5 kgf/cm^2 at 417 rev/min (6 m/s) with the heater ON and cooling means OFF. Start the run at 93 °C and run for either 10 minutes or until 288 °C obtained, whichever occurs first. Take simultaneous readings of friction force and drum temperature at 30 second intervals and record the time required to reach 288 °C.

A.5.3 First recovery run

Immediately following completion of first fade run in A.5.2, turn off heater and turn on cooling means (adjusted so that the 'free running' cooling curve of the drum follows the cooling curve in Fig. 4 with ± 14 °C and make a 10 second application at each 55 °C interval during cooling from 260 °C to 93 °C.

A.5.4 Second wear measurement

Repeat the initial wear measurement in A.4.5.

A.5.5 Wear run

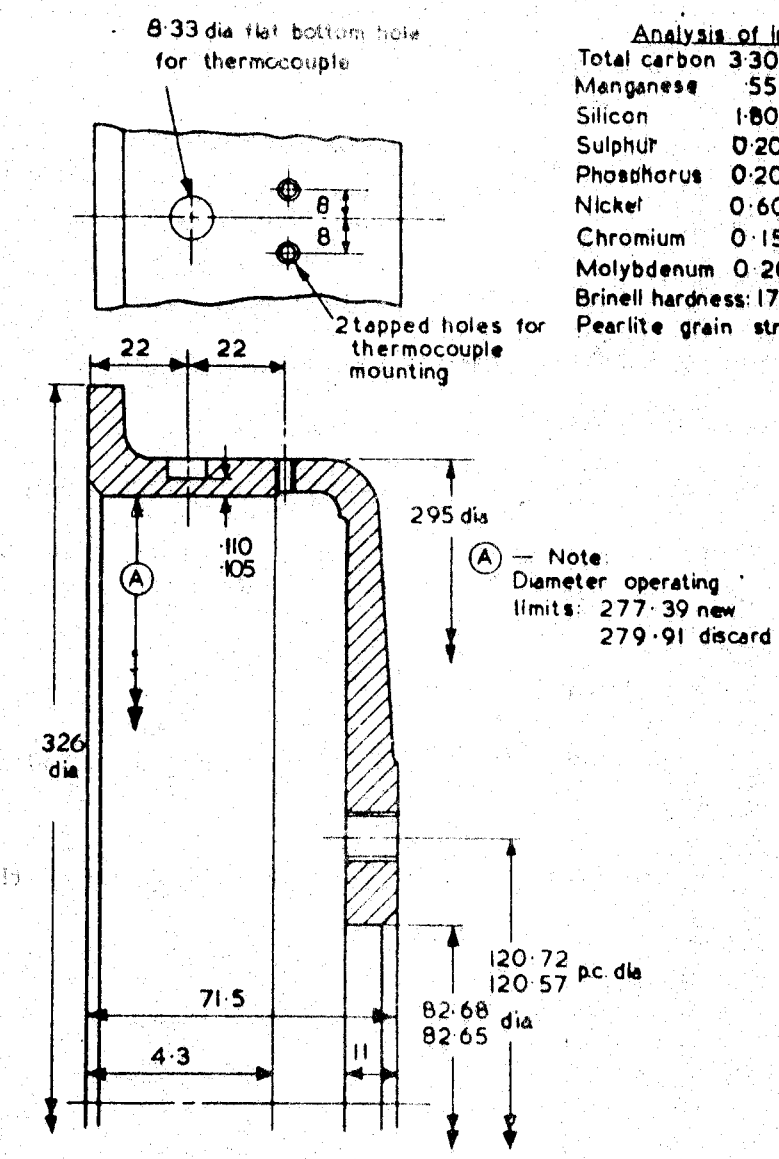
Run for 20 second ON and 10 second OFF, at 10.5 kgf/cm^2 and 417 rev/min (6 m/s) for 100 applications. Start the run at a drum temperature of 205 ± 11 °C and maintain the average of the maximum and minimum temperature for each application at 205 ± 11 °C.

A.5.6 Third wear measurement

Immediately upon completion of the wear run in A.5.5, cool to 93 °C and repeat the initial wear measurement in A.4.5.

A.5.7 Second fade run

Immediately upon completion of the third wear measurement in A.5.6 and with the heater voltage adjusted, as specified in the first fade run in A.5.2, run at a continuous load of 10.5 kgf/cm^2 at 417 rev/min (6 m/s) with the heater ON and the cooling means OFF. Start the run at 93 °C and run for either 10 minutes or until 343 °C is reached, whichever occurs first. Take simultaneous readings of friction force and drum temperature at 30 second intervals and record time required to reach 343 °C.



Analysis of Iron %

Total carbon	3·30 to 3·50
Manganese	·55 to ·75
Silicon	1·80 to 2·10
Sulphur	0·20 max.
Phosphorus	0·20 max.
Nickel	0·60 to 0·70
Chromium	0·15 to 0·25
Molybdenum	0·20 to 0·30
Brinell hardness:	179 to 229
Pearlite grain structure	

Fig.2. Typical friction materials test drum

A.5.8 Second recovery run

Immediately following the completion of the second fade run in A.5.7, turn off the heater, turn on the cooling means (adjusted as specified for the first recovery run in A.5.3) and make a 10 second application at each 55°C interval during cooling from 315 °C to 93 °C.

A.5.9 **Baseline re-run**

Repeat the base line run in A.5.1.

A.5.10 **Final wear measurement**

Repeat the initial wear measurement in A.4.5.

A.5.11 **Measurement of final thickness and mass**

Measure and weigh as described in A.4.4.

A.6 **SELECTION OF PLOT POINT FOR COEFFICIENT OF FRICTION VALUE**

During the intermittent application runs, the coefficient of friction values are taken at the end of each application.

A.7 **PRESENTATION OF TEST DATA**

A.7.1 Fig.5 shows a recommended form of plot sheet for uniformity in the presentation of test data.

A.7.2 Fig. 6 shows a recommended form of data sheet for use by the test operator.

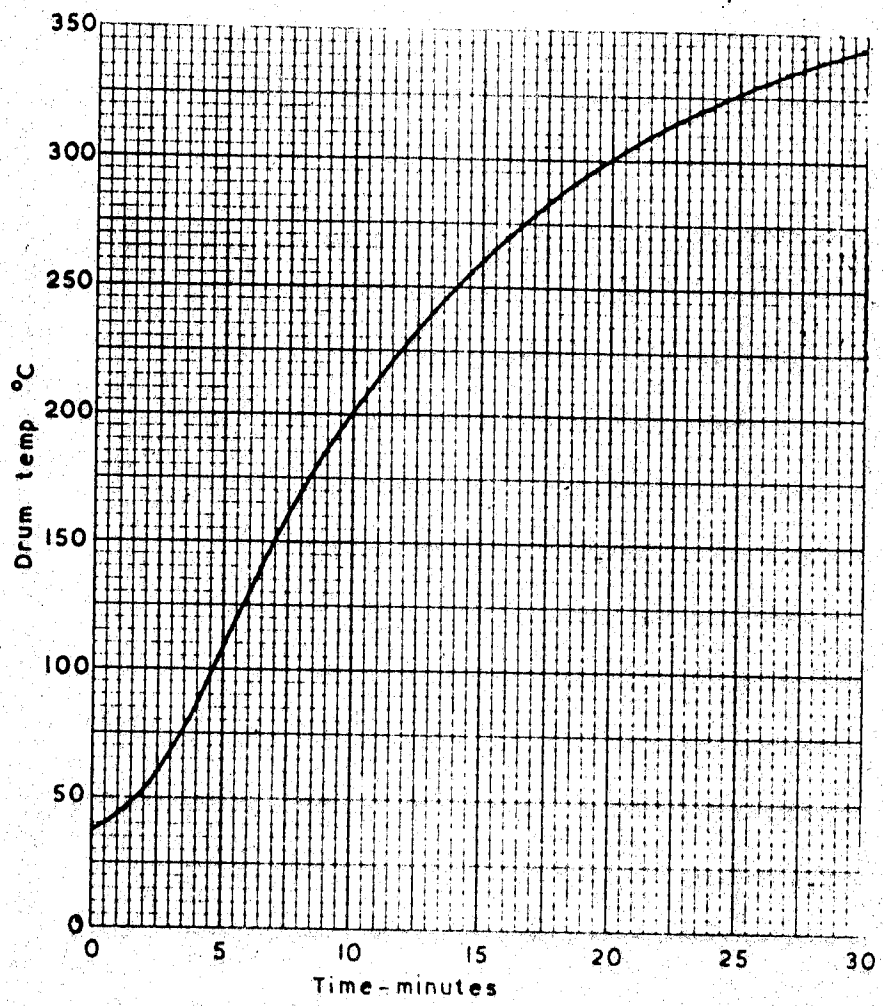


Fig.3. Standard drum heating curve, friction materials test machine

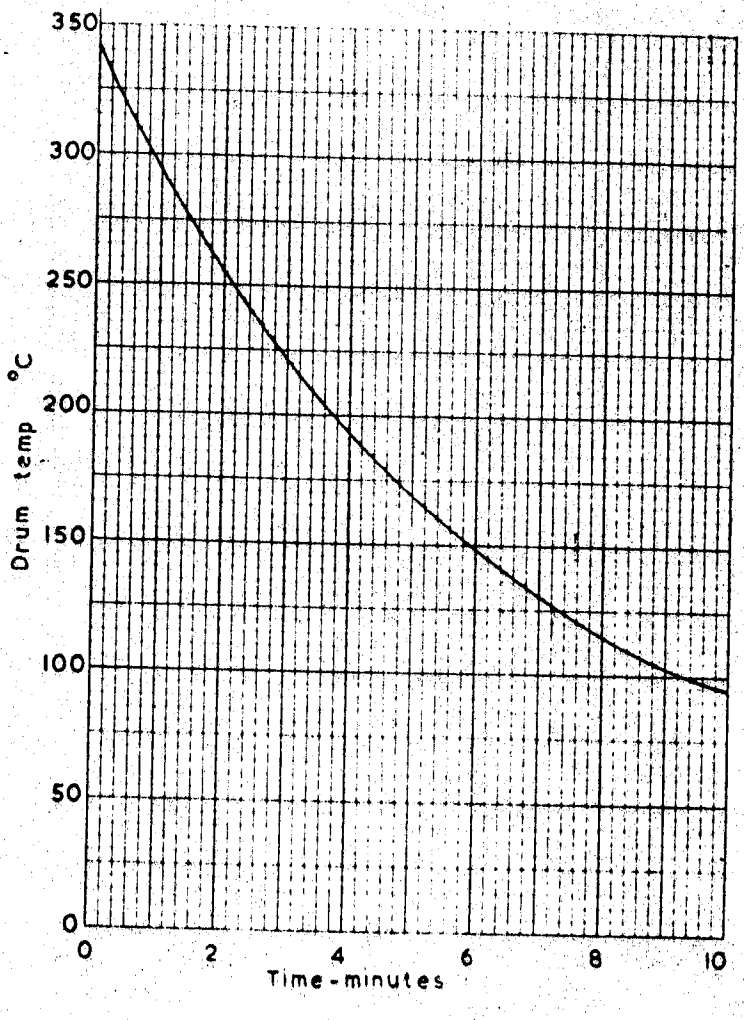


Fig.4. Standard drum cooling curve, friction materials test machine

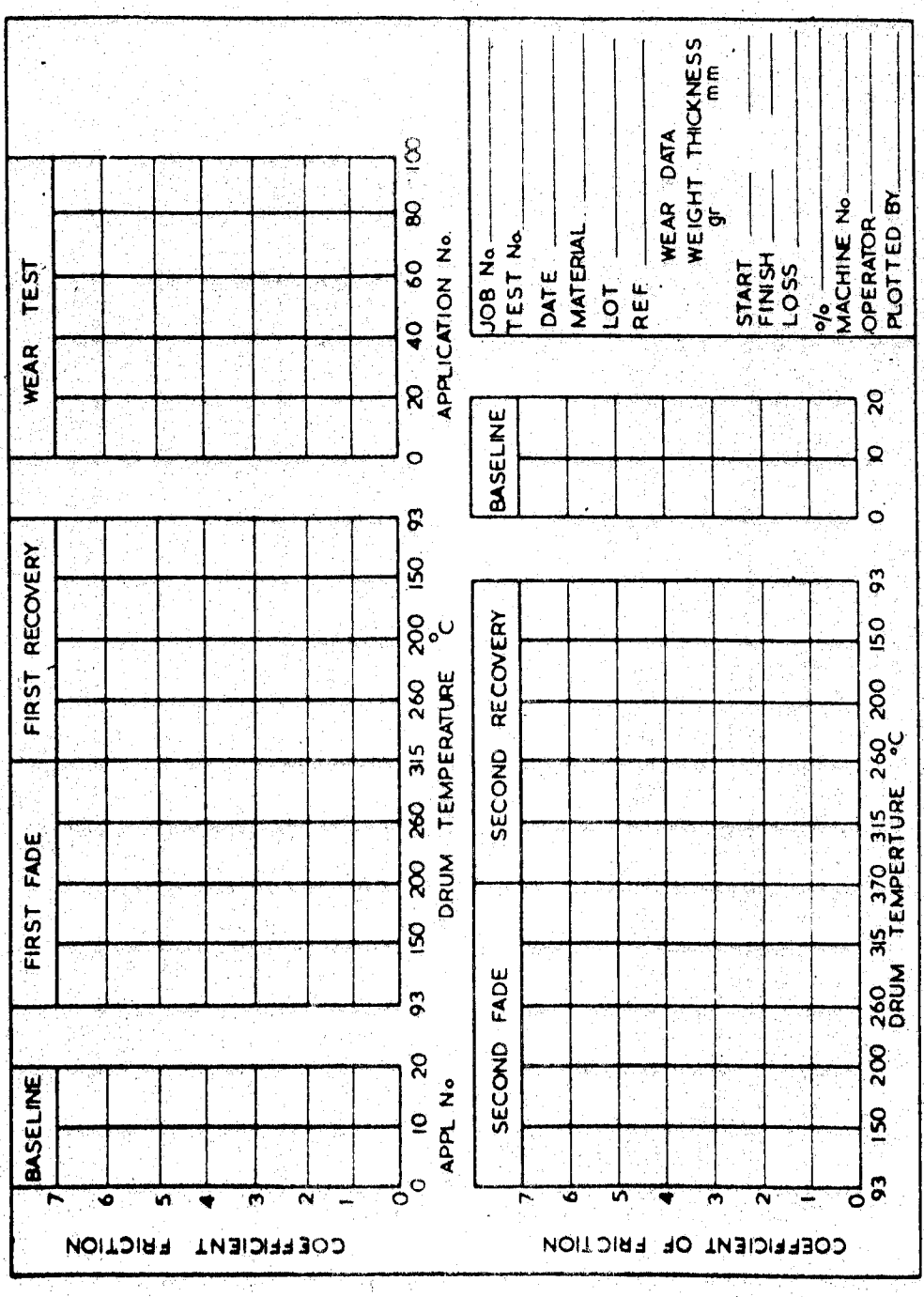


Fig.5. Recommended master form plot sheet

MATERIAL			JOB No.
LOT			TEST No.
REFERENCE			DATE
			OPERATOR
	WEIGHT	THICKNESS	INDICATOR READING
INITIAL			
FINAL			
LOSS			

ITEM 4.5.1. BASELINE		
APPL. No.	GAUGE	C OF F
1		
5		
10		
15		
20		

ITEM 4.5.2 FIRST FADE			
MIN	°C TEMP	GAUGE	C OF F
0			
.5			
1.			
1.5			
2.			
2.5			
3.			
3.5			
4.			
4.5			
5.			
5.5			
6.			
6.5			
7.			
7.5			
8.			
8.5			
9.			
9.5			
10			

ITEM 4.5.3 FIRST RECOVERY		
TEMP °C	GAUGE	C OF F
260		
200		
150		
93		

REMARKS

ITEM 4.5.4 INDICATOR RDN

ITEM 4.5.5 WEAR TEST		
APPL. No.	GAUGE	C OF F
1		
10		
20		
30		
40		
50		
60		
70		
80		
90		
100		

ITEM 4.5.6 INDICATOR RDN

ITEM 4.5.9 BASELINE		
APPL. No.	GAUGE	C OF F
1		
5		
10		
15		
20		

ITEM 4.5.7 SECOND FADE			
MIN	°C TEMP	GAUGE	C OF F
0			
.5			
1.			
1.5			
2.			
2.5			
3.			
3.5			
4.			
4.5			
5.			
5.5			
6.			
6.5			
7.			
7.5			
8.			
8.5			
9.			
9.5			
10			

ITEM 4.5.8 SECOND RECOVERY		
TEMP °C	GAUGE	C OF F
315		
260		
200		
150		
93		

Fig.6. Recommended master form log sheet

SRI LANKA STANDARDS INSTITUTION

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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.

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