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प्रलेख प्रेषण सूचना/ DOCUMENT DESPATCH ADVICE

टीईडी 4/ TED 4/T-97

31-08-2018

**ऑटोमोटिव ब्रेकिंग सिस्टम, स्टीयरिंग सिस्टम, वेहिकल टेस्टिंग एवं पर्फार्मेंस एवलुयेशन विषय समिति, टीईडी 4**

**AUTOMOTIVE BRAKING SYSTEMS, STEERING SYSTEMS, VEHICLE TESTING AND PERFORMANCE EVALUATION SECTIONAL COMMITTEE, TED 4**

क (परिवहन इंजीनियरिंग विभाग परिषद। पंइविप। के रूचि रखने वाले सदस्य

1( Interested Members of Transport Engineering Division Council, TEDC

ख(विषय समिति टी ई डी 4

2( All Members of TED 4

ग (अन्य सभी रूचि रखने वाले निकाय

3. All Others Interested.

महोदय/महोदया, Dear Sir/ Madam,

निम्नलिखित प्रलेख संलग्न हैं:

Please find enclosed the following draft Standard:

प्रलेख संख्या /Document No.

विषय/ Title

**TED 4 ( 12595) W**

***Draft Indian Standard Guideline Specifications  
For Replacement Brake Lining Assemblies  
And Drum Brake Linings For Power-Driven  
Vehicles And Their Trailers***

कृप्या उपरोक्त संशोधन मसौदा का अवलोकन कर अपनी सम्मतियां यह बताते हुए भेजें, कि यदि अंततः यह प्रलेख राष्ट्रीय मानक के रूप में स्वीकृत हो जाए, तो इस पर अमल करने में आपके व्यवसाय अथवा कारोबार में क्या कठिनाइयां आ सकती हैं।

Kindly examine this draft and forward your views stating any difficulty which you are likely to experience in your business or profession, if this is finally adopted as Indian Standard.

सम्मति की अन्तिम तिथि/ **Last date for comments:30.10.2018**

सम्मति यदि कोई हो तो पीछे दिए गए प्रारूप में लिख कर, ऊपरलिखित पते पर अधोहस्ताक्षरी को भेजें।

Comments, if any, may please be made in the format given overleaf and mailed to the undersigned at the above address.

धन्यवाद, **Thanking you,**

भवदीय, **Yours faithfully,**

(आर आर सिंह) **(R.R.Singh)**

**Scientist 'E' & Head (TED)**

वैज्ञानिक 'ई' एवं प्रमुख) परिवहन इंजि.(

संलग्न: ऊपरलिखित /Encl: As above

**FORMAT FOR SENDING COMMENTS ON  
BIS DOCUMENTS**

[Please use A4 size paper only and type within fields indicated. Comments on each clause/sub-clause be started on a fresh paper. Information in column 3 should include reasons for the comments and suggestions for modified wording of the clause when the existing text is found not acceptable. Adherence to this format facilitates Secretariat's work]

**NAME OF THE COMMENTATOR/ORGANIZATION:**

**DOCUMENT NUMBER AND TITLE: TED 4 ( 12595) W Draft Indian Standard Guideline  
Specifications For Replacement Brake Lining Assemblies And Drum Brake Linings For Power-  
Driven Vehicles And Their Trailers**

SL. NO. (1)	Clause/Sub-clause/ Para No. Commented (2)	COMMENTS/SUGGESTIONS (3)

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Automotive Braking Systems, Vehicle Testing and Performance Evaluation Sectional Committee, TED 4

## FOREWORD

(Formal Clause. To be added later on.)

Brake lining is a consumable safety critical sub-component of brake system. Need of adequate quality of such crucial part is of paramount importance. Though standards are available for performance verifications of Original Equipment fitted brake systems, no standards were available for Replacement Brake Lining Assemblies.

While preparing this standard, considerable assistance is derived from ECE R 90 - Revision 1 – Amendment 3 (Supplement 7 to the 01 series of amendments – date of entry into force Jan. 18, 2006 (Issue 4 Mar. 2006)). Uniform Provisions Concerning the Approval of Replacement Brake Lining Assemblies and Drum Brake Linings for Power- Driven Vehicles and their Trailers.

For the purpose of deciding whether a particular requirement of this draft standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this draft standard.

*Draft Indian Standard***GUIDELINE SPECIFICATIONS FOR REPLACEMENT BRAKE LINING ASSEMBLIES AND DRUM BRAKE LININGS FOR POWER-DRIVEN VEHICLES AND THEIR TRAILERS****1 SCOPE**

**1.1** This standard applies to replacement service brake lining assemblies intended for use in friction brakes forming part of the braking system of power-driven vehicles and their trailers and semi trailers authorized for use on public roads.

**1.2** Replacement brake lining assemblies may be approved for fitment and use on power-driven vehicles and their trailers and semi trailers having type approval in accordance with IS:11852 or IS:14664. Replacement drum brake linings designed to be riveted to a brake shoe may be approved for fitment and use on power-driven vehicles and trailers having type approval in accordance with IS: 11852 and classified in categories M3, N2, N3, T3 and T4.

**2 REFERENCES**

The following standards contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

<i>IS No.</i>	<i>Title</i>
11852	Automotive vehicles – Brakes and Braking Systems
14664	Automotive vehicles - Performance requirements and Testing Procedures for Braking System of Two and Three Wheeled Motor Vehicles
AIS-007(Revision 3)	Information on Technical Specification to be submitted by the Vehicle Manufacturer
ISO 6312	Road Vehicles - Brake Linings – Shear strength of disc brake pad and drum shoe assemblies – Test procedure
ISO 2039 – 2	Plastics – Determination of hardness – Part 2 : Rockwell hardness

**3 DEFINITIONS**

For the purpose of this standard, the following definitions shall apply.

**3.1 Braking system** – has the meaning assigned in IS:11852 (Part 1), clause 2 and 3.

**3.2 Friction brake** – means the part of a braking system in which the forces opposing the movement of a vehicle are developed by friction between a brake lining and a wheel disc or drum moving relatively to each other.

**3.3 Brake lining assembly** – means a component of a friction brake, which is pressed against a drum or disc, respectively, to produce the friction force;

**3.3.1 Shoe assembly** – means a brake lining assembly of a drum brake.

3.3.1.1 **“Shoe”** means a component of a shoe assembly, which carries the brake lining.

3.3.2 **“Pad assembly”** means a brake lining assembly of a disc brake.

3.3.2.1 **“Backplate”** means a component of a pad assembly, which carries the brake lining.

3.3.3 **“Brake lining”** means the friction material component with the shape and final dimension to be fixed on to the shoe or backplate.

3.3.4 **“Drum brake lining”** means a brake lining for a drum brake.

3.3.5 **“Friction material”** means the product of a specified mixture of materials and processes, which together determine the characteristics of a brake lining.

3.4 **“Brake lining type”** means a category of brake lining, which do not differ in friction material characteristics.

3.5 **“Brake lining assembly type”** means wheel sets of brake lining assemblies, which do not differ in brake lining type, dimension or functional characteristics.

3.6 **“Drum brake lining type”** means wheel sets of brake lining components, which after fitment to the shoes do not differ in brake lining type, dimensions or functional characteristics.

3.7 **“Original brake lining”** means a brake lining type referenced in the vehicle type approval documentation, Table 5 of AIS-007.

3.8 **“Original brake lining assembly”** means a brake lining assembly conforming to the data attached to a vehicle type approval documentation.

3.9 **“Replacement brake lining assembly”** means a brake lining assembly of a type approved under this standard as a suitable service replacement for an original brake lining assembly.

3.10 **“Original drum brake lining”** means a drum brake lining conforming to the data attached to a vehicle type approval documentation.

3.11 **“Replacement drum brake lining”** means a drum brake lining of a type approved under this standard as a suitable service replacement when fitted to a shoe for an original drum brake lining.

3.12 **“Manufacturer”** means the organization, which can assume technical responsibility for the brake lining assemblies or drum brake linings and can demonstrate that it possesses the necessary means to achieve conformity of production.

#### **4. APPLICATION FOR APPROVAL**

4.1 An application for approval of a replacement brake lining assembly type or a replacement drum brake lining type for (a) specific vehicle type (s) shall be submitted by the manufacturer of the replacement lining assembly/replacement drum brake lining or his duly accredited representative.

4.2 An application may be submitted by the holder of (a) vehicle type approval(s) to CMV Rule No. 96 in respect of replacement brake lining assemblies or replacement drum brake linings conforming to the type recorded in the vehicle type approvals(s) documentation.

4.3 An application for approval shall be accompanied, in triplicate, by a description of the replacement brake lining assembly or replacement drum brake lining with regard to the items specified in Annex A and by the following particulars:

4.3.1 diagrams showing functional dimensions of the replacement brake lining assembly or replacement drum brake lining;

4.3.2 an indication of the positions of the replacement brake lining assembly or replacement drum brake lining on the vehicles for which approval to fit is sought.

4.4 Brake lining assemblies or drum brake linings of the type for which approval is sought shall be made available in sufficient quantity to perform the approval tests.

4.5 The applicant shall agree with and make available to the technical service responsible for conducting approval tests the suitable representative vehicles(s) and/or brake(s).

4.6 The notified testing agency shall verify the existence of satisfactory arrangements for ensuring effective control of the conformity of production before type approval is granted.

4.6.1 The applicant shall submit values for friction behavior in accordance with Annex 8, paragraph 2.4.1 or 3.4.1 respectively of this standard.

## **5 SPECIFICATIONS AND TESTS**

### **5.1 General**

A replacement brake lining assembly or a replacement drum brake lining shall be so designed and constructed that, when substituted for the assembly or lining originally fitted to a vehicle, the braking efficiency of that vehicle accords with that of the approved vehicle type.

Specifically:

a) vehicle equipped with replacement brake lining assemblies or replacement drum brake linings shall satisfy the relevant braking prescriptions of IS:11852 or IS:14664 including its amendments:

b) a replacement brake lining assembly or a replacement drum brake lining shall display performance characteristics similar to that of the original brake lining assembly or original drum lining it is intended to replace;

c) a replacement brake lining assembly or a replacement drum brake lining must possess adequate mechanical characteristics.

**5.1.1** Replacement brake lining assemblies or replacement drum brake linings conforming to the type specified in vehicle type approval documentation to Table 5 of AIS- 007 are deemed to satisfy the requirements of paragraph 5 of this standard.

### **5.2 Performance Requirements**

5.2.1 Replacement brake lining assemblies for vehicles of categories M<sub>1</sub>, M<sub>2</sub> and N<sub>1</sub>.

Replacement brake lining assemblies shall be tested according to the prescription of Annex C and must satisfy the requirements stated in this Annex. For speed sensitivity and cold performance equivalence one of the two methods described in Annex C shall be used.

5.2.2 Replacement brake lining assemblies and replacement drum brake linings for vehicles of categories M<sub>3</sub>, N<sub>2</sub> and N<sub>3</sub>.

Replacement brake lining assemblies and replacement drum brake linings shall be tested according to the prescription of Annex D, using one of the two methods described in paragraph 1 (vehicle test) or in paragraph 2 (inertia dynamometer test) and shall satisfy the requirements stated in this Annex.

5.2.3 Replacement brake lining assemblies for vehicles of categories T<sub>1</sub> and T<sub>2</sub>.

Replacement brake lining assemblies shall be tested according to the prescriptions of Annex E and shall satisfy the requirements stated in this Annex.

5.2.4 Replacement brake lining assemblies and replacement drum brake linings for vehicles of categories T<sub>3</sub> and T<sub>4</sub>.

Replacement brake lining assemblies and replacement drum brake linings shall be tested according to the prescriptions of Annex F and shall satisfy the requirements stated in this Annex. For the tests one of the two methods described in IS: 11852 shall be used.

5.2.5 Replacement brake lining assemblies for Two and Three wheeled vehicle categories.

5.2.6 Replacement brake lining assemblies shall be tested according to the prescriptions of Annex G and shall satisfy the requirements stated in this Annex.

### 5.3 Mechanical Characteristics

5.3.1 Replacement brake lining assemblies for vehicles of categories M<sub>1</sub>, M<sub>2</sub>, N<sub>1</sub>, T<sub>1</sub>, T<sub>2</sub> and Two & Three wheeled vehicle categories.

5.3.1.1 Replacement brake lining assemblies of the type for which approval is requested shall be tested for shear strength according to standard ISO 6312:1981 or ISO 6312:2001.

The minimum acceptable shear strength is 250 N/cm<sup>2</sup> for pad assemblies and 100 N/cm<sup>2</sup> for shoe assemblies.

5.3.1.2 Replacement brake lining assemblies of the type for which approval is requested shall be tested for compressibility strength according to standard ISO 6310:1981 or ISO 6310: 2001.

The compressibility values shall not exceed 2percent at ambient temperature and 5percent at 400°C for pad assemblies and 2percent at ambient temperature and 4percent at 200°C for shoe assemblies.

5.3.2 Replacement brake lining assemblies and replacement drum brake linings for vehicles of categories M<sub>3</sub>, N<sub>2</sub>, N<sub>3</sub>, T<sub>3</sub> and T<sub>4</sub>.

5.3.2.1 Shear Strength

This test applies only to disc brake and assemblies.

Replacement brake lining assemblies of the type for which approval is requested shall be tested for shear strength according to standard ISO 6312:1981 or ISO 6312:2001. Brake lining assemblies may be divided into two or three parts to match the test machine's capability.

The minimum acceptable shear strength is  $250 \text{ N/ cm}^2$ .

#### 5.3.2.2 Compressibility

Replacement brake lining assemblies and replacement drum brake linings of the type for which approval is requested shall be tested for compressibility according to standard ISO 6310:1981 or ISO 6310: 2001. Flat specimens according to sample Type I may be used.

The compressibility values shall not exceed 2 percent at ambient temperature and 5 percent at  $400^\circ\text{C}$  for pad assemblies and 2 percent at ambient temperature and 4 percent at  $200^\circ\text{C}$  for shoe assemblies and drum brake linings.

#### 5.3.2.3 Material Hardness

- a) This requirement applies to drum brake lining assemblies and drum brake linings.
- b) Replacement brake lining assemblies or replacement drum brake linings of the type for which approval is requested shall be tested for hardness according to standard ISO 2039-2:1987.
- c) The hardness figure for the friction material at the rubbing surface shall be the mean value out of five sample linings from different production batches (if available) by taking five measurements at different places of each brake lining.

## **6.PACKAGING AND MARKING**

6.1 Replacement brake lining assemblies or replacement drum brake linings conforming to a type approved in accordance with this standard shall be marketed in axle sets.

6.2 Each axle set shall be contained in a sealed package constructed to show previous opening.

6.2.1 In the case of replacement drum brake linings rivets of suitable size and material shall be provided together with the brake linings.

6.3 Each package shall display the following information:

6.3.1 the quantity of replacement brake lining assemblies or replacement drum brake linings in the package;

6.3.2 manufacturer's name or trade mark;

6.3.3 make and type of replacement brake lining assemblies or replacement drum brake linings;

6.3.4 the vehicles/axles/brakes for which the contents are approved;



6.3.5 the approval mark.

- 6.4 Each package shall contain fitting instructions in English and Hindi languages, supplemented by the corresponding text in the language of the country where it is sold.
  - 6.4.1 with particular reference to auxiliary parts.
  - 6.4.2 stating that replacement brake lining assemblies or replacement drum brake linings should be replaced in axle sets;
  - 6.4.3 with, in the case of replacement drum brake linings, a general statement calling attention to the following points:
    - a) the integrity of the shoe platform, abutment and pivot;
    - b) freedom of the shoe from distortion, deformation and corrosion;
    - c) the type and size of rivet to be used;
    - d) the required riveting tools and forces.
- 6.5 Each replacement brake lining assembly or replacement drum brake lining shall display permanently one set of approval data (*see* Annex B)
  - a) the approval mark;
  - b) the date of manufacture, at least month and year; or batch number
  - c) make and type of brake lining.

**ANNEX A**  
**DESCRIPTION OF THE REPLACEMENT BRAKE LINING ASSEMBLY OR**  
**REPLACEMENT BRAKE DRUM LINING**

(Clause 4.3)

<b>A-1</b>	<b>Details of manufacturer*</b>	:	
A-1.1	Manufacturer's name & address	:	
A-1.2	Telephone No	:	
A-1.3	FAX. No.	:	
A-1.4	E mail address	:	
1.5	Contact person	:	
1.6	Plant/(s)of manufacture	:	
	* In case of imported items, above details shall be supplied for importer also.		
<b>2.0</b>	<b>Vehicle model for which used</b>	:	
2.1	Name of model / Variant (s)	:	
2.2	Type of vehicle (2 Wheeler/3 Wheeler/ Passenger/Goods/others)	:	
2.3	Category of vehicle(As per IS:14272, as applicable)	:	
<b>3.0</b>	<b>Vehicle Performance</b>	:	
3.1	Max. design speed, km/h	:	
<b>4.0</b>	<b>Weights</b>	:	
4.1	Vehicle kerb weight, kg	:	
4.1.1	Front axle	:	
4.1.2	Rear axle	:	
4.1.3	Total	:	
4.2	Gross vehicle weight, kg	:	
4.3	Maximum permissible axle weights, kg	:	
4.3.1	Front axle	:	
4.3.2	Rear axle	:	
4.4	Gross combination weight (for vehicles with trailer/semi-trailer)	:	
4.5	Maximum permissible axle weights (for vehicles with trailer/semi-trailer), kg	:	
4.5.1	Front axle, tractor	:	
4.5.2	Rear axle, tractor	:	
<b>5.0</b>	<b>Vehicle Dimensions</b>	:	
5.1	Length, mm	:	
5.2	Width, mm	:	
5.3	Height, (Unladen) mm	:	
5.4	Wheel base, mm	:	
5.5	Wheel track, mm	:	
5.5.1	Front	:	
5.5.2	Rear	:	
<b>6.0</b>	<b>Engine</b>	:	
6.1	Type	:	
6.2	Manufacturer's name	:	
6.3	Working principle (Four/two stroke)	:	
6.4	Max. net power of engine on bench , kW (specify standard and tolerance)	:	
<b>7.0</b>	<b>Transmission</b>	:	
7.1	Type (Manual/Automatic/semi-automatic)	:	
7.2	Clutch type (wet/dry/multiplate/hydraulic)	:	
7.3	Gear box Type	:	

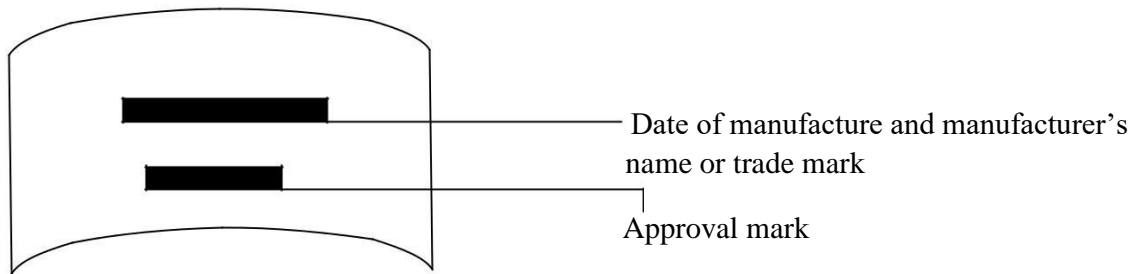
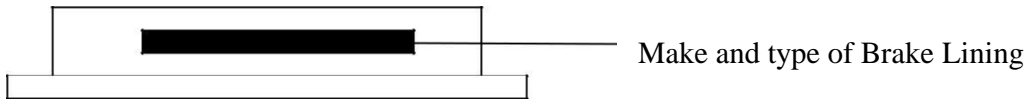
7.4	Gear shifting control system	:	
7.5	Gear ratio	:	
	Gear box ratio	:	
		1st:	
		2nd:	
		3rd:	
		4th:	
		5th:	
		6th:	
		Over drive:	
		Reverse:	
7.6	Wheel drive	:	
<b>8.0</b>	<b>Tyres</b>	:	
8.1	No. and arrangement of wheels	:	
8.1.1	Front wheel	:	
8.1.2	Rear wheel	:	
8.1.3	Other wheel	:	
8.2	Tyre type (Radial/cross ply) ,size & ply rating	:	
8.2.1	Front wheel	:	
8.2.2	Rear wheel	:	
8.2.3	Other wheel	:	
8.3	Inflation pressure-Unladen, kg/cm <sup>2</sup>	:	
8.3.1	Front	:	
8.3.2	Rear	:	
8.3.3	Other wheel	:	
8.4	Inflation pressure-Laden kg/cm <sup>2</sup>	:	
8.4.1	Front	:	
8.4.2	Rear	:	
8.4.3	Other wheel	:	
<b>9.0</b>	<b>Steering system</b>	:	
9.1	Type ( handle bar/steering wheel)	:	
<b>10.0</b>	<b>Braking system</b>	:	
10.1	Type (drum / disc/leading/trailing)	:	
10.1.1	Front	:	
10.1.2	Rear	:	
10.2	Control System (operated by hand/foot)	:	
10.2.1	Front	:	
10.2.2	Rear	:	
10.2.3	Combined	:	
10.3	Free play of Control ,mm	:	
10.3.1	Front	:	
10.3.2	Rear	:	
10.3.3	Combined	:	
10.4	Lining/Pad	:	
10.4.1	Nominal Dimensions, (mm) (Length x Width x thickness)	:	
10.4.2	Whether asbestos / asbestos free	:	
10.4.3	Front	:	
10.4.4	Rear	:	
10.5	Area per wheel (cm <sup>2</sup> )	:	

10.5.1	Front	:	
10.5.2	Rear	:	
10.6	Make and material designation	:	
10.6.1	Front	:	
10.6.2	Rear	:	
10.7	Brake Drum or Disc Effective dia. mm	:	
10.7.1	Front	:	
10.7.2	Rear	:	
10.8	Material (if the braking surface is non ferrous)	:	
10.8.1	Front	:	
10.8.2	Rear	:	
10.9	Nominal Size of master cylinder mm	:	
10.9.1	Operating stroke of the master cylinder, mm	:	
10.10	Nominal Size of wheel cylinder mm	:	
10.10.1	Front	:	
10.10.2	Rear	:	
10.11	Parking Brake	:	
10.11.1	Braking Wheel	:	
10.11.2	Type	:	
10.11.3	Control (operated by hand/foot)	:	
10.12	Locking device	:	
<b>11.0</b>	<b>Any other feature which manufacturer desires to declare</b>		

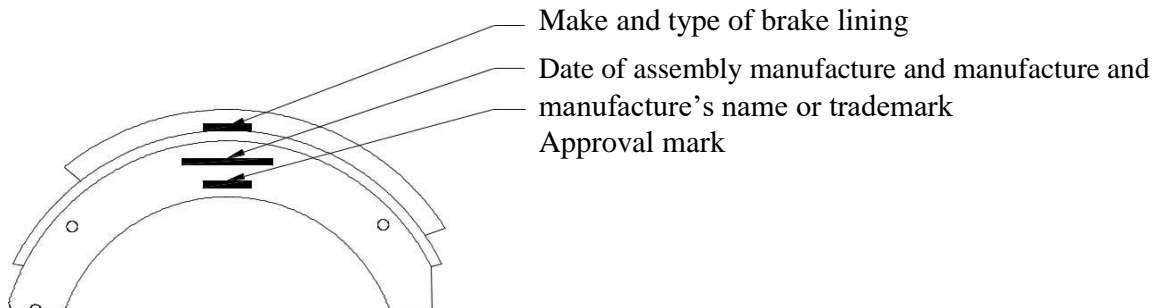
Test agency	Manufacturer	Document no. ( indicating also revision status )
Signature	Signature	
Name	Name	
Designation	Designation	
Date	Date	Sheet no. -- of --

**ANNEX B**  
(Clause 6.5)

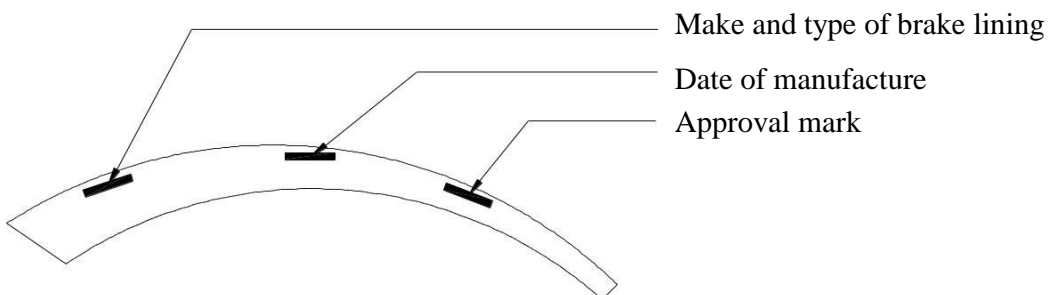
**B- 1 EXAMPLES OF PAD ASSEMBLY MARKING**



**B- 2 EXAMPLES OF SHOE ASSEMBLY MARKING**



**B-3 EXAMPLES OF DRUM BRAKE LINING MARKING**



**ANNEX C**  
(Clause 5.2.1)  
**REQUIREMENT FOR REPLACEMENT BRAKE LINING ASSEMBLIES**  
**FOR VEHICLES OF CATEGORIES M1, M2 AND N1**

**C-1 CONFORMANCE WITH IS:11852**

Compliance with the requirements of IS:11852 shall be demonstrated in a vehicle test.

**C- 1.1 Test Vehicle**

A vehicle which is representative of the type(s) for which the replacement brake lining assembly approval is required shall be equipped with the replacement brake lining assemblies of the type for which approval is requested and instrumented for brake testing as required by IS:11852 (Part 1 to 8).

Brake linings submitted for test shall be fitted to the relevant brakes and until a fixed burnishing procedure is established, shall be burnished to the manufacturer's instructions in agreement with the technical service.

C-1.2 The braking system of the vehicle shall be tested according to the requirements for the vehicle category in question (M<sub>1</sub>, M<sub>2</sub> or N<sub>1</sub>) in IS:11852 (Part 3). The applicable requirements or tests are:

**C-1.2.1 Service Braking System.**

C-1.2.1.1 Type-P test with engine disconnected, vehicle laden.

C-1.2.1.2 Type-P test with engine connected, vehicle unladen and laden, according to IS:11852 (Part 3), cl. 3.2.2.2 (stability test) (only the test with initial speed  $v = 0.8 V_{max}$ ).

C-1.2.1.3 Type-F Test

**C-1.2.2 Secondary Braking System**

C-1.2.2.1 Type-P test with engine disconnected, vehicle laden (this test may be omitted in cases where it is obvious that the requirements are met e.g. diagonal split braking system).

**C-1.2.3 Parking Braking System**

(Only applicable if the brakes for which lining approval is sought are used for parking).

C-1.2.3.1 Downhill test at 18percent gradient, vehicle laden.

C-1.3 The vehicle shall satisfy all the relevant requirements stated in IS: 11852 for that category of vehicles.

## C-2 ADDITIONAL REQUIREMENTS

Compliance with the additional requirements shall be demonstrated by using one of the two following methods.

### C- 2.1 Vehicle Test (Split Axle Test)

For this test the vehicle shall be fully laden and all brake applications made with engine disconnected, on a level road.

The vehicle service brake control system shall be equipped with a means of isolating front and rear axle brakes so that either may be used independently of the other.

Where brake lining assembly approval is required for front axle brakes the rear axle brakes shall remain inoperative throughout the test.

Where brake lining assembly approval is required for rear axle brakes the front axle shall remain inoperative throughout the test.

#### C- 2.1.1 Cold Performance Equivalence Test

A comparison of the cold performance of the replacement brake lining assembly and the original brake lining assembly shall be made by comparing the results of testing to the following method.

C- 2.1.1.1 Make a minimum of six brake applications at spaced increments of pedal effort or line pressure up to wheel lock or alternatively, up to a mean fully developed deceleration of  $6 \text{ m/s}^2$  or up to the allowed maximum pedal force for the category of vehicle in question from an initial speed as given in the table below:

Vehicle Category	Test speed in km/h	
	Front axle	Rear axle
M <sub>1</sub>	70	45
M <sub>2</sub>	50	40
N <sub>1</sub>	65	50

The initial brake temperature at the start of each application shall be  $\leq 100^\circ\text{C}$ .

C-2.1.1.2 Note and plot pedal force or line pressure and mean fully developed deceleration for each application and determine the pedal force line pressure required to achieve (if possible) a mean fully developed deceleration of  $5 \text{ m/s}^2$  for front axle brakes and  $3 \text{ m/s}^2$  for rear axle brakes. If these values cannot be achieved with the maximum allowed pedal force determine alternatively the pedal force or line pressure required to achieve maximum deceleration.

C-2.1.1.3 The replacement brake lining assembly shall be considered to show similar performance characteristics to the original brake lining assembly if the achieved mean fully developed decelerations at the same control force or line pressure in the upper two thirds of the generated curve are within 15percent of those obtained with the original brake lining assembly.

#### C-2.1.2 Speed Sensitivity Test

C-2.1.2.1 Using the pedal force derived from paragraph 2.1.1.2 of this Annex and with initial brake temperature  $\leq 100^{\circ}\text{C}$  make three brake applications from each of the following speeds:

Front axle 65, 100 km/h and 135 km/h where  $V_{\text{max}}$  exceeds 150 km/h.

Rear axle 45, 65 km/h and 90 km/h where  $V_{\text{max}}$  exceeds 150 km/h.

C-2.1.2.2 Average the results for each group of three applications and plot speed against corresponding mean fully developed deceleration.

C-2.1.2.3 Mean fully developed decelerations recorded for the higher speeds shall lie within 15percent of that recorded for the lowest speed.

## C-2.2 Inertia Dynamometer Test

### C-2.2.1 Test Equipment

For the tests an inertia dynamometer shall be equipped with the vehicle brake in question. The dynamometer shall be instrumented for continuous recording of rotational speed, brake torque, pressure in the brake line and number of rotations after brake application, braking time and brake rotor temperature.

### C-2.2.2 Test Conditions

C-2.2.2.1 The rotational mass of the dynamometer shall correspond to half the axle portion of the maximum vehicle mass as listed in the table below and to the rolling radius of the largest tyre that is authorized for that vehicle type(s).

Vehicle Category	Axle portion of maximum vehicle mass	
	Front axle	Rear axle
M <sub>1</sub>	0.77	0.32
M <sub>2</sub>	0.69	0.44
N <sub>1</sub>	0.66	0.39

C-2.2.2.2 The initial dynamometer rotational speed shall correspond to the linear vehicle speed as stated in paragraphs 2.2.3 and 2.2.4 of this Annex and shall be based on the dynamic rolling radius of the tyre.

C-2.2.2.3 Brake linings submitted for test shall be fitted to the relevant brakes and until a fixed burnishing procedure is established, shall be burnished to the manufacturer's instructions in agreement with the technical service.

C-2.2.2.4 If cooling air is used, the speed of the airflow at the brake shall be:

$$V_{\text{air}} = 0.33v$$

where:



$v$  = vehicle test speed at initiation of braking.

### C-2.2.3 Cold Performance Equivalence Test

A comparison of the cold performance of the replacement brake lining assembly and the original brake lining assembly shall be made by comparing the results to the following method.

C-2.2.3.1 From the initial speed of 80 km/h for M<sub>1</sub> and N<sub>1</sub> and 60 km/h for M<sub>2</sub> and with brake temperature  $\leq 100^{\circ}\text{C}$  at the start of each application make a minimum of six brake applications at spaced intervals of line pressure up to a mean fully developed deceleration rate of  $6 \text{ m/s}^2$ .

C-2.2.3.2 Note and plot line pressure and mean fully developed deceleration for each application and determine line pressure required to achieve  $5 \text{ m/s}^2$ .

C-2.2.3.3 The replacement brake lining assembly shall be considered to show similar performance characteristics to the original brake lining assembly if the achieved mean fully developed decelerations at the same control force or line pressure in the upper two thirds of the generated curve are within 15percent of those obtained with the original brake lining assembly.

### C-2.2.4 Speed Sensitivity Test

C-2.2.4.1 Using the line pressure derived from paragraph 2.2.3.2 and with initial brake temperature  $\leq 100^{\circ}\text{C}$  make three brake applications from rotational speed corresponding to vehicle linear speeds of:

75, 120 km/h and 160 km/h where  $V_{\text{max}}$  exceeds 150 km/h.

C-2.2.4.2 Average the results for each group of three applications and plot speed against corresponding mean fully developed deceleration.

C-2.2.4.3 Mean fully developed decelerations recorded for the speeds shall lie within 15percent of that recorded for the lowest speed.

**ANNEX D**

(See 5.2.2)

**REQUIREMENTS FOR REPLACEMENT BRAKE LINING ASSEMBLIES  
AND DRUM BRAKE LININGS FOR VEHICLES OF  
CATAGORIES M<sub>3</sub>, N<sub>2</sub> AND N<sub>3</sub>****D-1 VEHICLE TEST****D-1.1 Test Vehicle**

A vehicle which is representative of the type(s) for which the replacement brake lining assembly approval or drum brake lining approval is required shall be equipped with brake lining assemblies or drum brake linings of the type for which approval is sought and instrumented for brake testing as required by IS: 11852

Brake linings submitted for test shall be fitted to the relevant brakes and, until a fixed burnishing procedure is established, shall be burnished to the manufacturer's instructions in agreement with the technical service.

**D- 1.2 Tests and Requirements**

D-1.2.1 Conformance with IS: 11852.

D-1.2.1.1 The braking system of the vehicle shall be tested according to the requirements for the vehicle category in question (M<sub>3</sub>, N<sub>2</sub> or N<sub>3</sub>) in IS: 11852 (Part 3). The applicable requirements or tests are:

**D-1.2. 1.1.1 Service Braking System**

D-1.2.1.1.1.1 Type-P test with engine disconnected, vehicle laden

D-1.2.1.1.1.2 Type-P test with engine connected, vehicle unladen and laden according to IS: 11852 (Part 3) cl. 3.2.2.2 (stability test and only the test with initial speed  $V = 0.8 v$  max).

D-1.2.1.1.1.3 Type - F test according to IS: 11852 (Part 3) cl. 3.3.1 and 3.3.3

D-1.2.1.1.1.4 Type – H Test

The laden vehicle must be tested in such a manner that the energy input is equivalent to that recorded in the same period of time with the laden vehicle driven at an average speed of 30 km/h on a 2.5percent down-gradient for a distance of 6 km with the gear disengaged, the braking energy being taken by the service brakes alone.

**D-1.2.1.1.2 Secondary Braking System**

D-1.2.1.1.2.1 Type-P test with engine disconnected, vehicle laden (this test may be omitted if covered by tests according to paragraph 1.2.2. of this Annex).

D-1.2.1.1.3 Parking Braking System (Only applicable if the brakes for which lining approval is sought are used for parking).

## D-1.2.1.1.3.1 Downhill test at 18percent gradient, vehicle laden.

D-1.2.1.2 The vehicle Shall satisfy all relevant requirements stated in IS: 11852 for that category of vehicle.

## D-1.2.2 Additional Requirements (Split Axle Test)

For the tests mentioned below the vehicle shall be fully laden and all brake applications made with engine disconnected, on a level road.

The vehicle service brake control system shall be equipped with a means of isolating front and rear axle brakes so that either may be used independently of the other.

Where brake lining assembly approval or drum brake lining approval is required for front axle brakes the rear axle brakes shall remain inoperative throughout the test.

Where brake lining assembly approval or drum brake lining approval is required for rear axle brakes the front axle brakes shall remain inoperative throughout the test.

## D-1.2.2.1 Cold Performance Equivalence Test

A comparison of the cold performance of the replacement brake lining assembly or the replacement drum brake lining and the original brake lining assembly or the original drum brake lining shall be made by comparing the results of testing to the following method.

D-1.2.2.1.1 Make a minimum of six brake applications at spaced increments of pedal or line pressure up to wheel lock or, alternatively, up to a mean fully developed deceleration of  $3.5 \text{ m/s}^2$  or up to the maximum allowed pedal force or up to the maximum line pressure from an initial speed of 45 km/h and with a brake temperature  $\leq 100^\circ\text{C}$  at the start of each application.

D-1.2.2.1.2 Note and plot pedal force or line pressure and mean fully developed deceleration for each application and determine the pedal force or line pressure required to achieve (if possible) a mean fully developed deceleration of  $3 \text{ m/s}^2$ . If this value cannot be achieved determine alternatively the pedal force or line pressure required to achieve maximum deceleration.

D-1.2.2.1.3 The replacement brake lining assembly or the replacement drum brake lining shall be considered to show similar performance characteristics to the original brake lining assembly or the original drum brake lining if the achieved mean fully developed decelerations at the same control force or line pressure in the upper two thirds of the generated curve are within 15percent of those obtained with the original brake lining assembly or the original drum brake lining.

## D-1.2.2.2 Speed Sensitivity Test

D-1.2.2.2.1 Using the pedal force derived from paragraph 1.2.2.1.2. of this Annex and with initial brake temperature  $\leq 100$  °C, make three brake applications from each of the following speeds:

40 km/h down to 20 km/h,

60 km/h down to 40 km/h and

80 km/h down to 60 km/h (if  $v_{max} \geq 90$  km/h)

D-1.2.2.2.2 Average the results for each group of three applications and plot speed against corresponding mean fully developed deceleration.

D-1.2.2.2.3 Mean fully developed decelerations recorded for the higher speeds shall lie within 25 percent of that recorded for the lowest speed.

## **D-2 INERTIA DYNAMOMETER TEST**

### **D- 2.1 Test Equipment**

For the tests an inertia dynamometer shall be equipped with the vehicle brake in question. The dynamometer shall be instrumented for continuous recording of rotational speed, brake torque, pressure in the brake line and number of rotations after brake application, braking time and brake rotor temperature.

#### **D- 2.1.1 Test Conditions**

D- 2.1.1.1 The rotational mass of the dynamometer shall correspond to half the axle portion of 0.55 of the maximum vehicle mass and the rolling radius of the largest tyre that is authorised for that vehicle type(s).

D- 2.1.1.2 The initial dynamometer rotational speed shall correspond to the linear vehicle speed as stated in the paragraphs below and shall be based on the dynamic rolling radius of the smallest tyre that is authorised for that vehicle type(s).

D- 2.1.1.3 Brake lining assemblies or drum brake linings submitted for the test shall be fitted to the brake and until a fixed burnishing procedure is established, shall be burnished to the manufacturer's instructions in agreement with the technical service.

D- 2.1.1.4 If cooling air is used, the speed of the airflow at the brake shall be:

$$V_{air} = 0.33v$$

where:

$v$  = vehicle test speed at initiation of braking.

D- 2.1.1.5 The actuation cylinder fitted to the brake must be of the smallest size that is authorised for that vehicle type(s).

#### **D- 2.2 Tests and Requirements**

##### **D- 2.2.1 Tests derived from IS: 11852 (Part 7)**

###### **D- 2.2.1.1 Type-P Test**

From the initial speed of 60 km/h with a brake temperature  $\leq 100$ °C at the start of each application make a minimum of six brake applications at spaced intervals of line pressure up to the line pressure that is permanently guaranteed by the braking system of the vehicle type(s) (e.g. cut in pressure of the compressor). A mean fully developed deceleration of at least  $5 \text{ m/s}^2$  must be achieved.

###### **D- 2.2.1.2 Type-P Test, High Speed Performance**

Make three brake applications with a brake temperature of  $\leq 100$  °C at the start of each application from a speed of 100 km/h where approval is directed to vehicles of category N<sub>2</sub> and 90 km/h where approval is directed to vehicles of categories M<sub>3</sub> and N<sub>3</sub> using the guaranteed line pressure as defined in paragraph 2.2.1.1. The mean value of the achieved mean fully developed decelerations of the three applications must be at least 4 m/s<sup>2</sup>.

#### D- 2.2.1.3 Type-F Test

##### D- 2.2.1.3.1 Heating Procedure

Make 20 consecutive snub applications with V<sub>1</sub> = 60 km/h and V<sub>2</sub> = 30 km/h with a cycle time of 60 s starting at a brake temperature of  $\leq 100$  °C at the first application. The line pressure shall correspond to a deceleration of 3 m/s<sup>2</sup> at the first application and must remain constant throughout the succeeding applications.

##### D- 2.2.1.3.2 Hot Performance

On completion of the heating procedure the hot performance shall be measured under the conditions of paragraph 2.2.1.1 above using the guaranteed line pressure as defined in paragraph 2.2.1.1 (the temperature conditions may be different). The mean fully developed deceleration with the heated brake must not be less than 60 percent of the value achieved with the cold brake or 4 m/s<sup>2</sup>.

##### D- 2.2.1.3.3 Recovery

Starting 120 s after the hot performance brake application makes 5 full stops with the line pressure used in paragraph 2.2.1.3.1. above and with intervals of at least 2 minutes from the initial speed of 60 km/h. At the beginning of the fifth application the brake temperature shall be  $\leq 100$ °C and the mean fully developed deceleration achieved shall be within 10 percent of that calculated from the relation line pressure/deceleration of the Type-P test at 60 km/h.

## D- 2.2.1.4 Type -H Test

## D- 2.2.1.4.1 Heating Procedure

The brakes shall be heated by constant braking torque corresponding to a deceleration of  $0.15 \text{ m/s}^2$  at a constant speed of 30 km/h during a period of 12 minutes.

## D- 2.2.1.4.2 Hot Performance

On completion of the heating procedure the hot performance shall be measured under the conditions of paragraph 2.2.1.1 above using the guaranteed line pressure as defined in paragraph 2.2.1.1 (the temperature conditions may be different). The mean fully developed deceleration with the heated brake must not be less than  $3.75 \text{ m/s}^2$ .

## D- 2.2.1.5 Static Test for Parking Performance

D- 2.2.1.5.1 For the whole range of applications determine the worst case regarding input force to the brake, maximum vehicle mass to be braked by one axle and tyre radius.

D- 2.2.1.5.2 Apply the brake with the input force as determined under paragraph 2.2.1.5.1 above.

D- 2.2.1.5.3 Put a slowly increasing torque on the dyno shaft in order to turn the drum or disc. Measure the output torque at the brake in the moment the dyno shaft begins to move and calculate corresponding axle braking force using the tyre radius as determined under paragraph 2.2.1.5.1.

D- 2.2.1.5.4 The brake force measured under paragraph 2.2.1.5.3 divided by one-half of the vehicle mass as determined under paragraph 2.2.1.5.1 must give at least a quotient of 0.18.

## D- 2.2.2 Cold Performance Equivalence Test

A comparison of the cold performance of the replacement brake lining assembly or the replacement drum brake lining and the original brake lining assembly or the original drum brake lining shall be made by comparing the results of the Type-P test as described in paragraph 2.2.1.1.

D- 2.2.2.1 The Type-P test as prescribed in paragraph D- 2.2.1.1 shall be performed with one set of the original brake lining assembly or the original drum brake lining.

D- 2.2.2.2 The replacement brake lining assembly or the replacement drum brake lining shall be considered to show similar performance characteristics to the original brake lining assembly or the original drum brake lining if the achieved mean fully developed decelerations at the same line pressure in the upper two thirds of the generated curve are within 15 percent of those obtained with the original brake lining assembly or the original drum brake lining.

D- 2.2.3 Speed Sensitivity Test

D- 2.2.3.1 Using the guaranteed line pressure as defined in paragraph 2.2.1.1 and with initial brake temperature  $\leq 100^{\circ}\text{C}$ , make three brake applications from each of the following speeds:

60 km/h down to 30 km/h,

80 km/h down to 60 km/h and

110 km/h down to 80 km/h (if  $v_{\text{max}} \geq 90$  km/h).

D- 2.2.3.2 Average the results for each group of three applications and plot speed against corresponding mean fully developed deceleration.

D- 2.2.3.3 Mean fully developed decelerations recorded for the higher speeds shall lie within 25percent of that recorded for the lowest speed.

**ANNEX E**

(Clause 5.2.3)

**REQUIREMENTS FOR REPLACEMENT BRAKE LINING  
ASSEMBLIES FOR VEHICLES OF CATEGORIES T<sub>1</sub> AND T<sub>2</sub>****E-1 GENERAL**

The test method described in this Annex is based on an inertia dynamometer test. Alternatively the tests may be carried out on a test vehicle or on a rolling road test bench provided that the same test conditions are achieved and the same parameters measured as in the inertia dynamometer test.

**E-2 TEST EQUIPMENT**

For the tests an inertia dynamometer shall be equipped with the vehicle brake in question. The dynamometer shall be instrumented for continuous recording of rotational speed, brake torque, pressure in the brake line or actuation force, number of rotations after brake application, braking time and brake rotor temperature.

**E- 2.1 Test Conditions**

E- 2.1.1 The rotational mass of the dynamometer shall correspond to half the relevant axle portion of the maximum vehicle mass and the rolling radius of the largest tyre that is authorised for that vehicle type(s).

E- 2.1.2 The initial dynamometer rotational speed shall correspond to the linear vehicle speed as stated in paragraph 3.1 of this Annex and shall be based on the dynamic rolling radius of the smallest tyre that is authorised for that vehicle type(s).

E- 2.1.3 Brake linings submitted for the test shall be fitted to the relevant brake and until a fixed burnishing procedure is established, shall be burnished to the manufacturer's instructions in agreement with the technical service.

E- 2.1.4 If cooling air is used, the speed of the airflow at the brake shall be:

$$V_{\text{air}} = 0.33v$$

where:

v = vehicle test speed at initiation of braking.

E- 2.1.5 The actuation device fitted to the brake must correspond to the vehicle installation.

**E-3 TESTS AND REQUIREMENTS****E- 3.1. Type-P Test**

From the initial speed of 60 km/h with a brake temperature  $\leq 100^{\circ}\text{C}$  at the start of each application make a minimum of six consecutive brake applications at spaced intervals of line pressure or application force up to the maximum line pressure or up to  $6 \text{ m/s}^2$  deceleration. Repeat the last brake application using an initial speed of 40 km/h.



**E- 3.2 Type - F Test****E- 3.2.1 Heating Procedure**

The brake shall be heated with continuous braking according to the requirement of IS: 11852 (Part 3) cl.3.3.2 starting with a brake rotor temperature  $\leq 100^{\circ}\text{C}$ .

**E- 3.2.2 Hot Performance**

On completion of the heating procedure the hot performance from an initial speed of 40 km/h shall be measured under the conditions of paragraph 3.2.1 above using the same line pressure or application force (the temperature conditions may be different). The mean fully developed deceleration with the heated brake must not be less than 60percent of the value achieved with the cold brake or  $3.5 \text{ m/s}^2$ .

**E- 3.3 Cold Performance Equivalence Test**

A comparison of the cold performance of the replacement brake lining assembly and the original brake lining assembly shall be made by comparing the results of the Type-P test as described in paragraph 3.1.

E- 3.3.1 The Type-P test as prescribed in paragraph 3.1 shall be performed with one set of the original brake lining assembly.

E- 3.3.2 The replacement brake lining assembly shall be considered to show similar performance characteristics to the original brake lining assembly if the achieved mean fully developed decelerations at the same line pressure or application force in the upper two thirds of the generated curve are within 15percent of those obtained with the original brake lining assembly.

**ANNEX F**

(Clause 5.2.4)

**REQUIREMENTS FOR REPLACEMENT BRAKE LINING ASSEMBLIES  
AND DRUM BRAKE LININGS FOR VEHICLES OF  
CATEGORIES T3 AND T4****F-1 TEST CONDITIONS**

The tests prescribed in this Annex may be carried out alternatively on a test vehicle or on an inertia dynamometer under the same conditions as mentioned in IS :11852 (Part 1 to 9),

Brake linings submitted for test shall be fitted to the relevant brakes and, until a fixed burnishing procedure is established, shall be burnished to the manufacturer's instructions in agreement with the technical service.

**F-2 TESTS AND REQUIREMENTS****F-2.1 Conformance with IS:11852 (Part 3),**

The brakes shall be tested according to the requirements of IS:11852 (Part 3 )

F-2.1.1 The results shall be reported in a form according to IS: 11852 (Part 3),

F-2.1.2 A comparison shall be made between these results and those obtained with the original brake lining assemblies or the original drum brake linings under the same conditions.

F-2.1.3 The achieved hot performance at the same input torque of the replacement brake lining assembly or the replacement drum brake lining in the Type-F test must be:

(a) equal to or higher than the hot performance of the original brake lining assembly or the original drum brake lining, or

(b) at least 90percent of the cold performance of the replacement brake lining assembly or the replacement drum brake lining.

The corresponding stroke of the actuator must not be  $\geq 110$  percent of the value achieved with the original brake lining assembly. In the case where the original brake lining assembly or drum brake lining has been tested against the Type-H test requirements, the minimum requirements of IS: 11852 (Part 3) are applicable for the replacement brake lining assembly or drum brake lining.

**F-2.2 Cold Performance Equivalence Test (Type-P)**

F-2.2.1 Under the conditions of paragraph 1 of this Annex and from an initial speed of 60 km/h with a brake temperature  $\leq 100^{\circ}\text{C}$  make 6 brake applications at spaced intervals of control force or line pressure up to 6.5 bar or an achieved deceleration of  $6 \text{ m/s}^2$ .

F-2.2.2 Note and plot control force or line pressure and mean brake torque or mean fully developed deceleration for each application.

F-2.2.3 Compare the results with those obtained with the original brake lining assemblies or the original drum brake linings under the same test conditions.

F-2.2.4 The replacement brake lining assembly or the replacement drum brake lining shall be considered to show similar performance characteristics to the original brake lining assembly or the original drum brake lining if the achieved mean fully developed decelerations at the same input force or line pressure in the upper two thirds of the generated curve are within -5percent and +15percent of those obtained with the original brake lining assembly or the original drum brake lining.

**ANNEX G**

(Clause 5.2.5)

**REQUIREMENTS FOR REPLACEMENT BRAKE LINING ASSEMBLIES  
FOR TWO AND THREE WHEELED VEHICLE CATEGORIES****G-1TEST CONDITIONS**

G-1.1 A vehicle which is representative of the type(s) for which the replacement brake lining assembly approval is required shall be equipped with the brake lining assemblies of the type for which approval is requested and instrumented for brake testing as required by IS: 14664.

G-1.2 Brake lining assemblies submitted for the test shall be fitted to the relevant brakes and, until a fixed burnishing procedure is established, shall be burnished to the manufacturer's instructions in agreement with the technical service.

**G-2TESTS AND REQUIREMENTS**

G-2.1 Conformance with IS: 14664

G-2.1.1 The braking system of the vehicle shall be tested according to the vehicle categories mentioned in IS: 14664 and applicable requirements or tests are

G-2.1.1.1 Type - P test with engine disconnected

The test is to be carried out only in the laden condition. Make a minimum of six brake applications at spaced increments of control force or line pressure up to wheel lock, or up to a deceleration of  $6 \text{ m/s}^2$  or up to the maximum allowed control force.

G-2.1.1.2 Type - P Test with Engine Connected

Only applicable for two and three wheeled vehicle categories.

G-2.1.1.3 Type -P Test with Wet Brakes

Not applicable to vehicles of category L5 or in cases of drum brakes or fully enclosed disc brakes not subjected to this test during approval to IS: 14464

G-2.1.1.4 Type -F Test

Only applicable for two and three wheeled vehicle categories.

G-2.1.2 The vehicle must satisfy all the relevant requirements stated in IS: 14464 for that category of vehicles.

G-2.2 **Additional Requirements**

G-2.2.1 Cold Performance Equivalence Test

A comparison of the cold performance of the replacement brake lining assembly and the original brake lining assembly shall be made by comparing the results of the Type-P test as described in paragraph 2.1.1.1.

G-2.2.1.1 The Type-P test as prescribed in paragraph 2.1.1.1 shall be performed with one set of the original brake lining assembly.

G-2.2.1.2 The replacement brake lining assembly shall be considered to show similar performance characteristics to the original brake lining assembly if the achieved mean fully developed decelerations at the same line pressure in the upper two thirds of the generated curve are within 15percent of those obtained with the original brake lining assembly.

#### G-2.2.2. Speed Sensitivity Test

This test is only applicable for vehicles of Categories L<sub>2</sub> and L<sub>5</sub> and shall be carried out with the laden vehicle under the conditions of the Type-P test with engine disconnected. However, the test speeds are different.

G-2.2.2.1 From the results of the Type-P test as described in paragraph 2.1.1.1 determine the control force or line pressure corresponding to the minimum required mean fully developed deceleration for that category of vehicle.

G-2.2.2.2 Using the control force or line pressure determined in paragraph 2.2.2.1 and with initial brake temperature  $\leq 100^{\circ}\text{C}$ , make three brake applications from each of the following speeds:

40 km/h, 80 km/h and 120 km/h (if  $v_{\text{max}} \geq 130$  km/h).

G-2.2.2.3 Average the results for each group of three applications and plot speed against corresponding mean fully developed deceleration.

G-2.2.2.4 Mean fully developed decelerations recorded for the higher speeds shall lie within 15percent of that recorded for the lowest speed.

**ANNEX H**  
(Clause 4.6.1)

**DETERMINATION OF FRICTION BEHAVIOUR BY  
MACHINE TESTING**

**H-1 INTRODUCTION**

**H- 1.1** Samples of a replacement brake lining assembly type shall be tested on a machine capable of generating the test conditions and applying the test procedures described in this Annex.

**H- 1.2** Test results shall be evaluated to determine sample friction behaviour.

**H- 1.3** The friction behaviour of samples shall be compared to assess conformity with the standard registered for a replacement brake lining assembly type.

**H- 2 REPLACEMENT BRAKE LINING ASSEMBLIES FOR VEHICLES OF M<sub>1</sub>, M<sub>2</sub>, T<sub>1</sub>, T<sub>2</sub>, TWO AND THREE WHEELED VEHICLE CATEGORIES**

**H- 2.1 Equipment**

**H- 2.1.1** The machine shall be designed to accept and operate a full size brake similar to those fitted to the vehicle axle used for approval testing to paragraph 5 of this standard.

**H- 2.1.2** The disc or drum rotational speed shall be  $660 \pm 10 \text{ min}^{-1}$  <sup>(1)</sup> without load and shall not fall below  $600 \text{ min}^{-1}$  on full load.

**H- 2.1.3** The test cycles and brake applications during the cycles to be adjustable and automatic.

**H- 2.1.4** Output torque or brake pressure (constant torque method) and working surface temperature shall be recorded.

**H- 2.1.5** Provision shall be made to direct cooling air across the brake at a rate of  $600 \pm 60 \text{ m}^3/\text{h}$ .

**H- 2.2 Test Procedure**

**H- 2.2.1 Sample Preparation**

The manufacturer's bedding schedule shall ensure a minimum of 80percent surface contact area for pad assemblies without exceeding a surface temperature of 300°C and 70percent surface contact area for leading shoe assemblies without exceeding a surface temperature of 200°C.

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NOTE - In the case of vehicles of categories L1 and L2, a lower test speed may be used.

**H- 2.2.2** Test Schedule

The test schedule comprises a number of consecutive braking cycles each containing X braking intervals of 5 seconds brake applied followed by 10 seconds brake released.

The following two methods may be used alternatively:

**H- 2.2.2.1** Test Schedule with Constant Pressure**H- 2.2.2.1.1** Pad Assemblies

The hydraulic pressure p under the piston(s) of the calliper shall be constant following the formula:

$$p^1 = \frac{M_d}{0.57 \cdot r_w \cdot A_k}$$

$$M_d = 150 \text{ Nm for } A_k < 18.1 \text{ cm}^2$$

$$M_d = 300 \text{ Nm for } A_k > 18.1 \text{ cm}^2$$

$$A_k = \text{area of calliper piston(s)}$$

$$r_w = \text{effective radius of disc}$$

No. of Cycle	Number of Brake Applications X	Initial Brake Rotor Temperature (°C)	Max. Brake Rotor Temperature (°C)	Forced Cooling
1	1 x 10	< 60	open	no
2-6	5 x 10	100	open (350) <sup>(1)</sup>	no
7	1 x 10	100	open	yes

(1) In the case of vehicles of category L, the temperature shall be limited to 350°C. If necessary, the number of applications per cycle must be reduced accordingly. However, in this case, the number of cycles shall be increased to keep the total number of applications constant.

**H- 2.2.2.1.2** Shoe Assemblies

The mean contact pressure at the brake lining working surface shall be constant at  $22 \pm 6$  N/cm<sup>2</sup> calculated for a static brake without self-energising.

No. of Cycle	Number of Brake Applications	Initial Brake Rotor Temperature (°C)	Max. Brake Rotor Temperature (°C)	Forced Cooling
1	1 X 10	< 60	200	yes
2	1 X 10	100	open	no
3	1 X 10	100	200	yes
4	1 X 10	100	open	no

**H- 2.2.2.2** Test Schedule with Constant Torque

This method applies only for pad assemblies. The brake torque shall be constant within a tolerance of  $\pm 5$  percent and adjusted to guarantee the maximum brake rotor temperatures given in the table below.

No. of Cycle	Number of Brake Applications	Initial Brake Rotor Temperature ( $^{\circ}\text{C}$ )	Max. Brake Rotor Temperature ( $^{\circ}\text{C}$ )	Forced Cooling
1	1 X 5	< 60	200-350 (200-250) <sup>(1)</sup>	no
2-4	3 X 5	100	200-350 (200-250)	no
6-9	1 X 10	100	200-350 (200-250)	no
10	4 X 5	100	200-350 (200-250)	no
11-13	1 x 10	100	200-350 (200-250)	no
14	3 x 5	100	200-350 (200-250)	no
	1 x 5	< 60	200-350 (200-250)	no

NOTE - Values in brackets are for two and three wheeled vehicle categories.

**H- 2.3** Evaluation of Test Results

Friction behaviour is determined from the brake torque noted at selected points in a test schedule. Where brake factor is constant, e.g. a disc brake, brake torque may be translated to coefficient of friction.

**H- 2.3.1** Pad Assemblies

**H- 2.3.1.1** The operational coefficient of friction ( $\mu_{op}$ ) is the mean of the values recorded during cycles 1qwo to seven (constant pressure method) or during cycles 2-4, 6-9 and 11-13 (constant torque method); measurement being made one second after commencing the first brake application of each cycle.

**H- 2.3.1.2** The maximum coefficient of friction ( $\mu_{max}$ ) is the highest value recorded during all cycles.

**H- 2.3.1.3.** The minimum coefficient of friction ( $\mu_{min}$ ) is the lowest value recorded during all cycles.

**H- 2.3.2** Shoe assemblies

**H- 2.3.2.1** The mean torque ( $M_{mean}$ ) is the average of the maximum and minimum values of brake torque recorded during the fifth brake application of cycles one and three.

**H- 2.3.2.2** The hot torque ( $M_{hot}$ ) is the minimum brake torque developed during cycles two and four. If the temperature exceeds  $300^{\circ}\text{C}$  during these cycles the value at  $300^{\circ}\text{C}$  is to be taken as  $M_{hot}$ .

**H- 2.4** Acceptance Criteria

**H- 2.4.1** With each application for approval of a brake lining assembly type there shall be submitted:

**H- 2.4.1.1** for pad assemblies, values for  $\mu_{op}$ ,  $\mu_{min}$ ,  $\mu_{max}$ .

**H- 2.4.1.2** for shoe assemblies, values for  $M_{mean}$  and  $M_{hot}$ .



**H- 2.4.2** During production of an approved brake lining assembly type, test samples must demonstrate compliance with the values registered under paragraph 2.4.1 of this Annex with the following tolerances:

**H- 2.4.2.1** for disc brake pads

$\mu_{op} \pm 15$ percent of registered value

$\mu_{min} >$  registered value

$\mu_{max} <$  registered value

**H- 2.4.2.2** for simplex drum brake linings:

$M_{mean} \pm 20$ percent of registered value

$M_{hot} >$  registered value.

### **H- 3 BRAKE LINING ASSEMBLIES AND DRUM BRAKE LININGS FOR VEHICLES OF CATEGORIES M<sub>3</sub>, N<sub>2</sub>, N<sub>3</sub>, T<sub>3</sub> AND T<sub>4</sub>**

#### **H- 3.1. Equipment**

**H- 3.1.1** The machine shall be equipped with a disc brake of the fixed calliper type with a cylinder diameter of 60 mm and a solid (not ventilated) disc having a diameter of  $278 \pm 2$  mm and a thickness of  $12 \text{ mm} \pm 0.5 \text{ mm}$ . A rectangular piece of the friction material with an area of  $44 \text{ cm}^2 \pm 0.5 \text{ cm}^2$  and a thickness of at least 6 mm shall be attached to the backing plate.

**H- 3.1.2** The disc rotational speed shall be  $660 \pm 10 \text{ min}^{-1}$  without load and shall not fall below 600 1/min on full load.

**H- 3.1.3** The mean contact pressure at the brake lining working surface shall be constant at  $75 \text{ N/cm}^2 \pm 10 \text{ N/cm}^2$ .

**H- 3.1.4** The test cycles and brake applications during the cycles to be adjustable and automatic.

**H- 3.1.5** Output torque and working surface temperature shall be recorded.

**H- 3.1.6** Provisions shall be made to direct cooling air across the brake at a rate of  $600 \pm 60 \text{ m}^3/\text{h}$ .

#### **H- 3.2 Test Procedure**

##### **H- 3.2.1 Sample Preparation**

The manufacturer's bedding procedure shall ensure a minimum of 80percent surface contact area without exceeding a surface temperature of 200°C.

**H- 3.2.2** Test Schedule

The test procedure comprises a number of consecutive braking cycles each containing a number of X braking intervals of 5 seconds brake applied followed by 10 seconds brake released.

No. of Cycle	Number of Brake Applications	Initial Brake Rotor Temperature	Forced Cooling
1	5	100	yes
2	5	increasing < 200	no
3	5	200	no
4	5	increasing < 300	no
5	5	300	no
6	3	250	yes
7	3	200	yes
8	3	150	yes
9	10	100	yes
10	5	increasing < 300	no
11	5	300	no

**H- 3.3** Evaluation of Test Results

Friction behaviour is determined from the brake torque noted in selected cycles of the test schedule. Brake torque shall be translated to coefficient of friction  $m$ .

The  $m$ -value of each brake application shall be determined as the mean value of the 5 seconds brake applied.

**H- 3.3.1** The operational coefficient of friction  $\mu_{op1}$  is the mean value of  $u$  recorded for the brake applications in cycles 1 and  $\mu_{op2}$  is the mean value of  $u$  recorded for the brake applications Cycle 9.

**H- 3.3.2** The maximum coefficient of friction  $\mu_{max}$  is the highest value of  $u$  recorded in an applications during cycles 1 to 11 inclusive.

**H- 3.3.3** The minimum coefficient of friction  $\mu_{min}$  is the lowest value of  $u$  recorded in an application during cycles to 11 inclusive.

**H- 3.4** Acceptance Criteria

**H- 3.4.1** With each application for approval of a replacement brake lining assembly type or a replacement drum brake lining type, there shall be submitted values for  $\mu_{op1}$ ,  $\mu_{op2}$ ,  $\mu_{min}$  and  $\mu_{max}$ .

**H- 3.4.2** During production of an approved replacement brake lining assembly type or replacement drum brake lining type, test samples must

demonstrate compliance with the values registered under paragraph 3.4.1 of this Annex within the following tolerances:

$\mu_{op1}, \mu_{op2} \pm 15\text{percent}$  of the registered value.

$\mu_{min} >$  registered value.

$\mu_{max} <$  registered value.

**ANNEX J**

**MODIFICATIONS AND EXTENSION OF TYPE APPROVAL OF THE  
REPLACEMENT BRAKE LINING ASSEMBLY OR THE  
REPLACEMENT BRAKE LINING**

**J-1** Every modification of replacement brake lining assembly type or replacement drum brake lining type shall be notified to the testing agency which granted the type approval. The test agency may then either:

Consider that the modifications made are unlikely to have appreciable adverse effects and that in any event the brake lining assembly or drum brake lining still complies with the requirements ; or

**J-1.2** require a further test report from the test agency responsible for conducting the tests.

## ANNEX K

### CONFORMITY OF PRODUCTION

K-1 Replacement brake lining assemblies or replacement drum brake lining assemblies approved to this standard shall be so manufactured as to conform to the type approved.

K-2 Original brake lining assemblies or original drum brake linings being the subject of an application under paragraph 4.2 of this standard are deemed to satisfy the requirements of Annex10.

K-3 To verify the requirements of Anex10 paragraph 1 are met, suitable controls of the production shall be applied. These shall encompass the control of raw materials and components used.

K-4 The holder of an approval shall in particular,

K-4.1 ensure that for each brake lining assembly type or replacement drum brake lining type, at least the relevant tests prescribed in paragraph 4.3 and the friction behavior tests described in Annex H of this standard are carried out on a statistically controlled and random basis in accordance with a regular quality assurance procedure;

K-4.2 ensure existence of procedures for effective control of the quality of the products;

K-4.3 have access to the control equipments necessary for checking the conformity of each approved type;

K-4.4 analyse the results of each type of test in order to verify and ensure the consistency of the product characteristics, making allowance for variation of an industrial production;

K-4.5 ensure that date data of test results are recorded and that Annexed documents remain available for a period to be determined in agreement with test agency.

K-4.6 ensure that any samples or test pieces giving evidence of non-conformity with the type of the test considered shall give rise to another sampling and another test. All the necessary steps shall be taken to re-establish the conformity of the corresponding production.

K-5 The competent authority which has granted the type approval may at any time verify the conformity controls methods applicable to each production unit.

K-5.1 In every inspection, the test books and production survey records shall be presented to the visiting inspector.

K-5.2 The inspector may take samples at random to be tested in manufacturer's laboratory. The minimum number of samples may be determined according to the results of the manufacturer's own verification.

K-5.3 When the quality level appears unsatisfactory or when it seems necessary to verify the validity of the tests carried out in application of paragraph 5.2, Annex K the inspector shall select samples to be sent to the test agency which has conducted the type approval tests.

K-5.4 The testing agency may carry out any tests prescribed in this standard.

K-5.5 The normal frequencies of inspections authorized by the testing agency shall be one per year. In case where negative results are recorded during one of these visits, the competent authority shall ensure that all necessary steps are taken to re-establish the conformity of production as rapidly as possible.