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Mazdoor Kisan Shakti Sangathan
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Jawaharlal Nehru
“Step Out From the Old to the New”

IS 15708 (2006): Road vehicles - brake linings - shear test procedure for disc brake pad and drum brake shoe assemblies
[TED 4: Automotive Braking Systems]
Indian Standard

ROAD VEHICLES — BRAKE LININGS — SHEAR TEST PROCEDURE FOR DISC BRAKE PAD AND DRUM BRAKE SHOE ASSEMBLIES

ICS 43.040.40

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

December 2006
FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Automotive Braking Systems, Vehicle Testing and Performance Evaluation Sectional Committee had been approved by the Transport Engineering Division Council.

This standard is based on ISO 6312: 2001 'Road vehicles — Brake linings — Shear test procedure for disc brake pad and drum brake shoe assemblies' issued by the International Organization for Standardization (ISO). This standard is basically adoption of ISO 6312. Keeping in view the practical difficulties in testing the sample within 30 s after removal from the heating unit as specified in clause 7 (b) of ISO 6312, the Committee responsible for the formulation of this standard has decided to adopt this ISO Standard with minor deviation as below:

In clause 7 (b) Substitute '60 s' for '30 s'.

The composition of the Committee responsible for the formulation of this standard is given in Annex B.

In reporting the results of a test or analysis made in accordance with this standard is to be rounded off, it shall be done in accordance with IS 2:1960 'Rules for rounding off numerical values (revised)'.

...
Indian Standard

ROAD VEHICLES — BRAKE LININGS — SHEAR TEST PROCEDURE FOR DISC BRAKE PAD AND DRUM BRAKE SHOE ASSEMBLIES

1 SCOPE

This standard specifies a method for measuring the strength of the bond connection between the lining material and the carrier in disc brake pad and drum shoe assemblies (shear strength). This standard is applicable to integrally moulded, riveted and bonded assemblies of both types of brake on road vehicles.

2 REFERENCE

The following standard contains provision, which through reference in this text, constitutes provision of this standard. At the time of publication, the edition indicated was 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 edition of the standard indicated below:

<table>
<thead>
<tr>
<th>IS No.</th>
<th>Title</th>
</tr>
</thead>
</table>

3 TERMS AND DEFINITIONS

For the purpose of this standard, the terms and definitions given in IS 11852 (Part 1) and the following shall apply.

3.1 Lining — Friction material component of a brake lining assembly.

3.2 Carrier — Component of a brake lining assembly to which the friction pad is attached.

3.3 Bond Area — Contact area between lining and carrier.

3.4 Shear Strength — Ratio of the load at failure divided by the bond area.

4 SYMBOLS AND UNITS

The symbols and preferred units used in this standard are given in Table 1.

<table>
<thead>
<tr>
<th>SI No.</th>
<th>Quantity</th>
<th>Symbol</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>i)</td>
<td>Shear force at failure</td>
<td>$F$</td>
<td>N</td>
</tr>
<tr>
<td>ii)</td>
<td>Area of bond</td>
<td>$A$</td>
<td>mm$^2$</td>
</tr>
<tr>
<td>iii)</td>
<td>Shear strength at failure</td>
<td>$\tau$</td>
<td>MPa</td>
</tr>
</tbody>
</table>

5 SAMPLING AND CONDITIONING

This procedure may be used on samples during product development, on finished products, or after special treatment or usage.

Testing may be performed on a complete assembly or section of an assembly.

Sample edges may be prepared to ensure good contact with the loading and fixed tools. Shims should be removed.

When testing a lined shoe, the test area may cover the full assembly or segments of an assembly confined by saw cutting down to the carrier (see Fig. 1).

Five samples should be used.

NOTE — The test procedure applies a load in a direction which might not be in accordance with the loading direction of the product in service. The shear behaviour could be influenced by high aspect ratio, chamfered or slotted pads.

6 TEST RIG AND FIXTURES

6.1 Test Rig

The test rig shall be a compression or tensile testing machine or similar (shear testing) machine of sufficient capacity to apply the shearing load by activating a ram.

The test rig shall be provided with equipment to register the exact load applied at the instant of shear failure.

The load application rate shall be controlled in such a way that the load increases at an average rate of 4 500 ± 1 000 N/s (as determined from typical vehicle-based evaluation). If a constant crosshead speed machine is being used the load rate shall be set to 10 ± 1 mm/min.

This shall be indicated in the results, which, it shall be noted, cannot be compared to tests conducted on machines of the constant load type. Shock loading shall be avoided.

6.2 Fixture

6.2.1 General

The shearing test fixture shall have the means to hold a test sample such that it is parallel to the loading tool. This tool shall have a radius of 1.5 mm at the part in contact with the test sample.

6.2.2 Drum Brake Shoe Assembly

The fixture (see Fig. 2) shall be designed so that the
FIG. 1 LINED SHOE IN SEGMENTAL TEST CONDITION

Key
1 = loading tool
2 = loading punch profile, $1 \pm 0.2$ mm clear of shoe platform
3 = lining face support
4 = fixed bottom tool
5 = shoe platform supported by tool (support $\leq$ platform thickness)
a = centre of thrust of top ram to be positioned thus
b = loading direction, parallel to shoe platform
c = through test tool

All dimensions in millimetres.

FIG. 2 DRUM BRAKE SHOE TEST FIXTURE
loading tool is in contact with the edge of the lining for the full sample length and thickness within \(1 \pm 0.2\) mm of the shoe platform.

Load application on the loading tool shall be in a direction parallel to the plane of the shoe platform. The shoe shall be supported to maintain uniform loading along the length of the lining sample.

The width of the loading tool shall be greater than the width, \(W\), of the lining.

6.2.3 Disc Brake Pad

The fixture (see Fig. 3) shall be designed such that:

a) Location of the plane of the backplate is parallel to the plane of the loading tool;
b) Loading tool is in contact with the edge of the lining within \(1 \pm 0.2\) mm of the backing plate (carrier) and conforms to the sample lining profile including taper angles;
c) Loading tool is self-aligning;
d) Loading tool is in contact with the full sample length of the lining edge parallel to the backplate support;
e) Load bearing edge of the backing plate rests against a rigid support with a thickness no greater than that of the backing plate;
f) In order to prevent assembly movement under testing, a pressure fixture applies a face load of \(0.5 \pm 0.15\) N/mm² of the lining area at a right angle to the shear load; and
g) Face load is applied in such a way that friction force is minimized and does not significantly influence the shear load measurement.

![Diagram of Disc Brake Pad Test Fixture](image)

**Key**

1 = loading tool (parallel to backing plate support) 
2 = backing plate support 
3 = face load fixture 
\(C\) = \(\leq\) backplate thickness 
\(a\) = direction of shear force 
\(b\) = pivot 
\(c\) = face load 
\(d\) = minimized friction at interface

All dimensions in millimetres.

**FIG. 3 Disc Brake Pad Test Fixture**
7 TEST PROCEDURE
The test procedure shall be carried out in accordance with the following (see Fig. 4 for a procedural flow diagram):

a) Conduct the test at ambient temperature 23 ± 5°C.
b) When shear tests at elevated temperatures are specified, heat the sample uniformly to a stabilized temperature within 30 min and test within 60 s after removal from the heating unit. Recommended temperatures are 200 ± 10°C for drum brake linings and 300 ± 10°C for disc pads.
c) Place the brake shoe or disc brake pad in the appropriate shear-test fixture.
d) Apply the load at the rate specified in 6.1, continuing until complete failure occurs.
e) Record the failure load together with the shear pattern expressed as a percentage as specified in 9.

8 CALCULATION OF SHEAR STRENGTH
Calculate the shear strength using the formula:

\[ \tau = \frac{F}{A} \]

where

\( \tau \) = shear strength, expressed, in megapascal (MPa);

\( F \) = shear force at failure, expressed, in newton (N); and

\( A \) = sample area, expressed, in mm\(^2\).

9 PRESENTATION OF RESULTS
The test report (see Annex A) shall include the following information:

a) Type and supplier of the brake shoe assembly or disc brake pad friction material, and batch identification.
b) Number of samples tested (five recommended).
c) Minimum and average shear-force, or minimum and average shear-strength, values, or both.
d) A description of the shear pattern, based on:
   1) Percentage failure:
      i) of clean carrier,
      ii) of adhesive, and
      iii) in the lining.
   2) Location of any clean carrier areas.
e) Comments (including mention of samples used as specified in 5) on deviations from normal test conditions such as special test temperature.
Test Procedure Flow Diagram

Start

Sampling and conditioning

Sampling

Test rig

Load rate control?

Yes

Crosshead speed (10 ± 1) mm/min

Constant load rate (4 500 ± 1 000) N/s

Fixture: loading tool 1.5 mm radius

Shear distance (1 ± 0.2) mm

Face load for disc brake pad (0.5 ± 0.15) N/mm²

C

Ambient test

Hot test

Yes

Hot test

200°C for the linings

300°C for the pads

No

Shear strength calculation

\[ \tau = \frac{F}{A} \text{ MPa} \]

Presentation of results

Fig. 4 Test Procedure
### Table 2 Test Parameters and Report of Results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Constant Load</th>
<th>Speed Transverse Load</th>
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<tr>
<td>Load rate</td>
<td>4 500 ± 1 000 N/s</td>
<td>10 ± 1 mm/min</td>
</tr>
<tr>
<td>Distance from carrier to loading tool</td>
<td>1 ± 0.2 mm</td>
<td>1 ± 0.2 mm</td>
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<tr>
<td>Loading tool radius</td>
<td>1.5 ± 0.5 mm</td>
<td>1.5 ± 0.5 mm</td>
</tr>
<tr>
<td>Face load</td>
<td>0.5 ± 0.15 N/mm²</td>
<td>0.5 ± 0.15 N/mm²</td>
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<tr>
<td>Heating test</td>
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<tr>
<td>Heating duration</td>
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<td>30 min</td>
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<td>Test dwell time after heating</td>
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<td>30 s</td>
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<td>Test temperature for drum brake lining</td>
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<td>200°C ± 10°C</td>
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<tr>
<td>Test temperature for disc brake pads</td>
<td>300°C ± 10°C</td>
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<td>Batch identification</td>
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<tr>
<td>Sample type</td>
<td>Full pad/pad section/full lined shoe/segment of lined shoe/other</td>
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<td>Sample area at point of shear</td>
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<td>Hot Test</td>
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<td>Number of samples test (five recommended):</td>
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<tr>
<td>Minimum shear strength</td>
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<td>Adhesive</td>
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<td>Failure in lining</td>
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<td>percent</td>
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<td>Location of clean areas</td>
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<td>Deviation from test procedure</td>
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<td>Test date</td>
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<td>Name of tester</td>
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### ANNEX B

**COMMITTEE COMPOSITION**

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

<table>
<thead>
<tr>
<th>Organization</th>
<th>Representative(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Research &amp; Development Establishment (VRDE), Ahmednagar</td>
<td>Dr. N. Karuppiah (Chairman)</td>
</tr>
<tr>
<td>Allied Nippon Ltd, Sahibabad</td>
<td>Shri V. Jay Kumar</td>
</tr>
<tr>
<td>Ashok Leyland Ltd, Chennai</td>
<td>Shri R. C. Menon</td>
</tr>
<tr>
<td>Association of State Road Transport Undertakings, New Delhi</td>
<td>Shri P. S. Sharma</td>
</tr>
<tr>
<td>Automotive Component Manufacturers Association of India, New Delhi</td>
<td>Shri P. M. Patle</td>
</tr>
<tr>
<td>Automotive Research Association of India, Pune</td>
<td>Shri K. N. D. Naik</td>
</tr>
<tr>
<td>Bajaj Auto Ltd, Pune</td>
<td>Shri S. S. Sandhu</td>
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<tr>
<td>Bosch Chassis Systems India Limited, Pune</td>
<td>Shri A. Akbar Badusha (Alternate)</td>
</tr>
<tr>
<td>Brakes India Ltd, Chennai</td>
<td>Shri T. M. Balaraman</td>
</tr>
<tr>
<td>Central Farm Machine Training &amp; Testing Institute, Budni</td>
<td>Shri T. V. Manel</td>
</tr>
<tr>
<td>Central Institute of Road Transport, Pune</td>
<td>Shri S. S. Patil</td>
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<tr>
<td>Central Road Research Institute, New Delhi</td>
<td>Shri D. N. Mander</td>
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<tr>
<td>Controllerate of Quality Assurance, (OFV), Jabalpur</td>
<td>Shri P. Venugopal</td>
</tr>
<tr>
<td>Eicher Tractors (A Unit of Eicher Motors Limited), Pithampur</td>
<td>Shri K. Kanabarilan</td>
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<td>Shri S. C. Jain</td>
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<td>Hero Honda Motors Ltd, Dharuhera</td>
<td>Shri R. K. Singh</td>
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<td>Hindustan Composites Ltd, Mumbai</td>
<td>Shri T. R. Mhetre</td>
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<td>Hindustan Motors Ltd, Hooghly</td>
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<td>HMT Ltd, Pinjore</td>
<td>Dr. T. S. Reddy</td>
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<tr>
<td>Indian Institute of Petroleum, Dehra Dun</td>
<td>Lt. Col. Sushil Sinha</td>
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<td>Kinetic Engineering Ltd, Pune</td>
<td>Shri S. L. Patle</td>
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<td>Mahindra &amp; Mahindra Ltd, Nashik</td>
<td>Shri S. Venkatesh</td>
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<td>Maruti Udyog Ltd, Gurgaon</td>
<td>Shri Bhushan Kothari</td>
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<tr>
<td>Ministry of Heavy Industries &amp; Public Enterprises, New Delhi</td>
<td>Shri C. S. Maikhuri</td>
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<td>Shri V. C. Mathew</td>
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<tr>
<td></td>
<td>Shri B. N. Das</td>
</tr>
</tbody>
</table>

7
Organization

Ministry of Road Transport and Highway, New Delhi
Rane Brake Linings Ltd, Chennai
Royal Enfield, Chennai
Scooter India Ltd, Lucknow
Society of Indian Automobile Manufacturers, New Delhi
Sundaram Brake Linings Ltd, Chennai
Sundaram Clayton Ltd, Chennai
Swaraj Mazda Ltd, Ropar
Tata Motors Limited, Pune
Toyota Kirloskar Motors Pvt Ltd, Bangalore
Tractor Manufacturers Association, New Delhi
TVS Motor Co Ltd, Hosur
Vehicle Factory, Jabalpur
Vehicle Research & Development Establishment, Ahmednagar
Volvo India Pvt Ltd, Bangalore
Yamaha Motor India Pvt Ltd, Faridabad
BIS Directorate General

Representative(s)

Shri B. BHANOT
Shri T. B. BADRIKARAYANAN
Shri L. RAMASAMY (Alternate)
Shri N. KRISHNAN
Shri R. AMBULAYAN (Alternate)
Shri P. D. JOSHI
Shri C. M. MEHTA (Alternate)
Shri K. K. GANDHI
Ms BHAVANISHRI JAYARAMAN (Alternate)
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Shri K. N. RAY (Alternate)
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Shri Y. SOMARA
Shri VIRAS PRANKAR (Alternate)
Shri K. KAMRAJ
Shri SAM SHAH (Alternate)
Shri ARNE KNABEN
Shri S. V. SUDERSON (Alternate)
Shri B. SARKAR
Shri P. K. SEHGA (Alternate)
Shri P. C. JOSHI, Scientist ‘E’ and Head (TED) [Representing Director General (Ex-officio)]

Member Secretary
Shri P. S. MURAL
Scientist ‘E’ (TED), BIS
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This Indian Standard has been developed from Doc No. TED 4 (538).

**Amendments Issued Since Publication**

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**BUREAU OF INDIAN STANDARDS**

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002  
*Telephones*: 2323 0131, 2323 3375, 2323 9402  
*website*: www.bis.org.in

Regional Offices:

- **Central**: Manak Bhavan, 9 Bahadur Shah Zafar Marg  
  NEW DELHI 110002  
  *Telephones*: 2323 7617, 2323 3841
- **Eastern**: 1/14 C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi  
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  *Telephones*: 2337 8499, 2337 8561, 2337 8626, 2337 9120
- **Northern**: SCO 335-336, Sector 34-A, CHANDIGARH 160022  
  *Telephones*: 260 3843, 260 9285
- **Southern**: C.I.T. Campus, IV Cross Road, CHENNAI 600113  
  *Telephones*: 2254 1216, 2254 1442, 2254 2519, 2254 2315
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