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JAPANESE INDUSTRIAL STANDARD

Method of hardness test for brake linings, pads and clutch facings of automobiles

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In the event of any doubt arising,
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JAPANESE INDUSTRIAL STANDARD   JIS D 4421-1996

Method of hardness test for brake linings, pads and clutch facings of automobiles

1 Scope This Japanese Industrial Standard specifies method of Rockwell hardness test for drum brake lining, disc brake pads and clutch facings of automobiles(hereafter referred to as "linings", "pads" and "facings", respectively).

> Remarks 1 The hardness obtained by this method is a kind of indentation hardness and it is obtained based on the depth of indentation remaining after removal of the test load.
>
> 2 The following standards are cited in this standard :
>
> JIS K 7202 *Method of Rockwell hardness test for plastics*
>
> JIS Z 8401 *Rules for rounding off of numerical values*
>
> JIS Z 9041 *Presentation and reduction of data*

2 Definitions For the purpose of this Standard the following principal definitions shall apply :

(1) **Rockwell hardness** The value of hardness obtained from the difference h (mm) between the depths of penetration of the indentor under the first and second applications of the standard load when the standard load is first applied to the specimen using the indentor, then the test load is applied and then the load is returned to the standard load, by means of the following formula :

$$\text{Rockwell hardness (HR)} = 130 - 500h$$

(2) **scale** The symbol which denotes combination of the type of indentor, test load and hardness calculation formula, in a Rockwell hardness expression.

3 Temperature and humidity for testing In general, the test shall be carried out in a room at a temperature 23 ± 2 ℃, and a relative humidity (50 ± 5) %.

4 Equipment and apparatus

4.1 Testing machine The Rockwell hardness testing machine shall be as follows :

(1) The testing machine shall comply with Annex 1 to JIS K 7202.

> Remarks 1 When the main parts of the testing machine have been disassembled, reassembled, modified or when the indentor has been replaced, it shall be verified again that the test machine is complying with Annex 1 to JIS K 7202.
>
> 2 Even if the testing machine is not subjected to the above treatment, the indirect inspection specified in 3.5 of Annex 1 to JIS K 7202 shall be carried out at certain intervals, appropriate to the frequency of use, to confirm that the overall error of the testing machine is within the permissible value.

2
D 4421-1996

3 It is desirable to carry out hardness tests periodically at shorter and suitable intervals by using the test blocks specified in Annex 2 to JIS K 7202, to control the precision of the testing machine, separately from the requirement of the above item.

(2) The testing machine shall be used on a sufficiently stable base with the indentor mounting spindle directed vertically.

4.2 Desiccator The desiccator shall be the one accommodating dried calcium chloride or silica gel.

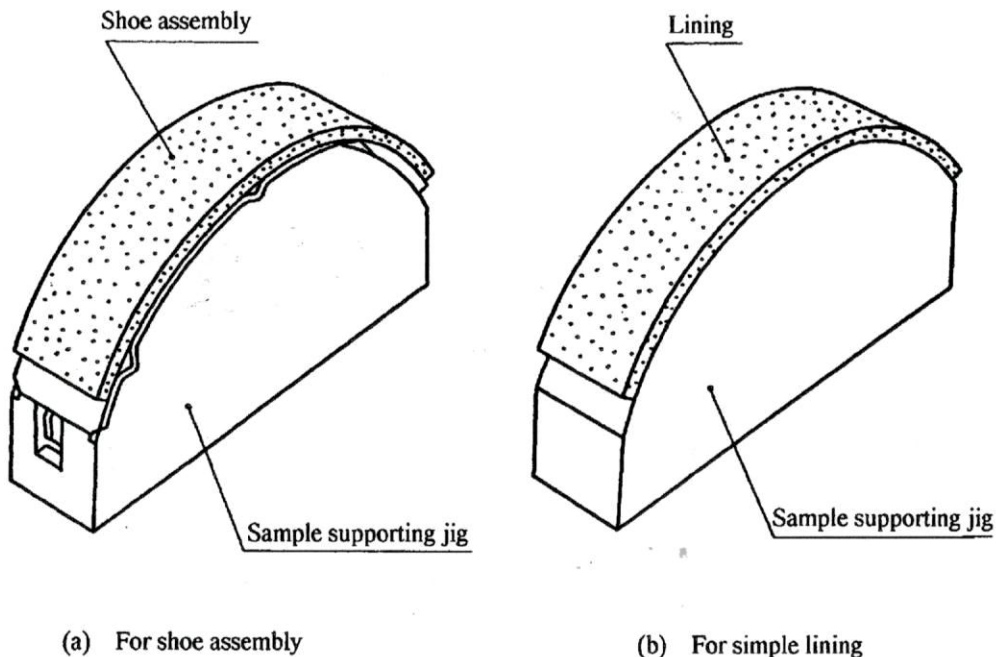**4.3 Sample supporting jig** The sample supporting jig illustrated in Fig. 1 shall be used.

(a) For shoe assembly (b) For simple lining

Fig. 1 Sample supporting jig

5 Sample The sample shall be as follows:

(1) The sample shall be new assembly, or simple lining, pad or facing.

In the case of simple components, enough thickness is desired so that no change appears on the back face due to generation of indentation.

(2) The sample size shall be subjected to the agreement between the parties concerned with acceptance.

(3) For preconditioning, the sample shall, as a rule, be allowed to stand in a desiccator for 24 h or more, or shall be dried in a hot air circulating dryer maintained at 150 ℃ for 1 h and then cooled to ordinary temperature in a desiccator.

6 Test procedures

6.1 Preparation before test The following preparation shall be carried out before Rockwell hardness test:

(1) In general scale S shown in Table shall be used as the hardness scale. If the value of hardness obtained based on scale S does not fall in a range of about 50 to 115, another scale should be selected from Table 1 so that the value falls in a range of about 50 to 115.

Table 1 Scale

Scale	Symbol for Rockwell hardness	Indentor	Standard load N	Test load N
M	HRM	Steel ball with 6.350 mm diameter	98.07	980.7
R	HRR	Steel ball with 12.700 mm diameter		588.4
S	HRS			980.7
V	HRV			1471.0

(2) The steel ball attached to the indentor shall be in such conditions that it can rotate without any resistance. It shall be verified that the steel ball is clean and free from any flaw.

(3) The interface where the end face of indenter mounting spindle and the load receiving face of indenter (holder) come in contact shall be clean.

(4) The sample supporting face of the sample supporting jig shall be clean.

(5) In such cases that the indentor, sample supporting jig, etc. are mounted or replaced, that the lifting and lowering screw of test machine is widely operated, that the work is started, preliminary tests shall be carried out two or more times in the same manner as the measurement of hardness.

6.2 Point of measurement The points of hardness measurement shall be as follows :

(1) The points of hardness measurement shall be so determined that the points are distributed uniformly over the sample as illustrated in the examples in Attached Fig. 1. The number of measurement points shall be 4 or 5 for small linings and pads, and shall be 5 or more for facings and large linings .

Remarks : The position where a hole exists on the backing metal of pad shall, as a rule, not be measured.

(2) As for samples of other shapes than shown in Attached Fig. 1, it is desired that the measurement point is apart from the center of existent indentation by $4d$ or more (d is the diameter of indentation) or apart from the edge of sample by $2.5d$ or more.

4
D 4421-1996

Remarks : It is desirable that the center of indentation is positioned 6 mm or more apart from the edge of sample although this distance differs according to the hardness of sample.

(3) The measurement point of simple lining may lie on the inside face of lining.

6.3 Test The Rockwell hardness test shall be carried out as follows :

(1) The surface of sample to be tested shall be positioned perpendicular to the indentor mounting spindle.

   The rear surface of the part of sample where indentations are formed shall be in close contact with the surface of sample supporting jig as far as possible.

(2) The position to which the indenter mounting spindle is raised for applying the standard load shall be within ± 5 in the hardness unit from the prescribed position ([1]). Then the pointer of indicator shall be adjusted to the set point (B 30) on dial plate.

   Note ([1]) This is the position where the pointer of indicator is right upward in an ordinary testing machine employing a dial gauge as the indicator.

   Remarks 1 When the spindle is raised beyond the said range, the test shall be invalidated and carried out again at another position of the sample.

   2 In the case of a testing machine with a specified range of raising position, the specification shall be followed.

(3) After completion of the procedure of (2), the increase of load shall be started as quickly as possible, and the test load shall be applied in 2 to 4 s as a rule.

   Remarks : For adjusting the loading speed, it is recommended to adjust the speed so that the loading operation takes 4 to 5 s when a test load of 980.7 N is applied without the sample in place.

(4) The duration for which application of the test load is continued shall be 15 s from starting the increase of test load in the procedure of (3).

(5) After completion of the procedure of (4), the load shall be reduced and returned to the standard load.

(6) After 15 s from initiation of decreasing load in the procedure of (5), the hardness value shall be read from the indicator to one decimal place.

(7) During the loading operations, the load shall be increased and decreased smoothly so that no shock or vibration is applied to the indentor.

7 Calculation The hardness shall be the mean value calculated from the measured values on each sample according to JIS Z 9041. Further, the range or standard deviation of the measured values shall also be obtained according to JIS Z 9041. The mean value shall be rounded off to an integer according to JIS Z 8401.

8 Indication of hardness The scale symbol shall be appended to the hardness value.

   Example : HRS 76

9 Record The following particulars shall be recorded on recording paper of the form shown in Attached Table 1:

(1)   Material and dimensions of sample

(2)   Position of hardness measurement and number of measurement points

(3)   Preconditioning of sample

(4)   Temperature and humidity in test room

(5)   Mean value

(6)   Range or standard deviation of measured values

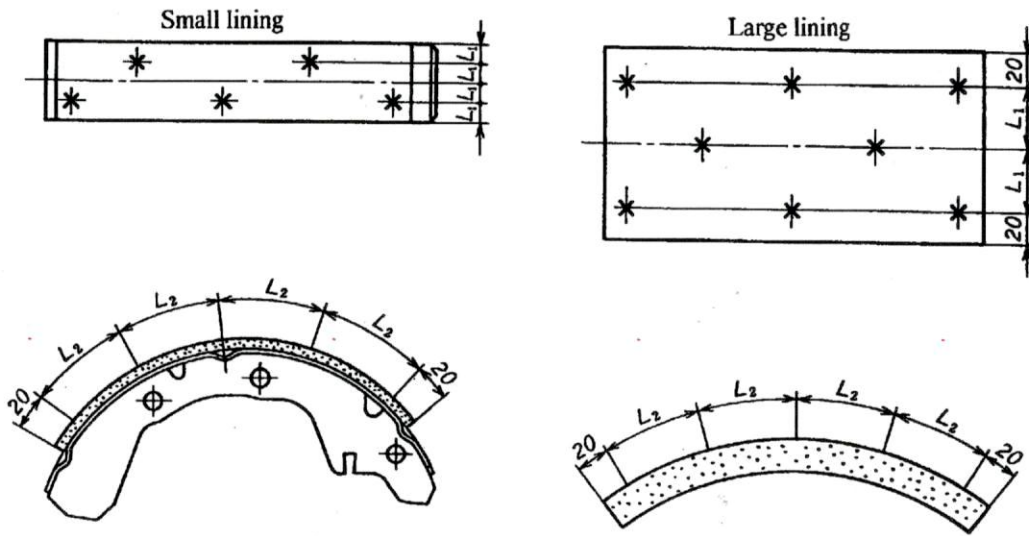(7)   Date of test

(8)   Other particulars

Related Standards :

JIS B 7726   *Rockwell and Rockwell superficial hardness testing machines*
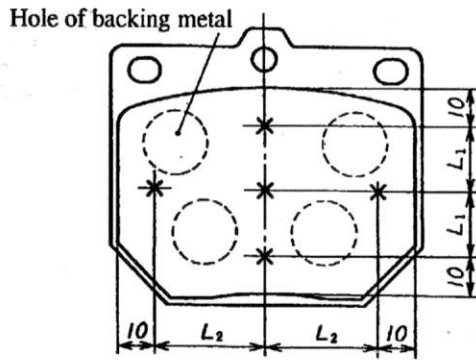
JIS B 7730   *Standardized blocks of Rockwell and Rockwell superficial hardness*

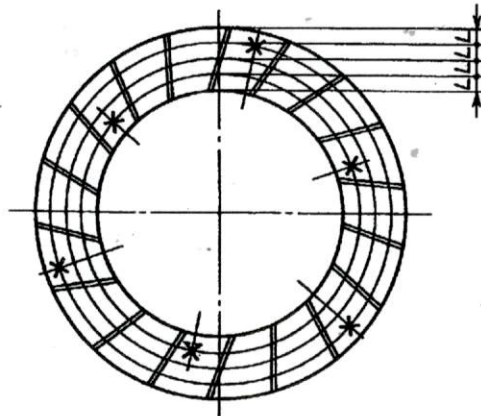JIS Z 2245   *Method of Rockwell and Rockwell superficial hardness test*

6
D 4421-1996

Unit : mm

Small lining

Large lining

(1) For lining

Hole of backing metal

(2) For pad

(3) For facing

Remarks : Mark **X** indicates point of measurement.

Attached Fig. 1 Examples of positions of hardness measurement

Attached Table 1　Form of hardness test recording paper (example)

Material		Date of test	
Type of brake		Test No.	
Dimensions of sample		Temperature in test room	℃
Hardness scale　M　R　S　V		Humidity in test room	%
Preconditioning of sample		Person of test	

Table of measured hardness values

| Sample No. | Position of measurement | | | | | | | | | | Mean value |
	1	2	3	4	5	6	7	8	9	10	
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
Overall mean value											
Maximum value											
Minimum value											
Standard deviation											
Particulars											

Figure illustrating points of measurement

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