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भारतीय मानक मसौदा

कोयला एवं संबद्ध खनिजों के अपघर्षक गुणधर्मों के परीक्षण की विधियाँ

(आईएस 9949 का दूसरा पुनरीक्षण)

Draft Indian Standard

**METHODS OF TEST FOR ABRASIVE PROPERTIES
OF COAL AND ASSOCIATED MINERALS**

(Second Revision of IS 9949)

(ICS 73.040)

Solid Mineral Fuels and Solid Biofuels
Sectional Committee, PCD 7

Last date for Comments:

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FOREWORD

(Formal clauses will be added later)

Coal and specially associated minerals exhibit abrasive properties in varying degrees. Wear of vital parts of crushers, pulverizers and burning equipment, and coal mining and conveying machinery pose serious problems. It is, therefore, important to assess the relative abrasion characteristics of coal for selection of right type of equipment and material of construction for mining, crushing, grinding and burning equipment.

The standard was originally published in 1981 and subsequently revised in 1986. The first revision was taken up to update the details of abrasion test apparatus and elaborate the test procedure prescribed. The method described was based on the modified procedure developed at US Bureau of Mines and at the BCURA Industrial Laboratories, England.

Since, no change in technology was observed while reviewing the standard, thus the Committee decided to take up this (*second*) revision by updating the reference clauses. Further, preparation of sample has been referred by IS 16143 (Part 1) to IS 16143 (Part 4); IS 16143 (Part 7) and IS 16143 (Part 8) as the erstwhile referred standard IS 436 (Part 1/ Sec 2) has been withdrawn.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revised*)'.

1 SCOPE

1.1 This standard specifies the method for determination of relative abrasion characteristics of coal including lignite and associated minerals.

2 REFERENCES

The standards listed below, contain provisions which through reference in this text, constitute the 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 standard listed below.

<i>IS No.</i>	<i>Title</i>
IS 460 (Part 1) : 2020	Test Sieves — Specification: Part 1 Wire Cloth Test Sieves (<i>fourth revision</i>)
IS 16143 (Part 2) : 2021 / ISO 13909-2:2016	Hard Coal and Coke - Mechanical Sampling: Part 2 Coal - Sampling from Moving Streams (<i>first revision</i>)
IS 16143 (Part 3) : 2021 / ISO 13909-3:2016	Hard Coal and Coke - Mechanical Sampling: Part 3 Coal - Sampling from Stationary Lots (<i>first revision</i>)
IS 16143 (Part 4) : 2021 / ISO 13909-4 : 2016	Hard Coal and Coke - Mechanical Sampling: Part 4 Coal - Preparation of test Samples (<i>first revision</i>)
IS 16143 (Part 7) : 2021 / ISO 13909-7 : 2016	Hard Coal and Coke - Mechanical Sampling: Part 7 Methods for determining the precision of sampling, sample preparation and testing (<i>first revision</i>)
PCD/07/19732	Methods for sampling of Coal and Coke: Part 1 Sampling of Coal, Section 1 Manual Sampling [<i>second revision of IS 436 (Part 1/Sec 1)</i>] [Under Revision]

3 TERMINOLOGY

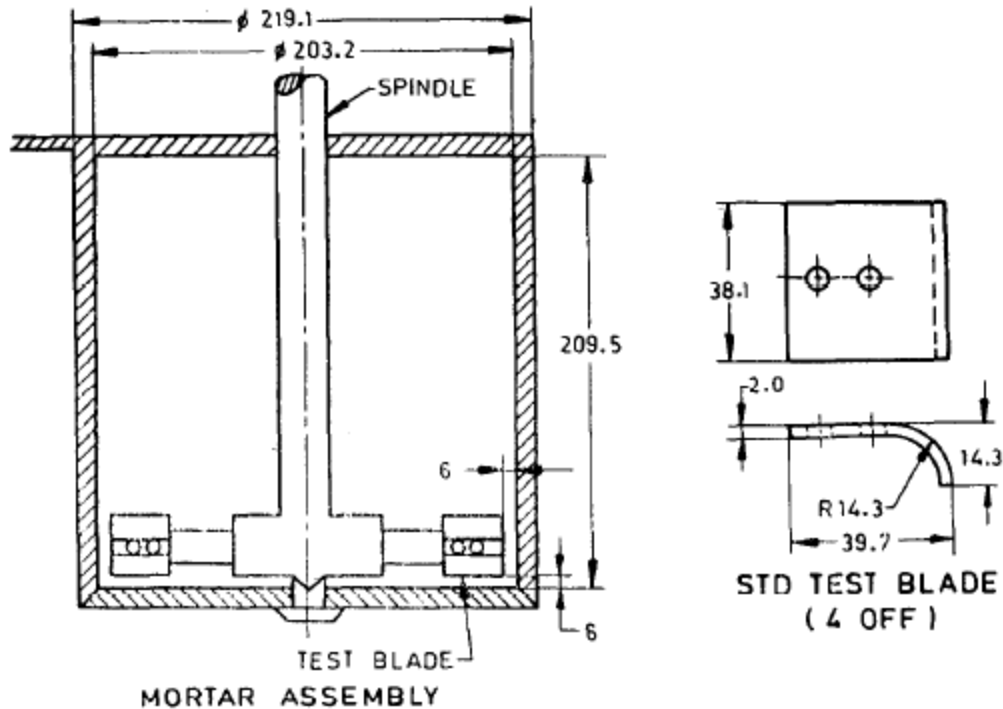
3.1 For purpose of this standard, the following definitions shall apply.

3.1.1 *Air Dried Coal*

The test sample of coal which is exposed to the atmosphere to bring it in equilibrium with the humidity conditions prevailing in the laboratory to avoid loss or gain of mass during weighing.

3.1.2 *Abrasion Index (A.I.)*

The mass of material loss expressed in mg/kg of coal when four standard metal blades (*see Fig. 1*) rotated in a known mass of coal of specified size under a given set of conditions.



All dimensions in millimetres.

FIG. 1 ABRASION TEST APPARATUS

4 PRINCIPLE

Abrasion index is calculated as the loss in mass of four blades resulting due to rotation in a known mass of coal under specified conditions.

5 APPARATUS

5.1 Sieves

Sieves of apertures 12.5 mm and 6.3 mm conforming to IS 460 (Part 1).

5.2 Dimensions of Screw/Bolts

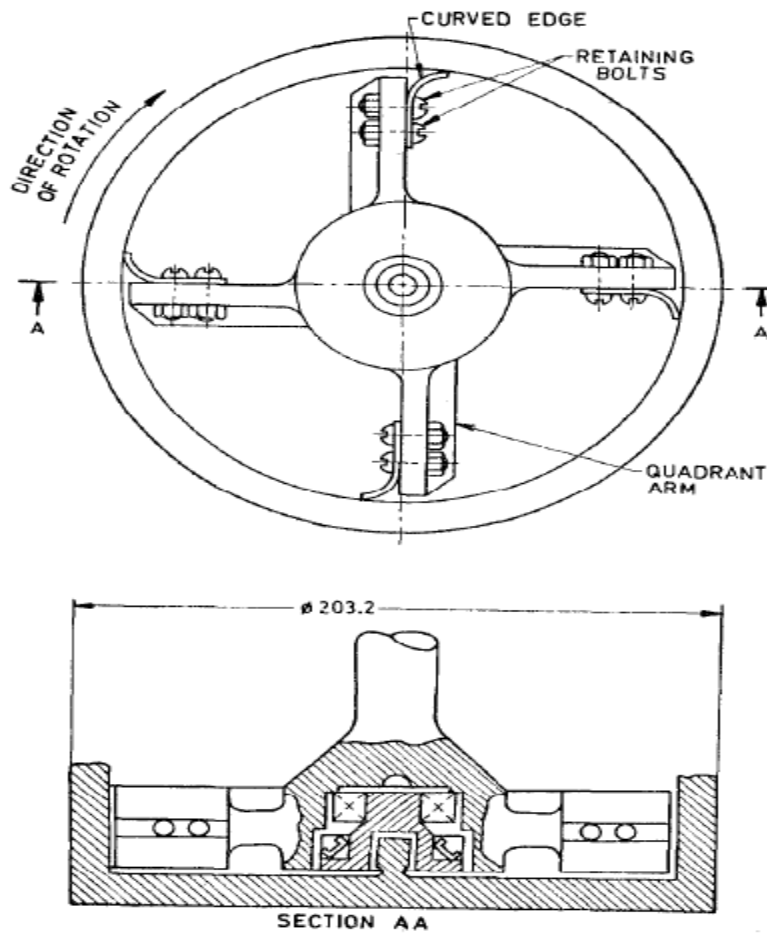
Screws used for fastening the blades with arms shall be of 4.7 mm diameter (2 BA) and 12.5 mm long. Two such screws shall be used for each of the four blades.

5.3 Abrasion Test Apparatus

The apparatus consists of a shaft of an overall length of 250 mm, diameter 19 mm and arm assembly to hold the wearing blades, a mortar that holds the test sample of coal and a drill press or a motor of 1.87 kW (2.5 hp) to provide rotation. The tentative dimensions are shown in Fig. 1. The mortar turned from extra strength pipe is 203.2 mm ID by 209.5 mm deep. A simple brass thrust bearing (SKEFKO Reference No. 6300 or equivalent Hoffman bearing) screwed through

the bottom of the mortar supports and centers the shaft. Alternately, the pointed end of the shaft may be made to rest on a small groove at the bottom of the mortar. Adjustment of this bearing maintains a 6 mm clearance between the bottom of the mortar and bottom edge of the wearing blades. Four square bars fastened to the underside of the mortar bottom radially at 90° intervals fit into matching grooves in the table of the drill press to center the mortar under the spindle of the drill press and prevent the mortar from rotating. A tight-fitting detachable cover on the mortar is provided with a clearance hole for the rotating shaft. Four blades, 39.7 mm in length, 38.1 mm in breadth and 2.0 ± 1 mm in thickness made from mild steel are carried on four radial arms spaced 90° apart (*see Fig. 2*). These arms are held in a hub on the shaft by set of screws. A clearance of 6 mm is maintained both between the blades and the bottom of the mortar and between blades and the wall of the mortar. The upper end of the shaft fits into the spindle of the drill press which is rotated by a motor of 1.87 kW to 2.25 kW (2.5 to 3.0 hp) at 1450 rpm. A revolution counter to shunt off the motor after 12000 revolutions, completes the abrasion apparatus. The blades shall be of hardness 150 ± 10 VPN and shall be machined from a bar of mild steel carbon content 0.28 to 0.32 percent.

NOTE — VPN and BHN in range of 150 to 200 shall be of the same order.



All dimensions in millimeter

FIG. 2 POSITIONING DEVICE

5.4 Balance

Two balances, one of 100 g capacity with a sensitivity of 0.001 g, and another of 10 kg capacity with 0.1 g sensitivity.

6 PREPARATION OF SAMPLE

6.1 The method for drawing and preparation of a representative coal sample shall be followed as prescribed under IS 436 (Part 1/Sec 1) by manual sampling; IS 16143 (Part 2); IS 16143 (Part 3); IS 16143 (Part 4) and IS 16143 (Part 7) by mechanical sampling.

6.2 The gross sample shall be reduced in stages first to pass through 12.5 mm screen and then through a sieve of aperture 6.3 mm. About 10 kg of sample thus prepared shall be spread on a suitable tray and kept exposed to the atmosphere for 24 h.

7 PROCEDURE

7.1 Take out the four blades from the arms and put them into a beaker containing acetone so that blades are completely dipped into acetone. After some time take out the blades, dry them by rubbing with glass-wool or clean with a piece of flannel and keep in a calcium chloride desiccator, for 5 min. Then accurately weigh the four blades separately to the nearest milligram and fit them in the four arms of the shaft with its curved edge and round head of the retaining screws facing the direction of rotation. Fit the shaft to the thrust bearing. Weigh accurately 2 ± 0.001 kg of thoroughly mixed air-dried sample and transfer to the mortar cleaned of all material from the previous test.

7.2 After the rotating period (approximately 8 min) remove the blades and clean them with acetone as described in **7.1** and dry in a desiccator for about 5 min. Then weigh the blades separately to the nearest milligram. A damaged blade or one with apparently roughened surface should be replaced immediately. The blades may be rejected after they suffer a loss of 1 g or after completing 35 tests whichever is earlier. A new set of blades will always be smoothed by a very paper (sandpaper) and then perform a pre-run by the operation of the apparatus in a charge of coal of known abrasion index.

8 CALCULATIONS

8.1 Record the initial mass of the four blades (designated S_1, S_2, S_3 and S_4) as M_1, M_2, M_3 and M_4 and final mass of the corresponding blades as M_1', M_2', M_3' and M_4' . The loss in mass due to abrasion of the four blades are $(M_1 - M_1')$, $(M_2 - M_2')$, $(M_3 - M_3')$ and $(M_4 - M_4')$ respectively. Report the total loss of the four blades in milligram.

8.2 So loss due to the abrasion $M = (M_1 - M_1') + (M_2 - M_2') + (M_3 - M_3') + (M_4 - M_4')$ expressed in mg.

8.3 The value of abrasion index is the average loss in mass of three independent tests expressed in mg per kg of sample taken for each test.

$$\text{Abrasion Index (A. I.)} = \frac{\bar{M}}{2} \text{ mg/kg}$$

where

\bar{M} = average loss in mass (M) in mg in three independent tests.

9 REPEATABILITY

The values of abrasion index for triplicate determination shall agree within 5 mg/kg.