



भारत सरकार रेल मंत्रालय

GOVERNMENT OF INDIA  
MINISTRY OF RAILWAYS

भारतीय रेलवे के WDG4 / WDP4 डीजल लोकोमोटिव के  
लिए एसबेस्टस रहित उच्च घर्षण कम्पोजीशन ब्रेक ब्लॉक  
की विशिष्टि

**SPECIFICATION OF NON-ASBESTOS HIGH FRICTION  
COMPOSITION BRAKE BLOCKS FOR WDG4 / WDP4 DIESEL  
LOCOMOTIVES OF INDIAN RAILWAYS**

विशिष्टि संख्या एम.पी- 0-0100-10 (रिवीजन.05)  
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SPECIFICATION NO. MP.0.0100-10 (REV- 05)  
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अनुसंधान अभिकल्प एवं मानक संगठन लखनऊ 226 011

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## LIST OF AMENDMENTS

S. No.	Amendment Date	Version	Details
1	February'2021	05	Revision of Annexure III, to include the values of limit of mean co-efficient of friction at test speed of 110, 130 & 150 kmph and removal of drag braking test at brake block force of 3400 kg.
			Revision of clause no. 3.1.8 to incorporate the typographical correction and adding field trial performance feedback format in compliance of MOM of the VC meeting on Specification/ STRs held on 29.08.2020.
			Addition in clause no. 4.2 (VI) to incorporate acceptance criteria in compliance of MOM of the VC meeting on Specification/ STRs held on 29.08.2020
			Annexure V: Para 5 : to incorporate the typographical correction
			Annexure VI: Add The Format for Acceptance Test
			Annexure VII: Add Field Trial Scheme of High Friction Composition Brake Blocks

## 1. SCOPE

This specification covers the requirements of non-asbestos high friction composition brake blocks for application on WDG4 & WDP4 diesel (General Motors USA Design) locomotives of Indian Railways.

## 2. REQUIREMENTS

### 2.1 GENERAL

- 2.1.1 This specification defines the necessary characteristics of brake blocks of composition material.
- 2.1.2 The high friction composition brake blocks shall be freely interchangeable with composition brake blocks to RDSO Drg. No. SKDP - 3630 (Alt.2) for WDG4 & WDP4 diesel locomotives having the parameters given in Annexure-I.
- 2.1.3 The composition of the material and the manufacturing method of series production of high friction composition brake blocks must always conform with that of the block for which approval has been given by RDSO.
- 2.1.4 The use of asbestos is prohibited.
- 2.1.5 The use of lead and zinc in the metal state or in the form of compounds is not allowed. The same applies to all other components if in the form of powder, particles or gas produced during the use of the brake blocks, they may constitute a danger to health or inconvenience to passengers.
- 2.1.6 The composition of the material constituting the brake block must be chosen to give the best balance between:-
- Braking characteristics.
  - Wear and service life of blocks.
  - Wear on the running surface of the wheels.
  - Effect on adhesion between the rail and wheel.
  - Proper heat dissipation of heat generated at wheel and brake block interface.
- 2.1.7 The characteristics laid down in this specification must be maintained for the complete usable thickness of the braking material.

### 2.2 FRICTION

- 2.2.1 As far as possible the co-efficient of friction must be independent of the initial braking speed, the state of bedding-in of the brake block, the specific pressure as well as the temperature and atmospheric conditions.
- 2.2.2 The tolerance bands of the mean co-efficient of friction shall be as per Annexure-II of this specification. The definition of the coefficients of friction is as per UIC 541-4-OR.

In order to ensure that better performance is achieved by minimising the risk of failure of wheel disc on account of thermal cracks and ensuring better conductivity, the following guidelines will be adopted.

- i) Minimum 70% of the values of mean coefficients of friction must fall within specified band.
- ii) Maximum 10% of the values of mean coefficients of friction may fall above the upper limit of the band.
- iii) Maximum 30% of the values of mean coefficients of friction may fall below the lower limit of the band.

2.2.3 Under the influence of dampness i.e. under wet conditions, the average co-efficient of friction must not vary by more than  $\pm 15\%$  in relation to the value obtained during braking when dry, with the other condition remaining the same.

2.2.4 After prolonged braking followed by braking to a stop, a particular high temperature occurs. Even in such condition the temperature on the opposite friction surfaces, must not exceed  $375^{\circ}\text{C}$ . The variation of average co-efficient of friction due to excessive heating must not exceed  $\pm 15\%$  in any case, in relation to the value obtained during braking in the cold and dry state.

### 2.3 GEOMETRICAL CHARACTERISTICS

2.3.1 The controlling dimensions of the brake block shall conform to the requirements given in the RDSO Drg. No SKDP – 3630 (Alt.2) placed at Annexure-IV.

2.3.2 The constructional features of the brake block must enable it to wear down to a thickness of about 10 mm, including the back plate, without the latter coming into contact with the running surface of the wheel.

### 2.4 MECHANICAL PHYSICAL AND CHEMICAL CHARACTERISTICS

2.4.1 The various elements making up the brake blocks must be spread uniformly in the body of the block. There must be no pitting, flakes or other defects. The material must not attack the opposing friction surface or give rise to the formation of metal inclusions.

2.4.2 The blocks must not cause heat damage to the wheels e.g. hot spots, cracks, flaking.

2.4.3 The values of density, hardness, compression modulus, cross breaking strength, acetone extract, ash content (loss on ignition), and back plate pull off strength must be given with the offer. However, the hardness of the brake block material in R scale must be in the range 85 to 115 and the back plate pull off strength of the brake block must not be less than 6.5 T. The acetone extract also must not exceed 3%.

2.4.4 The test procedure for these properties (as mentioned in 2.4.3) shall be as given in the Annexure V.

2.4.5 The manufacturer must mention their product specification, giving sufficient detail of the mechanical, physical and chemical features in their QAP. They should also indicate the composition of their material in broader terms indicating percentage of conductive fillers.

- 2.4.6 No method is laid down for fixing the composite material to the back plate. The back plate must be designed to withstand the forces likely to occur.
- 2.4.7 The composition brake block must not unduly affect adhesion between wheel and rail obtained on vehicles braked with cast iron blocks.

## 2.5 MARKING

- 2.5.1 The marking and colour coding on the brake block shall be as per Drawing No. SKDP – 3630 (Alt.2), placed at Annexure –IV.
- 2.5.2 These marks, preferably be punched, engraved or stamped. These must be applied in such a way so that the block can be identified, even after fully worn in service. The marking arrangement shall be got approved by RDSO before undertaking supply.

## 3. ACCEPTANCE PROCEDURE

### 3.1 Conditions for Vendor Approval

- 3.1.1 (a) The firm shall have a technical collaboration with a foreign manufacturer who has experience in manufacturing rail road brake blocks. The foreign collaborator must have existing manufacturing and test facilities including Full Scale dynamometer for manufacturing and testing of brake blocks. The collaborator will have to give detailed information including type acceptance test data run as per clause 2.2 and other details in accordance with clause no. 2.4.3. The test on dynamometer will be carried out by the collaborator as per test scheme given in Annexure – III.
- (b) The manufacturer will have to produce adequate evidence from their collaborator in support of good performance of the collaborator in manufacturer and supply of composition brake blocks for Rail Road application.
- 3.1.2 The condition of foreign collaboration is strictly applicable for those companies which are not in the business of manufacturing friction composition materials for industrial use. However, the companies, which are in the business of friction composition materials for industrial use and have established all the requisite manufacturing and testing facilities including full scale rail dynamometer conforming to ERRI B–126 / RP-18 specification for indigenous manufacturer of the railway brake blocks and are following a quality assurance plan to the satisfaction of RDSO may be exempted by the RDSO from the requirement of foreign collaboration. Such firm should submit dynamometer test results after testing of samples in their own dynamometer.
- 3.1.3 The information in para 3.1.1, 3.1.2 and 3.2.1 should be presented together with a request for type acceptance test by RDSO.
- 3.1.4 The manufacturer will submit two samples of brake blocks for type acceptance test on RDSO's brake dynamometer and samples will be tested as per Test scheme given in Annexure III. Conformance of both the samples to the specification will be treated as dynamometer test passed. One samples means no. of brake block used per wheel. The testing charges will be paid by the manufacturer as per the prevailing guidelines for vendor approval.

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- 3.1.5 During the tests, the blocks must not reveal any sign of combustion, formation of flaking, sweating of the binding material, permanent grating or other defects.
- 3.1.6 The wear should be uniformly distributed over the entire depth of the block, it should be as low as possible and be largely independent of the type of brake load application. The specific wear value of each brake block found by weighing should not exceed 5 cc/kwh.
- 3.1.7 The brake blocks tested on the dynamometer must meet the requirements given in para 2.2 of this specification.
- 3.1.8 On successful completion of the dynamometer testing at RDSO, 300 nos. brake blocks shall undergo field trials for a period of one year. Field performance feedback format is given in Annexure VII.

The manufacturer shall have to submit QAP as per clause 3.2.1 for approval before undertaking manufacture of these brake blocks.

The brake blocks will be supplied for field trial only after inspection by Motive Power Directorate of RDSO.

- 3.1.9 Two samples out of 300 initial brake blocks shall be picked up by the RDSO to undertake full scale dynamometer test. The manufacturer shall arrange this testing of blocks on his own/with collaborator. Alternatively the manufacturer may send the brake block for testing at RDSO at his own cost. This test will be carried out as per Test scheme given in Annexure III

**3.2 Conditions For Approved Vendor**

- 3.2.1 The manufacturer shall get his Quality Assurance Plan approved by RDSO before undertaking manufacture of the brake block. The Quality Assurance Plan must contain the details of process of manufacture, process controls and quality records maintained as well as the drawing showing dimensions. The QAP must also contain the acceptable readings of the following parameters along with the method of testing in detail. The methods of testing shall however conform to those provided in Annexure V of this specification. In case of (d), (e) and (f) acceptable limits should be within  $\pm 15\%$  of nominal values.

- a) Compression modulus (Max)
- b) Cross breaking strength (Min)
- c) Acetone extract (Max)
- d) Ash content (loss on ignition)
- e) Hardness
- f) Density
- g) Back plate pull of strength
- h) Any other test

- 3.2.2 The approved vendor shall undertake full scale dynamometer test as per Annexure- III and submit the result to RDSO/MP on the basis of 12,000-15,000 brake blocks supplied to railways. To audit the quality control RDSO at their discretion may pick up samples for confirmatory dynamometer testing at RDSO, Lucknow.

## 4 INSPECTION

4.1 The inspection of the brake blocks shall be carried out by Director General / RDSO or his authorised representative at the premises of the manufacturer. During development stage, inspection authority will be Motive Power Directorate of RDSO and during series production stage inspection authority will be QA Directorate of RDSO.

4.2 The inspection will be carried out as per the following procedure:-

- i) Manufacturer to submit pre-inspection report for the lots offered for inspection as per the approved QAP of the firm.
  - ii) Manufacturer to ensure traceability of each block to its parent mix batch number & heat number.
  - iii) The inspector shall inspect the quality records maintained by manufacturer for the entire lot.
  - iv) Each lot offered for inspection shall consist of 500 brake blocks or part thereof. The lot No. shall represent the mix batch numbers and heat No. out of which these brake blocks have been manufactured.
  - v) 3% of every offered lot of 500 no. brake blocks will be selected at random and checked for dimensional accuracy, during developmental stage. Once the manufacturer is approved for regular supply of brake blocks this sample size of 3% will get reduced to 2%. Dimensions are to be checked as per approved drawing of manufacturer. However it is to be ensured that blocks from different mix batches will be taken up for inspection.
- (A) One brake block selected at random from the above lot shall be tested for the following :
- a) Compression modulus
  - b) Cross breaking strength
  - c) Acetone extract
  - d) Ash contents (loss on ignition)
  - e) Hardness
  - f) Density

The brake block shall be accepted based on acceptable readings given in the RDSO approved QAP of the manufacturer. The method of testing shall be as given in UIC -541-4 OR or as per the method of testing indicated in their approved QAP, which will in general be in conformity with Annexure V.

- (B) One brake block selected at random from the same lot to be tested for back plate pull off strength and accepted based on acceptance values specified in approved QAP of the firm.



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- (C) One brake block selected at random will be subjected to any other test to be included in the QAP of the firm as decided by the manufacturer and RDSO.
- vi) The regular inspection shall be carried as per the format for acceptance test given in Annexure VI.

4.2.1 The brake block shall conform to the requirements mentioned in the QAP of the firm and approved by RDSO. If any of the samples selected as per para 4.2 fail to meet the requirements of any of the requirements, double the quantity of samples stipulated in clause 4.2 shall be selected for tests. If during re testing any of the brake blocks fail to meet the requirements of any of the tests the entire lot of brake blocks offered for inspection shall be rejected and brake blocks shall be rendered unserviceable.

4.2.2 The rejected lot shall be destroyed.

**5 TESTING FACILITIES:**

- i) Manufacturer shall have adequate facilities for checking of brake block according to dimensional tolerances shown on the drawing.
- ii) Manufacturer shall have adequate facilities for determining the characteristics as laid down in para4.2.(v)
- iii) The manufacturer shall have in house full scale dynamometer facilities conforming to ERRI B-126 / RP-18 specification to test the brake blocks as per test scheme laid down in Annexure III.

**6 REVISION OF SPECIFICATION / DRAWING**

- i) RDSO reserves right to change / revise any part of the specification.
- ii) In case any revision of the specification / drawing takes place within the period of approval, suitable time period shall be given to the firm depending upon the nature of the changes to implement the revised specification & the drawing of the product
- iii) Subsequent to the revision of the specification, testing of the brake blocks if required, shall be carried out on Full scale dynamometer at RDSO and the testing charges in such cases are not to be levied for approved supplier, if the samples are submitted within the stipulated time. However, if samples fail and re-testing is carried out, the same shall be charged.

**7 PACKING**

The brake block shall be securely packed in cardboard boxes so that there is no damage to brake block during transit & handling. It should be ensured that QAP submitted for approval by RDSO includes packing details.

**8 WARRANTY**

The warranty on account of manufacturing defect shall be 18 months from the month of supply or the duty life cycle i.e. time taken in reaching the wear limit of brake block whichever is earlier. Manufacturer shall replace defective brake blocks within a month's time from the receipt of information from user railway, without any cost.

**9 Date of Enforcement**

The date of enforcement of the specification is with effect from 1st April'21.

**10 Preference to Make in INDIA**

The Government of India policy on 'Make in India' shall apply.

**11 Vendor Changes in Approved Status**

All the provisions contained RDSO's ISO procedures laid down in Document No. QO-D-8.1-11, dated 22.01.2021 (Titled "Vendor-changes in approved status") and subsequent version/amendment thereof, shall be binding and applicable on the successful vendor/vendors in the contract floated by Railways to maintain of products supplied to Railways

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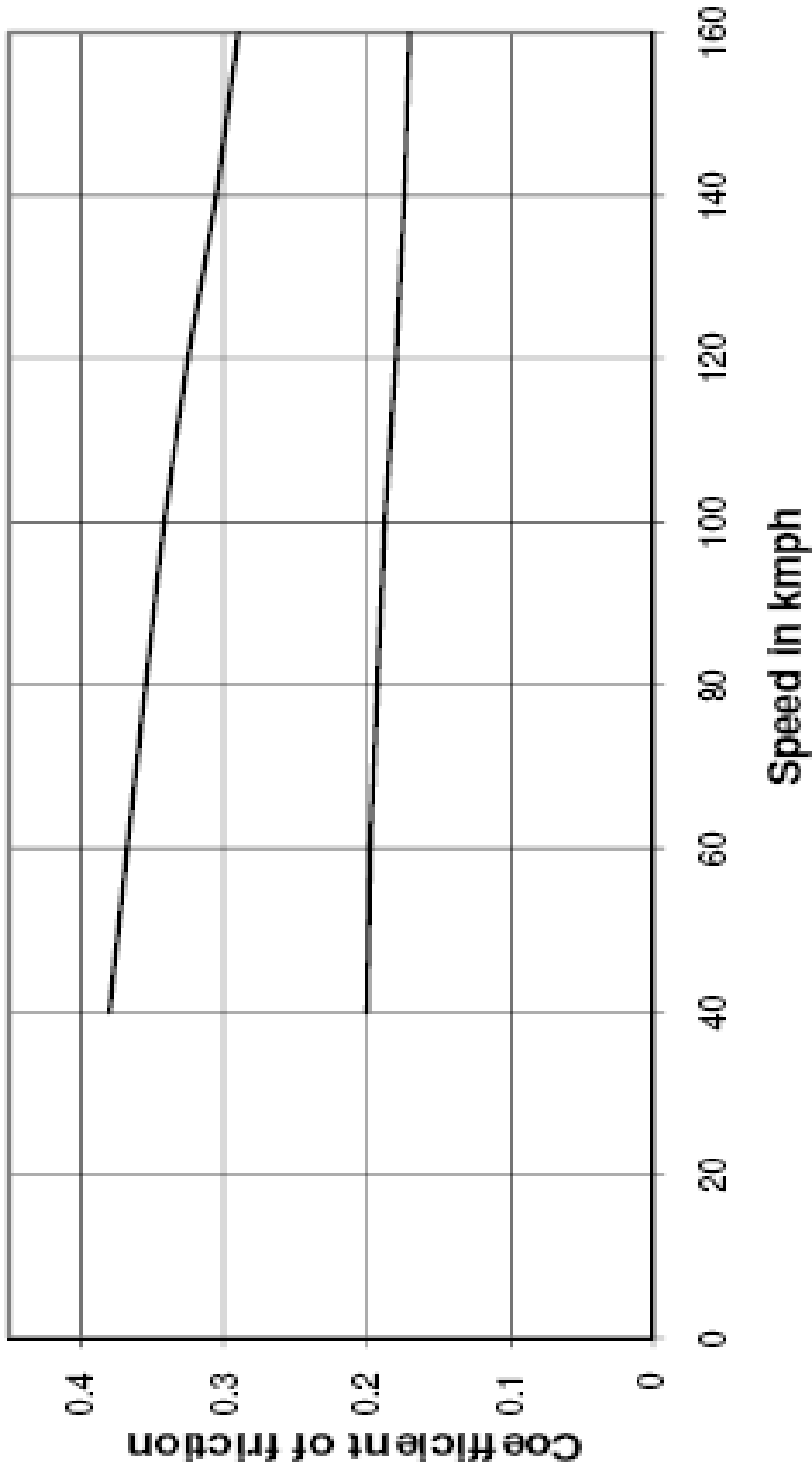
## Annexure-I

## Locomotive Data

S.No.	Particulars	
1.	Max. Axle load (t)	
	- WDG4	21
	- WDP4	19.5
2.	No. of Axles/loco	6
3.	Wheel dia (mm)	
	– New	1092
	– Condemning	1016
4.	No. of brake blocks per wheel	1
5.	Locomotive weight (t)	
	WDG4	126
	WDP4	117
6.	Total brake force	51.132 t
7.	Efficiency	100 %
8.	Max. speed (kmph)	
	- WDG4	100
	- WDP4	160
9.	Type of brake system	Air brake (CCB)
10.	Condemning thickness of brake block	10 mm

Annexure-II

**Mean Coefficient Of Friction Curve For High Friction Composition Brake Blocks**



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**Annexure III**

**PROGRAMME OF TEST FOR HIGH FRICTION COMPOSITION BRAKE  
BLOCKS ON BRAKE DYNAMOMETER FOR WDG4 & WDP4 DIESEL  
LOCOMOTIVES**

1. Diameter of wheel – 1092mm
2. No. of brake blocks /wheel – 1
3. Axle load – 21 t

<b>Brake application No.</b>	<b>Speed (km/h)</b>	<b>Force per wheel (kg)</b>	<b>Initial temp. of wheel tread (°C)</b>	<b>Remarks</b>
1	2	3	4	5
a-n	60	2000	20-100	Braking to stop until running in conditions of 85% is obtained. Weigh the brake block
1-5	40	3400	20-60	Braking to stop under dry conditions after cooling the wheel if necessary
6-10	60		60-80	-do-
11-15	80		80-90	-do-
16-20	100		-do-	-do-
21-25	110		-do-	-do-
26-30	120		-do-	-do-
31-35	130		-do-	-do-
36-40	140		-do-	-do-
41-45	150		-do-	-do-
46-50	160		-do-( weigh the brake block)	-do-
51-55	40		20-60	Braking to stop under wet conditions after cooling the wheel if necessary
56-60	60		60-80	-do-
61-65	80		80-90	-do-
66-70	100		-do-	-do-
71-75	110		-do-	-do-
76-80	120		-do-	-do-
81-85	130		-do-	-do-
86-90	140		-do-	-do-
91-95	150		-do-	-do-
96-100	160		-do-( weigh the brake block)	-do-
101-105	40	4940	20-60	Braking to stop under dry conditions after cooling the wheel if necessary
106-110	60		60-80	-do-
111-115	80		80-90	-do-
116-120	100		-do-	-do-
121-125	110		-do-	-do-
126-130	120		-do-	-do-
131-135	130		-do-	-do-
136-140	140		-do-	-do-
141-145	150		-do-	-do-

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146-150	160			-do-( weigh the brake block)
151-155	40		20-60	Braking to stop under wet conditions after cooling the wheel if necessary
156-160	60		60-80	-do-
161-165	80		80-90	-do-
166-170	100			-do-
171-175	110			-do-
176-180	120			-do-
181-185	130			-do-
186-190	140			-do-
191-195	150			-do-
196-200	160			-do-(weigh the brake block)
201-202	60	--	20-40	Drag braking with 45 H.P. for 20 minutes immediately by braking to stop with brake block force of 4940 kg per brake block under warm condition. Measure temperature of wheel and brake block after drag braking. Weigh the brake block at the end of the last stop.

The following parameters shall be recorded /measured/ calculated during the tests.

1. Wheel tread diameter before and after the tests.
2. Specific wear rate of the brake block.
3. Surface condition of brake blocks after test specifically in respect of grooving metallic inclusions, burning, non-uniform wear, overheating etc. and surface condition of wheel tyre in respect of polishing, pitting flaking, cracking and other defects after every test.
4. Initial and maximum temperature reached on brake block and wheel tread for each test during brake application.
5. General observations i.e. physical condition deterioration, smoke, smell, sparks and noise during tests.
6. Mean co-efficient of friction in during drag braking, dry and wet conditions.

The values of mean coefficient of friction are given below:-

Speed (kmph)	40	60	80	100	110	120	130	140	150	160
Upper limit ( $\mu$ )	0.380	0.368	0.355	0.342	0.334	0.325	0.315	0.305	0.297	0.290
Lower limit ( $\mu$ )	0.200	0.198	0.193	0.188	0.184	0.180	0.177	0.174	0.172	0.170



**Annexure V****Test Methods**

Test methods to check the mechanical, physical and chemical properties of the brake blocks are described below-

**Preparation of specimens**

The specimens are obtained from the brake blocks as described in Fig. 7 (A) in this Annexure. The diagram shows their location, form and dimension.

The specimens for the hardness test are prepared by first cutting sample of 40 mm x 40 mm x 10 mm from the block location as shown in Fig. 7 (A) of this Annexure, and machining the back until the whole holding plate has been removed and a smooth surface parallel to the top side (braking side) is obtained. The specimen intended for the hardness test may be used for density, before the hardness test is carried out and the specimen should be dried suitably to carry out the hardness test.

When preparing the specimens for measuring the modulus of elasticity, it must be ensured that the specimens are not overheated. The centre line of the specimen is arranged to be perpendicular to the upper side of the block. The end surfaces of the specimens are squared off to be perpendicular to the centre line of the specimen and parallel to one another. 6 specimens of diameter 13 mm and height 20 mm are measured to an accuracy of 10µm.

For Acetone Extraction test, two specimens of 3 gm each, representatives of the friction material is reduced to powder form by filling, milling, turning or boring without excessively heating the material. The powder is then sieved, using the sieves described under clause 3(c) and clause 3(d), preserving for extraction only the matter having passed through sieve 3(c) and retained by sieve 3(d). Suitable precaution must also be taken to prevent the powdered specimen from absorbing moisture.

For Ash Content test, a specimen of fine particles of 1 gm of the brake block is prepared by drilling out with 10mm dia. Drill bit without overheating. The drilling is done perpendicular to the working surface and the depth of the drilled holes shall not be more than 50% of the total brake block thickness.

The specimens for the Cross breaking strength test, are prepared by cutting sample of 120 mm x 15 mm x 10 mm from the block. The universal testing machine or special testing machine with suitable Jig & fixture having supporting span of 100 mm may be used for this test.

**1. Measurement of Density:**

The specimen is suspended by a thin thread from the hook of a weighing scale and its weight in air is measured to an accuracy of 1 mg. The Specimen is then freely suspended in water at temperature

Between 18°C and 24°C and then weighed again. Before weighing, any air bubbles adhering to the specimen must be removed which can be facilitated by adding a trace of detergent to the water.



The density is then obtained by the following formula:-

$$\frac{\text{Weight in Air}}{\text{Weight in Air} - \text{Weight in water}} \quad (\text{gm/cm}^3)$$

$$\text{Density of water} = 1 \text{ gm/cm}^3$$

## 2. **Hardness Test**

The test is carried out in accordance with method A of standard ASTM D 785-65.

For soft materials (< 100 HRX) a non- standard 19 mm ball is used in order to prevent wide scatter. The minimum (Initial) load is 10 kgf (98.0665 N), the maximum (total) load is 60 kgf (588.399 N).

The test scale is called "X".

For hardness value greater than 100 HRX, standard scale "R" is recommended.

Method A (scales "X" and "R").

After putting the specimen into position, the minimum load of 10 kgf is applied and the small pointer is set to zero within 10 seconds.

The large pointer is set to (B) 30 on the red scale within 10 seconds after the application of the minimum load and immediately after setting the dial, the minimum load of 10 kgf (98.0665 N) is increased to the maximum load of 60 kgf (588.399 N). The maximum load is then reduced to the minimum load after 15 seconds.

The Rockwell hardness HRR /HRX is read off on the red scale 15 seconds after the reduction of the maximum load.

The hardness value is obtained as follows:

Hardness value = Direct reading is noted.

Number of measurements and calculation of hardness:

Nine measurements are obtained on the two surfaces. Five measurements are to be obtained from upper surface & four measurements are to be obtained 5mm below the original upper surface. The minimum distance between two penetrations or between one penetration and the edge of the specimen shall be 10 mm. The arithmetical mean of these values is the surface hardness.

## 3. **Acetone Extraction Test:**

The following Materials and equipment are required:

- a) Pure acetone
- b) Apparatus for crushing the specimen into powder

- c) A sieve with a nominal mesh of 425  $\mu\text{m}$  in accordance with ISO standard 565 (1)
- d) A sieve with a nominal mesh of 250  $\mu\text{m}$  in accordance with ISO standard 565 (1)
- e) An analytical scale with an accuracy of 0.001g
- f) A Soxhlet extraction apparatus, which has been shown to produce similar results.
- g) A drying oven with air circulation adjustable to  $50 \pm 2^\circ\text{C}$

#### Test Procedure:

Two portions of the sieved material must be tested. One specimen of approx. 3 gm is weighed to an accuracy of 0.01 gm on calibrated filter paper with large pore size or in a thin extraction crucible. The use of whatman filter paper is considered acceptable for this purpose. After covering the crucible, or the filter paper containing the specimen, so that none of the powder can escape, the specimen placed into the siphon of the extraction apparatus. The condenser, siphon and flask, into which 50 ml to 200 ml of pure acetone has been filled, are then assembled. Heating is regulated so that siphoning occurs 20 to 30 times per hour and extraction is continued for at least six hours. At the end of this period the flask is withdrawn and the content is transferred to a smaller flask having previously been weighed to an accuracy of 0.001 gm. The empty flask is rinsed with approximately 20 ml acetone, which is then added to the extract.

The acetone is then evaporated by a suitable method, taking care that the temperature does not exceed  $50^\circ\text{C}$ . The receptacle holding the residue is then placed into the oven, where it remains for 30 minutes at a temperature of  $50 \pm 2^\circ\text{C}$ . The receptacle is then removed from the oven, cooled in a dryer to room temperature and weighed. Heating, cooling and weighing is repeated until a consistent mass is obtained, i.e. until the difference between two successive weighing does not exceed 0.003 gm.

The specimen content of matter soluble in acetone is obtained in the form of a mass percentage by applying the following formula:

$$\frac{m_1}{m_0} \times 100$$

Where:

- $m_0$  = Mass of the test specimen in gm.
- $m_1$  = Mass of dry extract in gm.

The arithmetical mean of the values obtained from the two portions of the test specimens is considered to be the specimen content of matter soluble in acetone.

**4. Modulus of elasticity (Compression):**

The specimens are submitted to test on Rockwell hardness tester, on which the ball has been replaced by a cylindrical mandrel of 13.3 mm diameter.

The minimum (initial) load is 10 kgf (98.0665 N) and the maximum (total) load is 35 kgf (343.233 N).

Before the test is started, the deflection of the test apparatus between minimum and maximum load is measured without the test specimen.

The following test sequence is applied to each as shown in the clause 7 (B).

The specimen is placed centrally underneath the mandrel, the minimum load is applied and the dial is again set to zero (black scale). The maximum load is then applied for 45 seconds, followed by an application of the minimum load for a further 10 seconds. The dial is again set to zero and the maximum load is applied again. The reading is taken, when after approximately 10 seconds the movement of the pointer suddenly slows down.

The deflection of the apparatus is then subtracted from this reading and the net deflection expressed in scale graduations is multiplied by two in order to obtain the depression  $\Delta h$  of the specimen in  $\mu\text{m}$ .

The modulus of elasticity E (mean value of the results obtained with the 6 specimens) is then calculated by the formula:

$$E = \frac{3.122 \times 10^5 \times h}{d^2 \times \Delta h} \text{ N/mm}^2$$

Where

h = Height of specimen (mm)  
d = Diameter of specimen (mm)  
 $\Delta h$  = Depression of specimen ( $\mu\text{m}$ )

**5. Ash content:****Procedure:**

Weigh previously ignited and cooled empty crucible (without lid) and record the weight W1. Load the drilled particles of 1 gm in pre- weighed crucible and weigh to an accuracy of  $\pm 0.1$  gm (W2). The crucible containing the sample is placed in the muffle furnace at  $825 \pm 25$  °C and left for 2 hours.

After ignition, the crucible shall be removed, cooled in a desiccators and weigh (W3). The ash content shall be calculated as follows.

$$\text{Ash content in \%} = \frac{W3 - W1}{W2 - W1} \times 100$$

Where

W1 = Weight of the crucible in gm

W2 = Weight of the crucible and sample in gm

W3 = Weight of the crucible and sample (after ignition) in gm

#### 6. Cross breaking strength:

The test shall be carried out at room temperature. The specimen shall be placed symmetrically across two parallel supports on UTM or special testing machine. Distance between supports shall be of 100 mm.

The load shall be applied squarely across the width of the specimen. The load shall be increased steadily so that the specimen fractures. Record the load in kg-f.

The cross breaking strength of the specimen is then obtained by the following formula: -

$$\text{Cross breaking strength} = 1.5 \times \frac{W \times L}{B \times d^2}$$

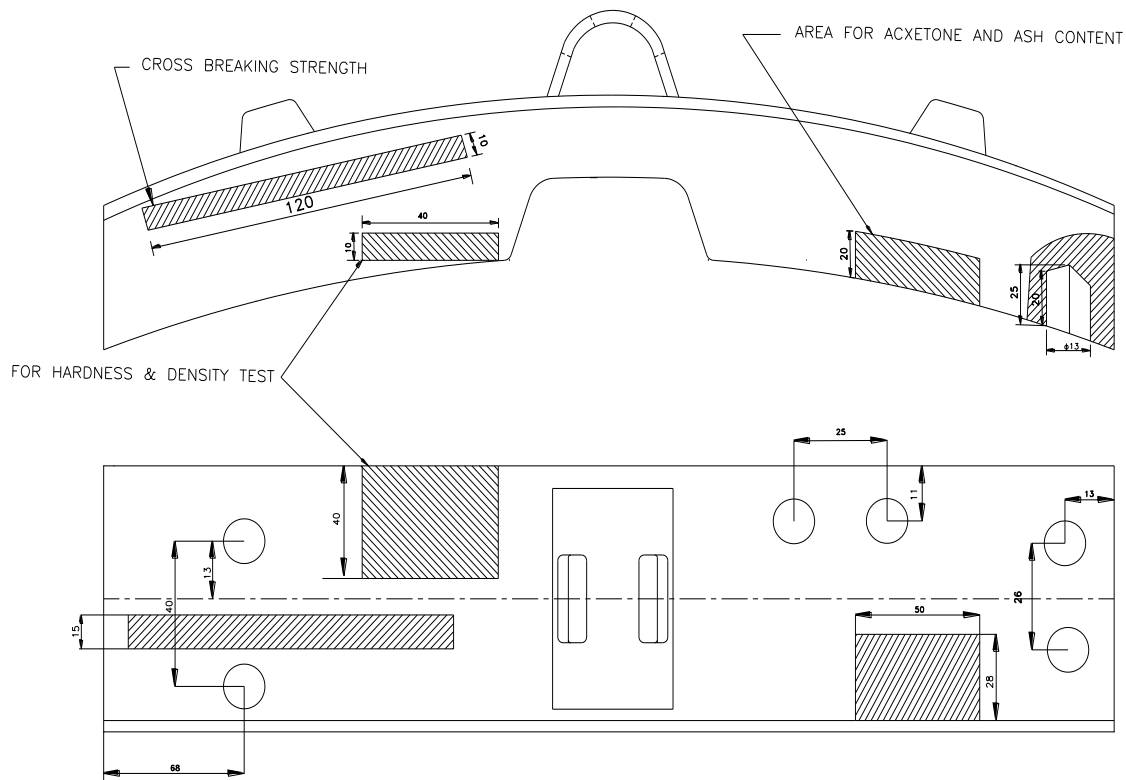
Where

W = Load in kgf

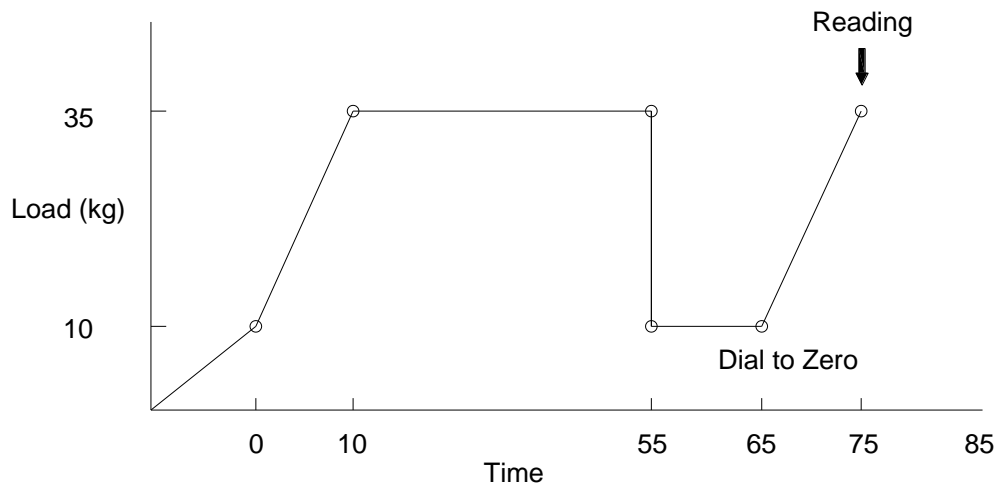
L = Distance between jaws of cross break jig

B = Width of the specimen (cm)

d = Thickness of the specimen (cm)



**Figure7 (A) Location, Form and Dimensions of Test Specimens**



**Figure 7(B) Test Procedure For Determining The Modulus Of Elasticity (E)**

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**Annexure VI**

The format for Acceptance test for High friction Composition Brake Block for Diesel & Electric Locomotives

<b>Sr. No.</b>	<b>Parameters</b>	<b>Specified Value</b>	<b>Observation</b>
1.	Visual Check	No. surface cracks	
2.	Dimensional Check	As per Approved drawing of Mfg. in QAP	
3.	Physical Properties		
	1. Compression modulus	As per Mfg. Approved QAP	
	2. Cross Braking Strength	As per Mfg. Approved QAP	
	3. Acetone extract	3% max	
	4. Ash Content / Loss on ignition	As per Mfg. Approved QAP	
	5. Hardness	85-115 (R-Scale)	
	6. Density	As per Mfg. Approved QAP	
	7. Back Plate Pull of Strength	Min 6.5 T	

**Annexure VII**

## Field Trial Scheme of High Friction Composition Brake Blocks for HHP Locomotive Application

**1. Objective:--**

To Study the suitability of high friction composition brake block for HHP locomotives working freight/ passenger trains.

**2. Parameters To Be Observed**

- i) Wear pattern & life of composition brake blocks.
- ii) General performance of brake system of locomotive.
- iii) General physical condition of brake block i.e. metallic inclusion, uniform wear, grooving, physical condition etc.
- iv) Effect on wheel i.e. wear, hot spot, crack developed in wheel due to thermal loading, tread damage etc.

**3. Procedure Of Trial**

- i) At the commencement of trial, approximately 10 locomotives shall be fitted with new composition brake blocks. Keep sufficient spare composition brake block (about 50% of the quantity fitted on locomotives) from the supply to be used as replacement of damaged or worn out brake blocks.
- ii) Before commencement of trial on locomotive, ensure that all the pressure setting are proper and brake rigging is in good working condition .
- iii) Pins and bushes of the rigging should be maintained properly.
- iv) Brake Block should be fitted with brake head using a proper key but brake head should not be worn out.
- v) Condemning wear limit marking with red colour should always remain on outer side of the locomotive.
- vi) Before commencement of trial, ensure that locomotive proportionate brakes and dynamic brakes are in working order.
- vii) Whenever any replacement of composition brake block is required, it should be replaced only by composition brake block of same supply. Mixing of any other type of brake blocks is not recommended. If no spare composition brake block is available trial should be stopped and all composition brake blocks should be removed. Final observations of brake block thickness & date of replacement has to be taken for all the removed brake blocks. These brake blocks should be stored for further study.

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- viii) During the trial, reason of replacement of composition brake blocks should also be recorded in the test format given in Annexure.
- ix) Tread diameter and wheel condition shall be checked before the commencement of the trial and shall be recorded in the format as given in the Annexure.
- x) Whenever wheel are changed, its tread diameter, date and kilometer earned will be recorded. Wheel diameter of new wheel shall also be recorded at the time of replacement.
- xi) Observation of brake blocks and wheel should be taken in all quarterly schedules till the completion of one year trial period.

**4. Closure Of Trial**

On expiry of one year trial period or when there is no spare brake blocks available to replace damaged/ worn out composition brake block on particular locomotive trial will be stopped on that locomotive. Trial will continue on other locomotives till these locomotives also reach to above mentioned conditions. In no case composition brake blocks used/replaced from a locomotive should be used as spare brake block for other nominated locomotives.

On completion of trials the thickness of each brake blocks shall be measured and this information has to be sent to RDSO separately for assessment of the life of each brake block.

**5. Feed Back**

Regular feedback at quarterly interval will be given to RDSO as per the format given below.

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Observation Taken During Field Trials Of High Friction Composition Brake Block On Locomotive

Loco Shed ----- Loco No. ----- Brake block supplied by -----Application (Express/Passenger/Goods): .....

Observation during quarterly schedule ----- 1<sup>st</sup> quarterly/ half yearly/3<sup>rd</sup> quarterly/ yearly

S.N.	Location of Brake block	Date of fitment	Brake block thickness is to be measured - *As shown in sketch			Km. Earned by loco. After fitment of brake blocks	Details of wheel turning, if done during trials			Wheel defect if any like Hot spot, Crack, Tread damage, Thermal loading etc	Date of replacement of brake block & its code	Brake system performance on loco.					Remarks
							Wheel dia. before wheel turning	Date of wheel turning	Wheel dia. after wheel turning			Maximum loco BC pressure during:		Loco proportionate brake working (Y/N)	Dynamic/ Blended Brake Working (Y/N)	Condition of brake rigging (whether operation is smooth)	
			A	B	Avg							Auto. Brake Appli.	Indi. Brake Appli.				
1	R1																
2	R2																
3	R3																
4	R4																
5	R5																
6	R6																
7	L1																
8	L2																
9	L3																
10	L4																
11	L5																
12	L6																

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Replacement Code -- A). Normal wear    B). B/Block cracked    C). B/ Block back plate broken  
D). B/ Block broken    E). B/ Block missing    F). B/ Block chipped off  
G). B/ Block replaced due to matching of Block thickness on the same brake beam    H). Other reason

