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ARISO Contact details:

Head office:

Phone:

(07) 3724 0000
+61 7 3724 0000

Email:

info@ariso.org.au

Web:

www.ariso.org.au

Standard Development Manager:

Name:

Cris Fitzhardinge

Phone:

0497 919 619

Email:

cfitzhardinge@ariso.org.au

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Data entry – draft starts next page

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SDM name	Cris Fitzhardinge
SDM phone	0497 919 619
SDM email	cfitzhardinge@ariso.org.au

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2	18/12/2025	Updated to incorporate draft 1 comments.
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0	1/06/2025	Initial version generated from the most recently published version.

Preface

This standard was prepared by the Brake Components – Part 1: Brake Blocks Development Group, overseen by the ARISO Rolling Stock Standing Committee.

The major changes in the is review are as follows:

- (a) Updates to the testing requirements for brake blocks.
- (b) Inclusion of instantaneous friction requirements.
- (c) Updates to the brake block material characteristics.

Objective

The objective of this standard is to describe the requirements for the manufacture and testing of medium- and high-friction composite brake blocks to be installed on:

- (a) locomotives and rolling stock (locomotive hauled rolling stock;
- (b) self-propelled passenger rolling stock; and
- (c) infrastructure maintenance rolling stock.

Compliance

There are four types of provisions contained within Australian Standards developed by ARISO:

- (a) Requirements.
- (b) Recommendations.
- (c) Permissions.
- (d) Constraints.

Requirements – it is mandatory to follow all requirements to claim full compliance with the Standard. Requirements are identified within the text by the term ‘shall’.

Recommendations – do not mention or exclude other possibilities but do offer the one that is preferred. Recommendations are identified within the text by the term ‘should’.

Recommendations recognize that there could be limitations to the universal application of the control, i.e. the identified control is not able to be applied or other controls are more appropriate or better.

For compliance purposes, where a recommended control is not applied as written in the standard it could be incumbent on the adopter of the standard to demonstrate their actual method of controlling the risk as part of their WHS or Rail Safety National Law obligations. Similarly, it could also be incumbent on an adopter of the standard to demonstrate their method of controlling the risk to contracting entities or interfacing organisations where the risk may be shared.

Permissions – conveys consent by providing an allowable option. Permissions are identified within the text by the term ‘may’.

Constraints – provided by an external source such as legislation. Constraints are identified within the text by the term ‘must’.

ARISO Standards address known hazards within the railway industry. Hazards, and clauses within this Standard that address those hazards, are listed in Appendix A.

Appendices in ARISO Standards may be designated either “normative” or “informative”. A “normative” appendix is an integral part of a Standard and compliance with it is a requirement, whereas an “informative” appendix is only for information and guidance.

Commentary

Commentary C Preface

This Standard includes a commentary on some of the clauses. The commentary directly follows the relevant clause, is designated by 'C' preceding the clause number and is printed in italics in a box. The commentary is for information and guidance and does not form part of the Standard.

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Section 1 Scope and general

1.1 Scope

This document applies to new, modified, and existing locomotive, hauled freight and passenger rolling stock, self-propelled passenger rolling stock and infrastructure maintenance rolling stock.

This document applies to the design, construction, and maintenance of friction material used in the development and construction of brake blocks.

Operation of rolling stock in regard to network safeworking rules and route standards is not covered.

This document applies to all rolling stock excluding that which operates on light rail and cane railway networks.

1.2 Normative references

The following documents are referred to in the text in such a way that *some* or all of their content constitutes requirements of this document:

- AAR Standard M-107/208, *Wheels, carbon steel*
- AAR Standard M-926, *Brake shoe, high-friction or metal type*
- AAR Standard S-4023, *Brake shoe limiting contour, low-friction composition type*
- AAR Standard S-431, *Brake shoe, high friction composition type – limiting contour*
- ASTM D297:2002, *Standard Test Methods for Rubber Products—Chemical Analysis*
- *UNIFE Railway Industry Substance List*

NOTE:

Documents for informative purposes are listed in a Bibliography at the back of the Standard.

1.3 Defined terms and abbreviations

For the purposes of this document, the following terms and definitions apply:

1.3.1

AAR

American Association of Railroads

1.3.2

coefficient of friction (CoF)

ratio of the resultant retarding force produced to the applied brake block force (normal to the friction material)

1.3.3

rolling stock operator (RSO)

As defined in Rail Safety National Law.

1.3.4

safety management system (SMS)

organizations system whose primary objective is to achieve safe rail operations

Note 1 to entry: Under co-regulation, the accreditation authority has the role of defining the minimum requirement for what must be included in a specific safety management system

Note 2 to entry: RSOs, rail infrastructure managers and rail transport operators are free to nominate equivalent or superior standards for their safety management system.

1.3.5

professional manner

work performed to a reasonable skill, care and diligence

Note 1 to entry: When the work is completed, it will also be fit for its intended use.

General rail industry terms and definitions are maintained in the ARISO Glossary. Refer to:

<https://www.ariso.org.au/glossary/>

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Section 2 Brake block material characteristics

Backing plates should be manufactured from steel, or other material type where verified, and validated via testing accepted under the RSO's and manufacturer's SMS.

Brake blocks shall be verified and validated via testing by the RSO and manufacturer. Successful dynamometer testing shall be undertaken prior to use of the brake blocks in service.

Manufacturers shall have a clearly defined process for managing quality of brake blocks, including the identification of potential performance variances.

Manufacturers shall advise the RSO in writing of any change or modification to their brake blocks that materially varies performance. Changes shall not be introduced without written advice to RSOs, and written acceptance from RSOs.

Brake blocks shall not contain asbestos or asbestos compounds.

Brake blocks must not contain any material prohibited from use in accordance with the current published UNIFE Railway Industry Substance List.

The friction material and its components used in the block, and its by-products in service, should be selected such that their emissions and associated effects minimize harm to the health of any human or animal.

Emission of odours from brake blocks shall be controlled to minimize unacceptable odour nuisance, as defined in the relevant state and territory legislation, under service braking conditions.

Brake blocks shall not deposit electrically resistant material on to the wheel tread or rail head that will result in a loss of signalling detection in accordance with AS 7505.

The safety data sheet (SDS) shall state the amount of friction material in the mass per brake block of:

- (a) each element with an atomic mass higher than titanium;
- (b) crystalline silica; and
- (c) organic halogens (Refer to the UNIFE Railway Industry Substance List).

The RSO shall obtain and keep a record of current SDS for each type of brake block in use.

Section 3 Brake block performance

The friction material and its components, under normal service conditions when fitted to a brake block holder in a bogie in nominal condition, shall not:

- (a) interfere with the function of, nor cause damage to, any equipment or property;
- (b) produce grooving, wear, spalling, thermal fracture growth, or any other detrimental effects to wheel tread surfaces, during the life of the brake block;
- (c) generate excessive noise whilst braking or cause the wheel or any other component to resonate or squeal excessively;

NOTE:

Acceptable levels of noise from squeal will depend on the operational area of the vehicle and local, state and federal legislation. Also refer to UIC 541-3 and UIC 541-4

- (d) show any sign of disintegration, or of the friction material separating from the backing plate, at any stage of block wear; or
- (e) generate sparks or hot material discharge that could initiate track-side fires.

The brake block testing requirements should be agreed between the manufacturer and the RSO. The RSO shall obtain and keep a record of previous test results for each type of brake block in use.

Wheel material and brake block compatibility should be assured by use of only the following combinations in Table 1 of wheel material and brake block type to reduce the incidence of thermal tread damage:

Table 1 Brake Block Types

Type of brake block	Class of wheel
Low friction	AAR Manual of Recommended Practices, Class A or equivalent
Medium friction	AAR Manual of Recommended Practices, Class A, B or equivalent
High friction	AAR Manual of Recommended Practices, Class A, B or C or equivalent
Cast iron	AAR Manual of Recommended Practices, Class A, B or C or equivalent

Brake blocks shall not be damaged, including loss of any part of the block, during transport, handling, installation, service life and removal procedures employed by the RSO, other than by the normal wear process.

Section 4 Friction characteristics

Friction of brake blocks shall be tested by a dynamometer in accordance with Section 8.

High-friction brake blocks: the nominal coefficient of friction (μ) shall be within the distance averaged coefficient of friction values shown in Appendix B. The minimum nominal static coefficient of friction (μ) shall be not less than 0.38 μ .

Other brake blocks: the nominal coefficient of friction shall be defined by the RSO to ensure the vehicle fitted with the intended blocks conforms within the maximum stopping distance requirements of the appropriate network. RSOs shall advise appropriate brake forces for determination of static friction behaviour, including assessment of worst case scenarios.

Friction levels of new blocks should not vary by more than 0.03 μ from the existing agreed coefficient of friction level used on a vehicle unless otherwise agreed between the manufacturer and the RSO.

Commentary C4

For example, the acceptable coefficient of friction variance could be greater for locomotives than for passenger or freight rolling stock.

Section 5 Instantaneous friction requirements

For each stop test (refer to Appendix B), the following instantaneous data shall be provided.

- (a) For graphs, axis values shall be displayed at regular intervals for both speed and friction, along with individual stop identification numbers on each corresponding graph.
- (b) Graphs of the instantaneous friction versus speed for each stop with linear axes ranging from 0 km/h to at least maximum speed and 0 km/h to at least maximum instantaneous friction.
- (c) The instantaneous friction from 5 % brake application force to 5 r/min and 95 % brake application force.
- (d) For drag or grade braking tests, the instantaneous friction versus time along with the corresponding six (6) instantaneous brake disc thermocouple temperatures for the entire test.

- (e) For static friction tests, the instantaneous friction versus time with the point of first disc movement marked on each static test. Multiple static test results may be displayed on one graph.

Section 6 Interchangeability

The means of assuring interchangeability should be agreed between the manufacturer and the RSO so that brake blocks should be compatible on the same type of rolling stock.

Medium-friction brake blocks should have an interface to the brake shoe holder complying with AAR Standard S-4023 unless otherwise agreed with the RSO.

For new rolling stock, all composite brake blocks should be high friction and manufactured in such a way that prevents them from being fitted to brake heads on vehicles designed for brake blocks having a different friction level.

High-friction brake blocks shall have an interface to the brake shoe holder complying with AAR Standard S-431 unless otherwise agreed with the RSO.

Tolerances on the brake block back radius shall be agreed with the RSO for all brake block types.

Section 7 Brake block manufacture

The brake block shall be free of all sharp edges and burrs.

Brake blocks should be manufactured under a quality management system developed between the RSO and the manufacturer.

Brake blocks should be finished in a professional manner that delivers a uniform contour and dimension as per design.

Section 8 Brake block dynamometer testing

Brake blocks shall be tested in accordance with the requirements listed in Appendix B for high-friction brake blocks or to the requirements agreed with the RSO for medium-friction brake blocks.

Brake block tests shall be carried out at intervals determined by the RSO in conjunction with the OEM.

Commentary C8

The AAR M-926 clause references listed in Appendix B show whether the requirements for testing are modified from those in AAR M-926

Section 9 Brake block performance validation

Brake block performance verification should be done in accordance with Appendix C.

Appendix A Hazard Register (Informative)

Hazard number	Hazard
4.1.1.5	Damage to the environment caused by excessive noise (Harm to the environment)
5.1.1.7	Sparks from brake equipment causing fire
5.1.1.9	Wheel skidding causing rough wheel tread condition and excessive rolling wheel/rail noise (Harm to the environment)
5.1.1.19	Rough wheel tread condition (excessive rolling wheel or rail noise) (Harm to the environment)
5.1.1.44	Braking causing excessive noise (Harm to the environment)
5.3.1.2	Hazardous substances
5.3.1.39	Harmful exposure to noise (Harm to persons)
5.6.1.1	Brakes being inadequate when moving
5.6.1.2	Brakes being inadequate when stationary
5.6.1.24	Background noise level in train being too high so that train crews are unable to hear the telecommunication system resulting in Train Control and train crews being unable to communicate (Out of Control Trains)
5.8.1.4	Brakes being inadequate when moving causing collision with stop blocks
5.8.1.6	Brakes being inadequate when moving causing side swipe by another train
5.9.1.36	Brake block material / residue is electrically insulating causing contaminated rail head surfaces leading to high wheel to rail electrical resistance resulting in the loss of signal detection so that trains are not detected (Signal failure)
5.9.1.37	
5.10.1.4	Inadequate braking on down grades
5.10.1.5	Brake fade
5.10.1.11	Friction elements are excessively worn or missing causing excessive braking stroke
5.10.1.15	Friction elements misaligned to tread / disc
5.10.1.39	Friction elements not conforming to tread/disc shape
5.12.1.17	Excessive brake material friction
5.13.1.12	Vehicle or wheelset over-braked
5.20.1.7	Excessive noise or vibration (Driver fatigue)
5.26.1.7	Excessive thermal loading from tread braking causing cracked wheels - (Wheel failure)
5.26.1.35	Wheels being scored, damaged or corroded causing cracked wheels (Wheel failure)

Hazard number	Hazard
5.26.1.47	Friction elements misaligned to wheel tread due to incorrect brake block fitted (Wheel failure)
6.5.1.27	Harmful exposure to noise (Harm to persons)

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Appendix B Test Requirements (Normative)

Step	Requirement	M-926 Clause	Modified
1.	<p>Test Sequence</p> <p>After wear-in as outlined in Step 9, certification tests shall be conducted in the following sequence:</p> <ul style="list-style-type: none"> a) Steps 10 to 12 Light grade test (weigh shoes before test). b) Steps 17 and 18 Light stop test series (weigh shoes before test). c) Steps 19 and 20 Heavy stop test series. d) Steps 21 to 28 Static tests (weigh shoe after last test). 	3.9	Yes
2.	<p>Failure to meet all requirements outlined in this specification shall constitute test failure. In addition, the conditions listed in Steps 33 to 36 may be cause for test failure at the discretion of the RSO even if all other test criteria are met.</p>	3.10	Yes
3.	<p>The condition of the test wheel shall be documented in the test report by recording the following:</p> <ul style="list-style-type: none"> a) New or used. b) Hardness and surface roughness. c) Rim thickness. d) Diameter (measured to ARISO Wheel Defect Manual – Appendix A). e) Out-of-round when at ambient temperature measurement (to AS 7517). 	4.1	Yes
4.	<p>Maximum wheel temperature at the start of test of shall be 60°C. Water cooling shall not be permitted between tests unless wet testing is being conducted.</p>	4.4	Yes
5.	<p>The effects of dynamometer resistance and any treatment of it in calculations shall be stated in the test report.</p>	4.5	Yes
6.	<p>All tests are to be made with a single-shoe brake arrangement.</p>	4.6	No
7.	<p>The inertial load of the test wheel shall be detailed in the test report.</p>	4.7	Yes
8.	<p>All brake shoe forces are average brake shoe forces calculated over the specific test period.</p>	4.8	No
9.	<p>The brake shoe shall be worn in in the following manner:</p> <p>Machine the shoe to match the radius of the test wheel when installed on the dynamometer without any brake force applied.</p> <p>Conduct one 45-minute grade test at 32 km/h with a 6.45 kN shoe force.</p> <p>Conduct five (5) stops from 129 km/h with a 17.8 kN shoe force.</p> <p>Conduct five (5) stops from 129 km/h with an 8.90 kN shoe force.</p> <p>Repeat Step 2 through to Step 4 until at least 85% bearing on the wheel is achieved.</p>	5.2	Yes

Step	Requirement	M-926 Clause	Modified
10.	Shoe performance in grade service shall be determined for heavy braking by measurement of the retarding force produced by an imposed constant brake shoe force on the wheel rotating at a constant speed of 32 km/h for a duration of 45 minutes for each test. The tolerance on speed shall be ± 0.8 km/h. Retarding force for each test shoe is calculated as an average over 5-minute segments of the grade test. A 45-minute test will consist of nine segments starting at 96% of the force setting. Using a 10 Hz low pass filter, data shall be collected at a rate not less than 200 Hz.	6.1	No
11.	A blower or suction fan shall be used to move air across the wheel and brake shoe to simulate car movement during the test. The air velocity shall be 24 km/h to 32 km/h at the brake shoe as measured by an anemometer.	6.2	No
12.	Grade Brake Test Requirements With a brake shoe force of $6.45 \text{ kN} \pm 0.2 \text{ kN}$ during each 5-minute test period, the average of the lowest retarding force produced during the test of each of the three shoes shall be not less than 1.78 kN	6.3	No
13.	Stop Test Series – The following test sequence carried out three times should be used for dynamometer testing for each of the speed ranges in the following table: a) 120 km/h to 0 km/h b) 100 km/h to 0 km/h c) 80 km/h to 0 km/h d) 60 km/h to 0 km/h e) 40 km/h to 0 km/h f) 20 km/h to 0 km/h Tests shall be done in a descending speed order, for example, 120 km/h to 0 km/h first. Test reports shall include a plot of instantaneous coefficient of friction against speed during the tests.	7.0	Yes
14.	The stop tests shall consist of making light braking and heavy braking stops from speeds as shown in the tables in Step 14 and 16 respectively. The tolerance for initial speed shall be ± 0.3 km/h prior to the initiation of braking.	7.1	No

Step	Requirement	M-926 Clause	Modified
15.	<p>The build-up of brake shoe force for the stop tests shall be nominally linear such that the brake shoe force rises from 0% to 50% of the force setting in 2 ± 0.25 seconds and to 96% of the force setting in 5 seconds. Brake shoe performance shall be determined by measurement of the friction during the stop, after build-up of net shoe force. The friction averaged over distance is calculated from 96% of the force build-up to 5 rpm. Using a 10 Hz low pass filter, data shall be collected at a rate not less than 200 Hz. Average friction over distance is calculated by the following equation:</p> $\mu_2 = \frac{1}{s_2} \sum \mu_i \Delta s_i$ <p><i>Where:</i> μ = instantaneous friction Δs_i = incremental distance s_2 = distance from 96% of the force build-up to 5 rpm μ_2 = If friction data is collected at equal distance intervals, μ_2 is the average of μ from 96% of the force build-up to 5 rpm</p>	7.2	Yes
16.	Enhanced cooling, other than that provided by fume-removal equipment, shall not be used for the stop tests.	7.3	No
17.	<p>Stop test series – For freight and passenger vehicles a schedule of brake block forces should be used with brake block forces from $5.0 \text{ kN} \pm 0.1 \text{ kN}$ to $25.0 \text{ kN} \pm 0.1 \text{ kN}$ carried out in decrements shown in Step 18, using the speed ranges and sequence detailed in Step 13.</p> <p>Brake blocks forces on locomotives should be tested from the value of the maximum force exerted by the locomotive brake system, which could be up to 42 kN.</p> <p>For testing purposes the default wheel loads shall be as below unless otherwise stipulated by the RSO:</p> <ul style="list-style-type: none"> • Locomotives – 12.5 t to 15 t • Freight 2.5 t (empty), 12.5 t (loaded) • Passenger 4 t (empty), 9 t (loaded) 	8.1	Yes

18. The average of the results of the three stop tests made from each designated speed for the three shoes shall conform to the requirements as specified in the tables below. 8.2 Yes

Tests for freight and passenger applications shall be conducted on wheels between 860 mm and 920 mm in diameter.

Appendix Table B-1 High Static Friction, High Dynamic Friction Blocks

kN	Speed (km/h)	Average Stop Distance CoF					
		20	40	60	80	100	120
5	Nominal	0.51	0.48	0.46	0.42	0.385	0.35
8	Nominal	0.48	0.46	0.43	0.39	0.355	0.32
12	Nominal	0.45	0.43	0.4	0.36	0.32	0.27
20	Nominal	0.41	0.38	0.35	0.305	0.26	0.2
25	Nominal	0.38	0.36	0.325	0.28	0.23	0.17

Appendix Table B-2 Low Static Friction, High Dynamic Friction Blocks

kN	Speed (km/h)	Average Stop Distance CoF					
		20	40	60	80	100	120
5	Nominal	0.45	0.43	0.4	0.36	0.32	0.29
8	Nominal	0.42	0.39	0.36	0.32	0.29	0.26
12	Nominal	0.38	0.36	0.33	0.3	0.27	0.24
20	Nominal	0.33	0.31	0.28	0.255	0.23	0.21
25	Nominal	0.3	0.28	0.26	0.24	0.22	0.2

Appendix Table B-3 Low Dynamic Friction Blocks

kN	Speed (km/h)	Average Stop Distance CoF					
		20	40	60	80	100	120
5	Nominal	0.35	0.35	0.33	0.32	0.31	0.29
8	Nominal	0.32	0.32	0.3	0.29	0.28	0.26
12	Nominal	0.26	0.255	0.24	0.23	0.22	0.2
20	Nominal	0.24	0.23	0.21	0.2	0.17	0.15
25	Nominal	0.23	0.22	0.2	0.185	0.15	0.13

For static CoF between 0.25 and 0.38 a standard deviation from the nominal values of up to 0.04 is permitted for all speeds and forces.

Step	Requirement	M-926 Clause	Modified																																
	<p>For CoF above 0.38, the RSO and OEM shall agree to the allowed deviation based on an assessment of the required:</p> <ul style="list-style-type: none"> net braking ratios; operational geography of the vehicle; static braking forces; deceleration rates; and stopping distance. <p>For locomotives, the maximum block force is in line with AAR RP599 Locomotive block tests shall be conducted on a nominal 40-inch wheel (990–1,060 mm diameter).</p> <p>All locomotive tests are conducted with a single block per wheel.</p> <p>For locomotives the three stop tests shall conform to the additional requirements as specified in the below table:</p> <table border="1"> <thead> <tr> <th colspan="2"></th> <th colspan="6">Average Stop Distance CoF</th> </tr> <tr> <th>kN</th> <th>Speed (km/h)</th> <th>20</th> <th>40</th> <th>60</th> <th>80</th> <th>100</th> <th>120</th> </tr> </thead> <tbody> <tr> <td>30</td> <td>Nominal</td> <td>0.35</td> <td>0.33</td> <td>0.31</td> <td>0.27</td> <td>0.22</td> <td>0.2</td> </tr> <tr> <td>44.5</td> <td>Nominal</td> <td>0.3</td> <td>0.29</td> <td>0.28</td> <td>0.24</td> <td>0.2</td> <td>0.19</td> </tr> </tbody> </table> <p>A standard deviation from the nominal values of up to 0.04 is permitted for all speeds and forces.</p> <p>NOTE: The above tables are based on EN-16452:2015, UIC 541-4:2007, and the AS 7510 series.</p>			Average Stop Distance CoF						kN	Speed (km/h)	20	40	60	80	100	120	30	Nominal	0.35	0.33	0.31	0.27	0.22	0.2	44.5	Nominal	0.3	0.29	0.28	0.24	0.2	0.19		
		Average Stop Distance CoF																																	
kN	Speed (km/h)	20	40	60	80	100	120																												
30	Nominal	0.35	0.33	0.31	0.27	0.22	0.2																												
44.5	Nominal	0.3	0.29	0.28	0.24	0.2	0.19																												
19.	Static friction tests should be conducted as soon as the wheel temperature has dropped to 60°C.	10.0	Yes																																
20.	Conduct the tests following the last heavy braking stop test. The shoe should not be removed for weighing until after the static friction tests are complete.	10.1	No																																
21.	Apply pressure to the brake cylinder to provide a brake shoe force 16.5 kN ±0.2 kN.	10.1.1	No																																
22.	Generate torque at a rate not to exceed 2.0 kN-m/s until wheel moves. The reading of torque value at breakaway will be used to compute the static coefficient of friction.	10.1.2	No																																
23.	Remove generated torque and release the brake. The wheel shall move at least one shoe length to count as a valid test.	10.1.3	No																																
24.	Repeat Step 21 to Step 23 inclusive for a total of nine (9) tests for each shoe.	10.1.4	No																																

25. Calculate the static COF using the following formula: 10.1.5 No

$$\mu_1 \frac{nm}{16.5 \times m}$$

Where:

μ_1 = COF

Nm = Maximum Torque

M = wheel radius

26. Minimum requirement for the average static CoF shall be 0.38 for the three shoes. 10.2 No

27. The material lost during the tests shall be determined by mass the shoes before the grade test and after the last static test for each shoe. The amount of the material lost in kilograms divided by the density of the friction material in kilograms per cubic centimetre will give the volume loss. Mass shall be determined to an accuracy of one (1) gram. Prior to final mass of test samples, shoes may be cleaned with compressed air. Density shall be determined by ASTM test method D-297 (hydrostatic method) on a sample taken from a shoe from the test lot. 11.1 No

28. The average of accumulated loss in brake block volume shall be less than 14.8 cm³ 11.2 No

29. Broken out sections that would condemn a brake shoe per the *Field Manual of the AAR Interchange Rules*, Rule 12, Fig. A, constitute test failure. Broken out sections shall be assessed in volume loss calculations. 11.3 No

30. Metal pickup on the brake shoe contact surface will be removed before final weighing of the brake shoe test samples. 11.4 No

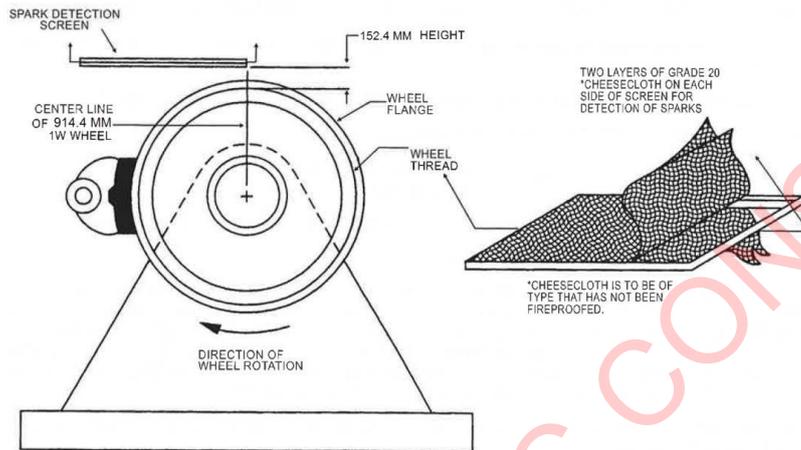
31. Damage to the backing plate of the brake block shall be inspected at the completion of the testing. Damage to the backing plate of the brake block, which impacts the ability to securely locate the brake block in position, shall not be permitted. 12.0 Yes

32. Wheel tread grooves and metal pickup. Brake shoe will be considered failed if the test wheel is condemned according to Rule 41 of the *Field Manual of the AAR Interchange Rules* (simplified finger gauge). 12.1.2 No

33. Photographic or video images representative of the above observed conditions may be included in the official test report. 12.2 No

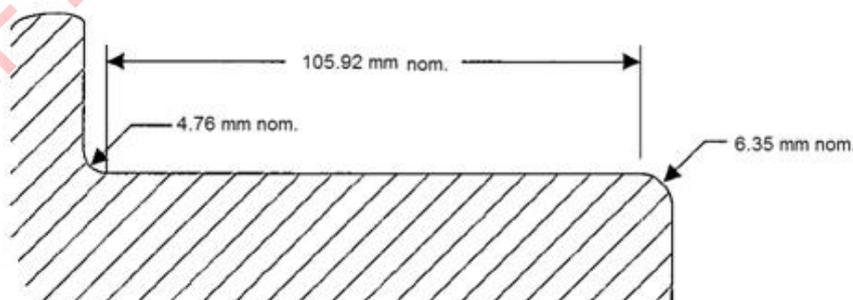
- | | | | |
|-----|--|------|----|
| 34. | Spark Detection Apparatus (only applicable to full cast iron brake blocks) | 12.3 | No |
|-----|--|------|----|

The spark detection screen is fabricated on a 25 mm thick frame with inside dimensions 305 mm wide x 559 mm long. This frame is positioned horizontally with its longitudinal axis directly over the wheel and centred with respect to width of the wheel. One end of the frame is fixed directly above the centreline of the wheel at a height of 152 mm above the wheel tread, and the other end extends over the brake shoe location. Results of spark detection testing shall be reported in official AAR test reports. Burn-through of both layers of cheese cloth shall constitute test failure.



Appendix Figure B-1 Spark detection apparatus

- | | | | |
|-----|---|--------------|-----|
| 35. | Where pertinent, each manufacturer is required to determine density, hardness and shear or pull-off strength for approved friction material and shall keep this information on file and available to the RSO. | 13.1 | Yes |
| 36. | The brake head will be centred in the actuator within 1.6 mm of the actuator centreline. | App. A 2.1 | No |
| 37. | The test wheel will be positioned so the centreline of the brake head is within 2.4 mm of the centre of the straight portion of the wheel tread. | App. A 2.1.2 | Yes |
| 38. | The wheel tread should be machined to a cylindrical configuration as shown in the figure below or an actual rail wheel may be used as agreed with the RSO. | App. A 2.2.1 | Yes |



Appendix Figure B-2 Wheel tread dimensions

39.	Surface finish will be measured parallel to the centreline of the dynamometer shaft at three equidistant locations around the test wheel tread with a NATA-traceable test device. All measurements shall be less than 1.6 µm.	App. A2.2.2	No
40.	Test wheel roundness will be measured with a dial indicator and shall not exceed 0.762 mm total indicator reading.	App. A 2.2.3	No
41.	Test wheel rim surface hardness will be measured at one location and shall be within the requirements of the <i>AAR Manual of Standards and Recommended Procedures</i> , Section G, Specification M-1071/M-208	App. A 2.2.4	No
42.	Additional cooling fans are not permitted if the M-926 grade test air cooling speed requirement (24 km/h to 32 km/h) is maintained and can be successfully demonstrated with a calibrated anemometer. Orientation of cooling fans to test wheel will be maintained during test. The test wheel shall not be water cooled unless wet testing is being conducted.	App. 2.3	Yes
43.	Where the test transducer in use has an in-built zero drift compensation feature, the zero-drift test outlined in AAR M-926, Appendix A, Section 4 does not have to be carried out.	App. A 4.0	Yes
44.	Dynamometer inertia, equivalent wheel load, and internal resistance should be listed along with the methods of measurement and computation. The methods of measurement and computation shall be given for dynamometers that generate a simulated inertial mass.	App. B 1.1	No
45.	Methods of measurement of speed, brake force, brake force build-up rates, retarding force, dynamic torque, static torque, and temperature should be described. Verification of calibrations should be furnished.	App. B 1.2	No
46.	Methods of data sampling and collection should be listed. These should include references to sampling rates, threshold limits for time and revolution counters, and schemes for averaging results.	App. B 1.3	No

Appendix C Brake Block Performance Validation Method (Informative)

Validation methods for a new brake block type or for a new supplier of brake blocks should include the following phases which do not require special network access or special test equipment.

The underlying principle is gradual introduction in increasing numbers of trial brake blocks fitted to a train in revenue service with regular monitoring of the condition of the trial brake blocks prior to each increase in the number of the new type of block under trial.

This type of progressive trial can typically take 12 months or more to complete. It involves several iterative stages and activities monitoring the following parameters:

- (a) Inspections for wheel damage.
- (b) Inspections for brake block wear rate.
- (c) Stopping distance tests to AS 7510.6
- (d) Wheel temperature monitoring at stopping distance tests.
- (e) Monitoring of cooler wheels after drag braking to ensure no underbraking from lower friction test blocks before larger scale trials.
- (f) Passing noise tests.
- (g) Driver feedback in all weather conditions.

Using unit coal train service as an example, following successful dynamometer testing of the new brake block type:

- (h) Fit up to 5% of wagons in a train with the new block type and run them for a month. This leaves a 5% buffer to allow for further brake cut outs without having to take the train out of service if a brake fault occurs elsewhere in the train. It also does not adversely affect train stopping distances in relation to signal spacing should the trial brake blocks not provide sufficient retardation when fitted to the train. This is because stopping distances for signals are typically validated with 10% of the train brakes cut out.
- (i) Inspect after the trial blocks after a month and if performance seems satisfactory then fit up to half a train of wagons with the trial brake block type and run them for 6 months monitoring the parameters listed above.
- (j) Inspect after six (6) months and if performance seems satisfactory, fit the trial brake blocks to the remaining half of the train with the new block type and run them for a further six (6) months while monitoring the parameters listed above.
- (k) Following successful performance and service being achieved, the new block type can be rolled out across further trains.

Bibliography (Informative)

- AS 2377, *Acoustics—Methods for the measurement of railbound vehicle noise*
- AS 4292, *Railway Safety Management*
- AS 7501, *Rolling Stock Certification*
- AS 7505, *Signal Detection Interface*
- AS 7510.6, *Braking Systems – Part 6: Train*
- AS 7514, *Railway Rolling Stock – Wheels*
- AS 7517, *Wheelsets*
- *AAR Interchange Rules*, Rule 12 – Brake Shoes and Shoe Keys
- *AAR Interchange Rules*, Rule 41 – Wheels
- UIC 541-3, *Brakes – Disc brakes and their applications – General conditions for the certification of brake parts*
- UIC 541-4, *Brakes with composite brake blocks – General conditions for the certification of composite brake blocks*
- ARISO Code of Practice – *Wheel Defects*