UGL REGIONAL LINX

MINIMUM OPERATING REQUIREMENTS FOR FREIGHT VEHICLES

CRN-STD-ROL-713026361-2287

CRN RS 002

LINKING COMMUNITIES. CONNECTING CUSTOMERS.

Table of Contents

Document Control

Function	Position	Name	Date
Approver	A&E Manager	Lucio Favotto	30.01.2022

Revision	Issue Date	Revision Description
1.0	30.01.2022	UGLRL Operational Standards Template applied; First approved and issued UGLRL version

Summary of changes made from previous version

Section	Summary of change
All	This document is based on the previous rail infrastructure maintainer (RIM). Full revision history is available on request from UGLRL.

1 Introduction

1.1 About this standard

This standard is a freight vehicle interface standard, covering the minimum technical requirements for the operation of freight vehicles on the NSW Country Regional Rail Network (CRN).

UGL Regional Linx Pty Ltd (UGLRL) has established interface requirements pertaining to all rail vehicles operating on the CRN. The requirements in this standard shall be read in conjunction with CRN RS 008, General Interface Requirements for Rolling Stock and CRN RS 010, Vehicle Acceptance Test and Inspection Requirements.

Users of this interface standard, be it owner/operators, designers, manufacturers, suppliers or maintainers of rail vehicles, or their component parts, are responsible for making their own enquiries in relation the applicability of this standard, as well as related national standards, guidelines and codes of practice, to their own situation or need. This standard was prepared with an awareness of known rail vehicle interface risks and seeks to address each of those risks, however it is the end users' duty of care, in preparing their own specifications, designs, processes and procedures, to assess the risks associated with and/or peculiar to their own situation.

When the words "shall" or "must" are used in this document, the requirements shall be read as mandatory for vehicles operating on the CRN.

When the word "should" is used in this document, the requirements shall be read as recommended.

When the word "may" is used in this document, the requirements shall be read as advisory.

The requirements of this standard will apply to all new, substantially modified freight vehicles and freight vehicles that have not operated previously on the CRN. Older freight vehicles with a historical background may not comply completely with this standard but will be assessed, considering the design and proposed use of the freight vehicle(s).

In this standard, the terms "owner", "operator" and "owner/operator" are used. They refer to the owner of the rolling stock, the operator using that rolling stock or, where both owner and operator are the one organisation.

1.2 Rolling stock standards suite

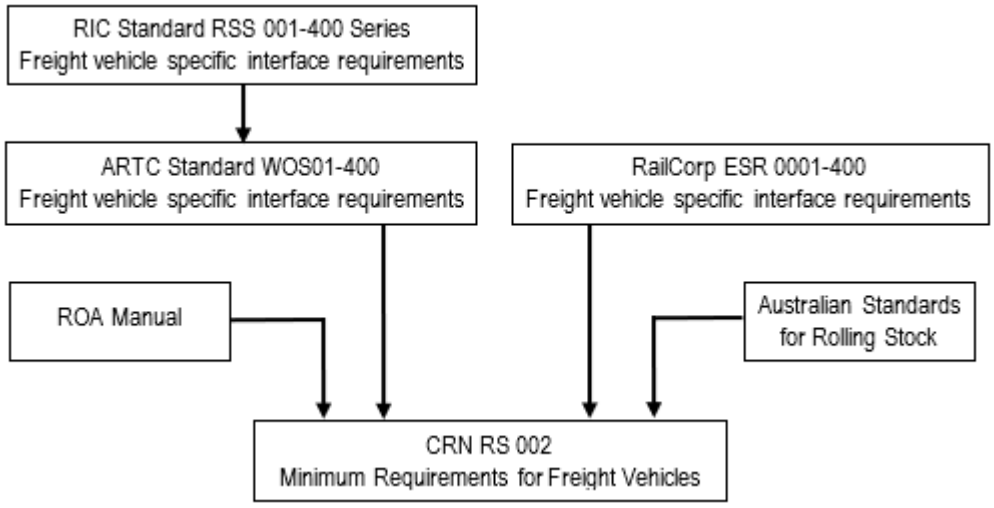
This standard is a part of a suite of rolling stock standards covering the interface between rolling stock and the CRN operating environment. The following documents form the core standards suite.

CRN RS 001	Minimum Operating Requirements for Locomotives
CRN RS 002	Minimum Operating Requirements for Freight Vehicles
CRN RS 003	Minimum Operating Requirements for Locomotives Hauled Passenger Vehicles
CRN RS 004	Minimum Operating Requirements for Multiple Unit Trains
CRN RS 005	Minimum Operating Requirements for Rail Bound Infrastructure Maintenance Vehicles
CRN RS 006	Minimum Operating Requirements for Road/Rail Infrastructure Maintenance Vehicles
CRN RS 008	General Interface Requirements for Rolling Stock
CRN RS 010	Vehicle Acceptance Test and Inspection Requirements

1.3 Standard development

This CRN standard was developed from existing standards that were originally issued by the Rail Infrastructure Corporation to the ARTC for the technical management of rolling stock operating on the NSW country and defined interstate network. Those standards have been further enhanced

and updated using relevant data from current RailCorp interface standards, the ROA Manual and the Australian Standards for Rolling Stock. The following flow chart shows the origins and development stages of the standard



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1.4 Australian Standards for Railway Rolling Stock

The RISSB (Rail Industry Safety and Standards Board), is currently producing the Australian Standards for Railway Rolling Stock which will eventually supersede the Railways of Australia (ROA Manual of Engineering Standards and Practices.

The current listing of Australian Standards for Railway Rolling Stock can be found on the website: www.rissb.com.au. The listed standards are categorised as being “Published”, “For Comment” or “Future”.

Australian Standards for Railway Rolling Stock are available from SAI Global Ltd. https://www.saiglobal.com/standards/

This standard refers to the relevant Australian Standard, where applicable.

1.5 Definition of a freight vehicle

For the purposes of interpretation of this standard a freight vehicle is a vehicle designed to carry general and intermodal freight or a variety of bulk commodities. Freight vehicles are marshalled together to form a train which is hauled by one or more locomotives.

1.6 Freight vehicle design

Freight vehicle design must generally comply with the interface requirements of this minimum operating standard. Where the Australian Standards for Railway Rolling Stock have been published, then compliance may be required with those standards also.

The ROA Manual of Engineering Standards and Practices was produced primarily to cover new or substantially modified vehicles operating on the interstate standard gauge rail network, therefore reference is also made to, and excerpts are included from the ROA Manual of Engineering Standards and Practices, where applicable.

The design of any rail vehicle shall also take into account the requirements of NSW Work Health and Safety legislation. Ongoing compliance with NSW Work Health and Safety requirements are the responsibility of the vehicle owner/operator.

The design of any freight vehicle shall take into account and demonstrate compliance with the requirements of relevant environmental legislation, in particular those requirements relating to noise and vibration.

As of 30 January 2022, newly introduced or substantially modified freight vehicles shall be subject to review and assessment, by the CRN, for compliance with the relevant standards and legislation. Freight vehicle owner/operators will be required to submit the necessary documentary evidence to verify that their freight vehicle is compliant.

Freight vehicles that do not fully comply with the standards and legislative requirements will be subject to critical review and in some cases may be permitted to operate under nominated restrictions as determined by the CRN Manager.

An Exemption Certificate may be issued for non-compliances with these standards, where the CRN Manager deems that the non-compliance is acceptable and does not compromise safety or relevant legislation.

1.7 Freight vehicles authorised to operate on the NSW Country Regional Network

Only freight vehicles approved to operate on the New South Wales rail network, accepted by the CRN Manager and registered with an accredited owner/operator by the Office of the National Rail Safety Regulator (ONRSR) will be permitted to operate on the CRN.

Freight vehicle owner/operators shall be responsible for registering each vehicle type they wish to operate with the ONRSR.

Freight vehicle owner/operators shall be responsible for obtaining vehicle acceptance for operation on the CRN.

Freight vehicles, to be fully accepted on to the CRN, must have relevant operating details published in the CRN Train Operating Conditions (TOC) Manual. (For interim or conditional acceptance, see below.)

Freight vehicles not published in the CRN Train Operating Conditions manual shall not be operated or moved on the CRN unless special approval in the form of a CRN TOC Waiver is issued. This approval is required for any movement including that of freight vehicles undergoing tests.

Freight vehicles with a defect as specified herein, sufficient for that freight vehicle to be removed from service, detected or known to be operating, on an adjacent rail network, shall not enter the CRN without the authority of the CRN Manager.

All freight vehicles must be maintained in a condition that meets or exceeds the minimum operating requirements contained in this standard. Where it is deemed that the condition of a freight vehicle has deteriorated below these minimum requirements, then the authority to operate that vehicle on the CRN may be withdrawn until it can be demonstrated that the freight vehicle roadworthiness has been reinstated.

1.8 Acceptance of new freight vehicles

To apply for new freight vehicle acceptance, the owner/operator shall complete the appropriate Vehicle Certification Request Form CRN RF 002, and submit it to the CRN Manager.

Where testing is to be conducted on the freight vehicle/s, refer to section 1.10 below.

Once a vehicle has been approved, details of the vehicle will then be published in the CRN Train Operating Conditions manual along with any special operating conditions.

Vehicle acceptance is for vehicle type compatibility with the CRN only, and does not warrant the structural integrity of all vehicles of that type, based on design and/or construction. Vehicle acceptance for operation on the CRN requires that such vehicles continue to be maintained fit for purpose, in accordance with the accredited Owner/Operators' vehicle maintenance standards.

1.9 Change of freight vehicle design or operating conditions

Where a freight vehicle has been modified or is proposed to be modified, such that the modification is going to impact on the vehicle's performance then the owner/operator must advise the CRN Manager and apply for a vehicle re-approval.

This applies to any modifications that may affect vehicle on-track performance such as flexibility of a vehicle structure, suspension stiffness, braking performance, increase in adhesion performance, loading of the vehicle, etc.

1.10 Testing of freight vehicles

Testing of any freight vehicle/s on the CRN shall not be carried out without the prior approval of the CRN Manager and the issuance of an appropriate CRN TOC Waiver.

New or substantially modified freight vehicles shall successfully undergo type testing in accordance with the guidelines and tests specified in CRN Standards CRN RS 008 and CRN RS 010, respectively, being conducted prior to acceptance, to confirm safe operation and compliance with the appropriate environmental requirements.

All of the static tests must be satisfactorily completed before the freight vehicle will be permitted to move on the CRN.

The CRN Manager reserves the right to:

- have a representative present for each of the tests.
- request the owner/operator to conduct further testing where it is suspected that the freight vehicle performance has deteriorated.
- have access to all relevant raw test data (this may apply to a number of tests).

Once the CRN Manager is satisfied with the performance of the freight vehicle/s, further testing may be carried out at the discretion of the owner/operator but only with prior notification and agreement of the CRN Manager.

For freight vehicles tested on the CRN or tested on other rail systems, the test results shall be submitted to CRN Manager for assessment, using the appropriate Freight Vehicle Information Pack listed above.

2 Freight vehicle components

The following sections cover component requirements which are specific to the operating safety of freight vehicles. Refer to CRN Standards CRN RS 008 and CRN RS 010 for general interface requirements and testing requirements, respectively.

3 Wheels

Reference: AS7514.2 Wheels.

This unit specifies the design, manufacture, and minimum operational requirements for integral steel wheels and tyred wheels on vehicles operating on the CRN network.

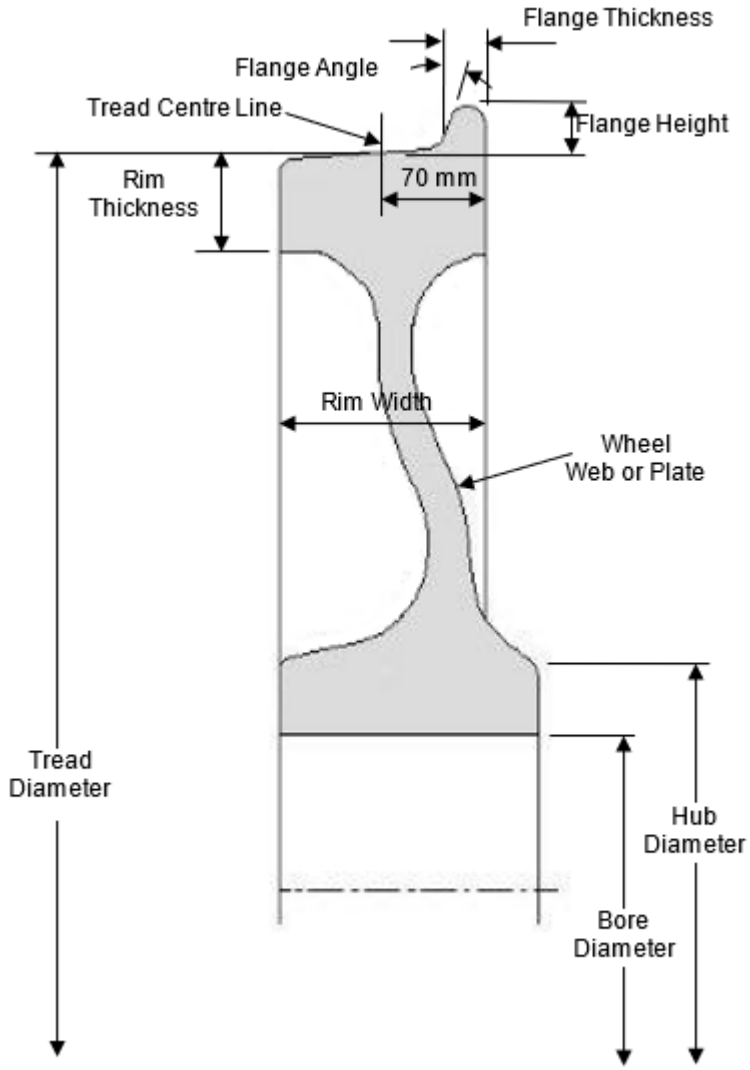


Figure 1 - Wheel parts and principal dimensions

3.1 Wheel diameter

The wheel diameter is measured at the wheel tread centre line, which is 70 mm from the back face of the wheel, as shown on the relevant profile drawing.

In determining and/or approving freight vehicle operating conditions, the CRN Manager will consider maximum axle load and the maximum P/D ratio, (ie the ratio of maximum static wheel load to minimum [worn] wheel diameter).

The maximum allowable P/D ratios for operation of worn wheels on the CRN are specified in CRN Standard CRN RS 008, Section 3.4 Table 2

Where it is proposed to operate freight vehicles having P/D ratios exceeding these limits, approval must be obtained from the CRN Manager.

Refer to CRN Standard CRN RS 008, Section 3.4 Table 3 for currently approved bogie/wheel load/wheel diameter combinations for new wheels.

3.2 Wheel width

Reference: AS7514 .2 Section 3.1

Wheel overall width, measured from the back of the flange to the wheel rim face, shall nominally range from 130 mm to 140 mm, with 140 mm being preferred, and mandatory for existing axle loads of 25 tonnes and above and all new freight vehicles.

3.3 Wheel Web Shape

Reference: AS7514.2 Section 3.3

Low stress wheels with S-shaped web are preferred for all rolling stock where tread braking is performed.

Low stress wheels with S-shaped web shall be used for all AAR Class C wheel material applications where tread braking is performed.

Conventional curved web wheels (parabolic web) are acceptable for AAR Class A and B wheel material applications.

Straight webbed wheels are to be avoided on tread braked vehicles where possible.

3.4 Alternate wheel designs

Alternate design methods may be used for integral steel wheels only, however, such proposals shall be subject to review by the CRN Manager.

This review will require submission of an analysis and the relevant technical information required by AAR Standard S660 - Procedure for Analytic Evaluation of Loco and Freight Car Wheel Designs, however the application of loads, rim condemning thickness and wheel profiles shall relate to the local conditions and the final approval shall be at the discretion of the CRN Manager.

3.5 Wheel manufacture

Reference: AS7514 Section 8

Wheels shall be manufactured in accordance with the processes described in AAR specifications M 107/M 208, or EN 13262, or UIC 812-3, or other equivalent standard.

Note that the above clause is strictly about the basic manufacturing process, and ancillary requirements contained in the referenced standards (such as certification by nominated bodies) are not applicable.

3.6 Wheel material

Reference: AS7514.2 Section 9

The following wheel materials are acceptable:

- AAR M-107/M-208, class A, B and C
- EN 13262, grade ER7, ER8 and ER9
- UIC 812-3, grade R7, R8 and R9
- Microalloy Class B
- Microalloy Class C

Details of the mechanical properties of Microalloy Class B & C can be found in AS 7514.2 Section 9.

3.7 Brake block compatibility

Reference: AS7514.2 Section 11

Only the combinations of wheel material and brake block type shown in Table 1 are recommended, in order to reduce the incidence of thermal tread damage.

Type of brake block	Dynamic coefficient of friction	Class of wheel
Low friction	< 0.2	AAR Class A or equivalent
Medium friction	0.2 – 0.25	AAR Class A or equivalent
High friction	>= 0.25	AAR Class A, B or C or equivalent
Cast iron		AAR Class A, B or C or equivalent

Table 1 - Wheel material brake block compatibility

Refer to CRN Standard CRN RS008, Section 7, for brake block friction characteristics.

3.8 Wheel identification

Reference: AS7514.2 Section 14.1 for new wheel designs and Section 14.2 for existing wheel designs.

New wheels shall be branded with the following marks:

- Manufacturer's mark
- Cast number, or serial number which can be identified with the specific cast, or both cast and serial number
- Steel grade
- Month and two last figures of the year of production

For wheels operating at speeds over 120 km/h: position of residual imbalance and its symbol

The wheel marking arrangement should comply with one of the following:

- Be marked on the hub-web fillet as shown in Figure 2
- Be marked on the hub front or back face according to AAR Specification M-107/M-208 Figure B.5 or ISO 1005-6 Figure 1
- Be cast on the web as per ISO 1005-6 Figure 2.

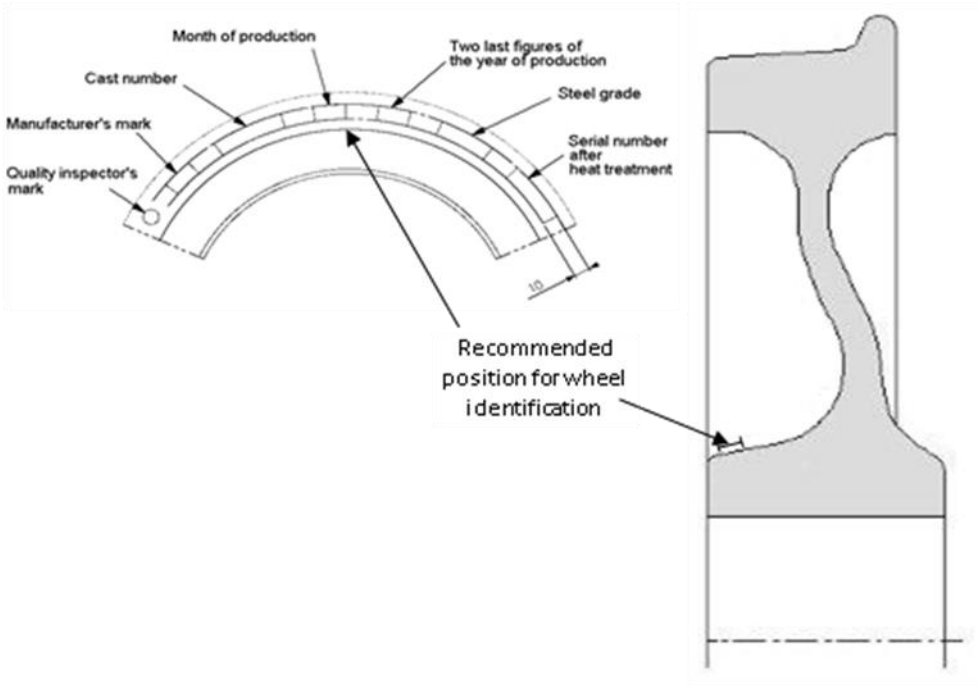


Figure 2 - Wheel identification

Replacement new wheels for existing wheel designs should be clearly branded on the hub or cast on the web with the following information:

- Manufacturer's mark
- Cast number, or serial number which can be identified with the specific cast, or both cast and serial number

3.9 Wheel profiles

Reference: AS7514.2 Section 7

The following wheel profiles are approved for use on the CRN.

3.9.1 WPR 2000 wheel tread profile

The WRP 2000 wheel tread profile is a generated worn wheel profile designed to match the prominent NSW worn rail profile. Refer to AS 7514.2 Appendix C for co-ordinate details for the WPR2000 wheel tread profile. Whilst this worn wheel profile was developed with a view to providing increased wheel life, in-service experience has shown that some freight vehicles are sensitive to the higher conicity produced at the root radius resulting in bogie hunting instability. If freight vehicles are prone to hunting with the WPR2000 profile, the ANZR1 profile may be used as a substitute.

The 7/8 flange variant of the WPR 2000 profile is also permitted on the CRN.

3.9.2 Test profile

For the test wheel tread profile refer to CRN Standard CRN RS 010 Section 19.3.

3.9.3 Standard ANZR profile (also known as the ANZR-1 profile)

This profile is depicted in Figure 3 below and is the base standard profile for all rolling stock operating on the CRN.

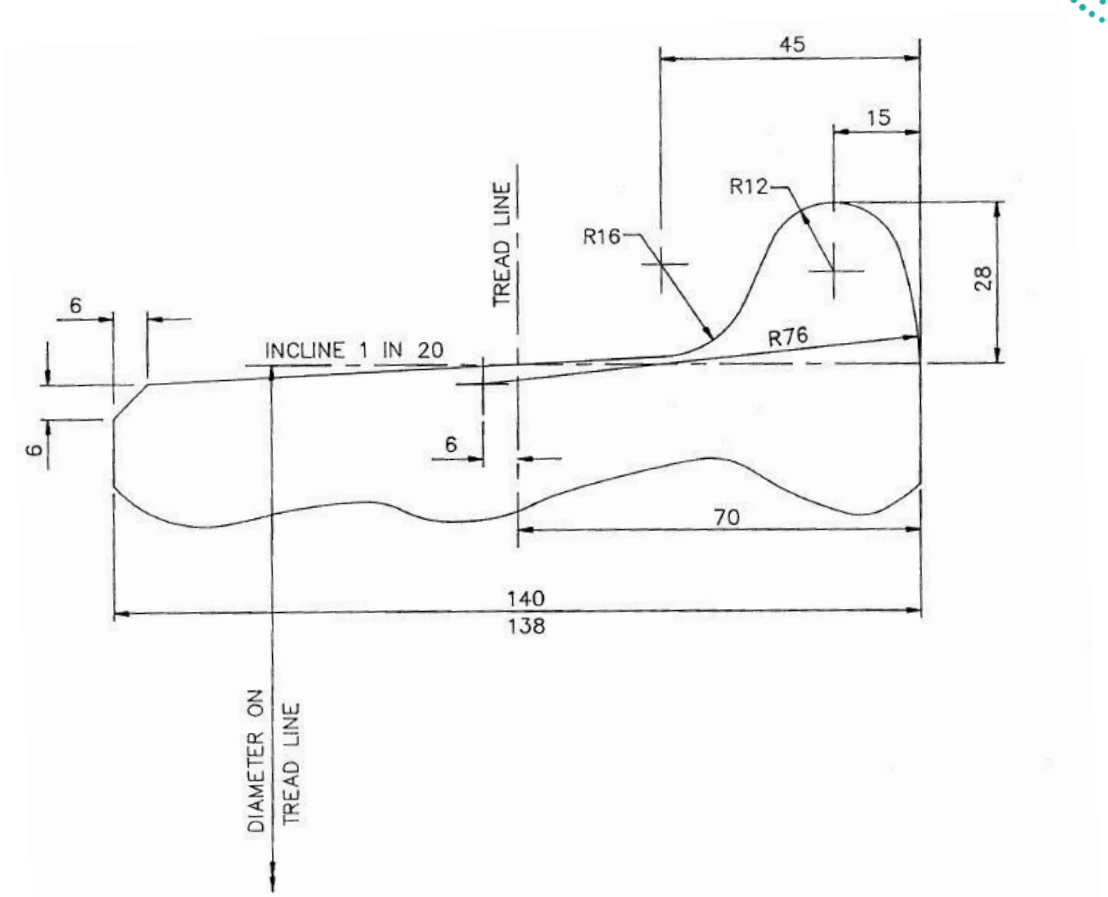


Figure 3 - ANZR1 Wheel Tread Profile

The 7/8 flange variant of the ANZR profile is also permitted on the CRN.

3.9.4 Alternate wheel tread profiles

Alternate wheel tread profiles will be considered, however, such proposals must be compatible with the rail profile and the CRN rail management methods and can only be used with the approval of the CRN Manager.

3.10 Wheel profile machining

3.10.1 Surface Finish

It is important when machining the wheel tread and flange profile that the surface finish be maintained within acceptable limits. This is to ensure that surfaces which normally contact the rail and/or check rail are smooth, free of machine chatter marks, surface waviness or grooving, which could contribute to a wheel flange climb derailment.

The surface finish of the wheel tread and flange, after machining shall not exceed 12.5 µm (micrometres) RA (Roughness Average).

3.10.2 Machine tolerance & undercutting

The profile of a freshly machined wheel tread and flange shall not deviate below the true profile by more than 0.25 mm. That is, it shall not be possible to insert a 0.25 mm feeler gauge beneath a profile gauge positioned on the wheel tread.

Undercutting, grooving or waviness of the tread surface between the flange back and the outer edge of the tread, is permitted but shall not exceed 0.25 mm in depth below the true tread profile.

3.10.3 Witness marks

Witness marks used for an indication of machining efficiency, are permitted between the flange tip and a point 10 mm above the wheel tread baseline and shall not exceed 1.2 mm in depth. It's contour shall be smooth and blend evenly into the wheel flange profile..

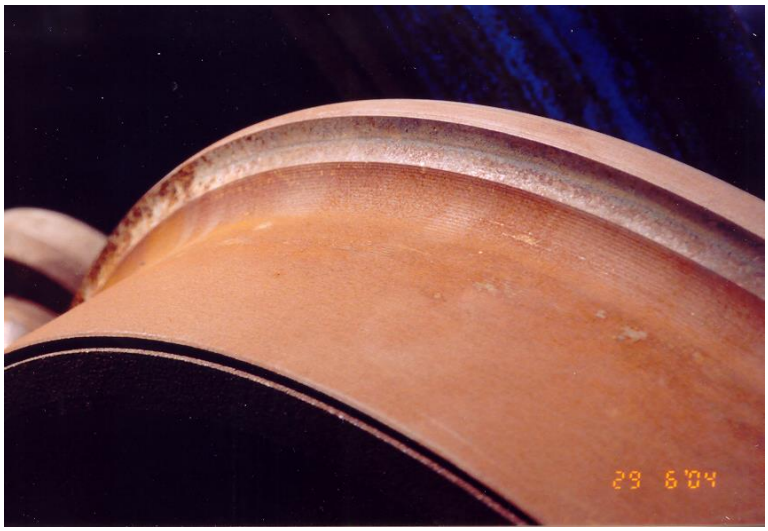


Figure 4 - An unacceptable witness mark

Witness marks permitted shall only be as a result of the wheel machining process, where the witness mark represents a section of the wheel surface which has not been machined, and contains the original surface material surface. Refer to Figures 4 and 5 for unacceptable and acceptable witness marks, respectively.

Witness marks shall not include wheel damage from derailments etc. or an incorrect machining process.

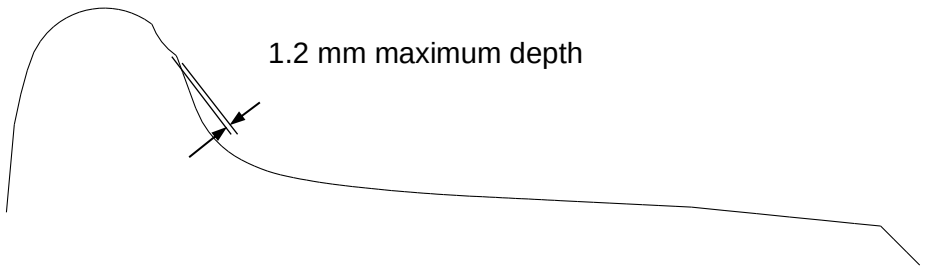


Figure 5 -Witness mark dimensional limit

3.11 Tyred wheels

3.11.1 Freight vehicles fitted with tyred wheels

Reference: AS7514.2 Section 15

Tyred wheels shall be only used on heritage rolling stock where such vehicles were originally equipped with tyred wheels.

Tyred wheels shall be assembled so that all components remain in place for the service life of the wheel.

The tyre and the rim of the wheel centre should have two adjacent punch marks, as a tyre-rim displacement indicator.

3.11.2 Brake block compatibility with tyred wheels

Reference: AS7514.2 Section 11

Only cast iron brake blocks shall be used with tyred wheels.

3.12 Wheel generated noise

Reference: AS7514.2 Section 6

Noise pollution has become an important environmental issue for the rail system as a whole, and owners/operators are encouraged to seek a wheel design that attenuates wheel noise emissions such as curve squeal.

3.13 Wheel minimum operating requirements

The following describes the minimum dimensional limits under which freight vehicle integral steel wheels may continue in service. For wheel defects and operating restrictions imposed for defective wheels found in service refer to CRN Standard CRN RS 015.

3.13.1 Wheel rim thickness limits

Reference: AS7514.2 Section 3.2

A freight vehicle shall not remain in service if it has a wheel rim thickness less than the limit specified below.

Vehicle Type	Minimum wheel rim thickness
Freight vehicles up to 25 tonne axle load	20 mm
Freight vehicles over 25 tonne axle load	22 mm

Table 2 - Minimum wheel rim thickness

3.13.2 Wheel defects and defect limits

For wheel defects, defect limits and risk mitigation measures refer to CRN Standard CRN RS 015.

4 Axles

Reference: AS7515.2 Axles

4.1 Axle Design

Reference: AS7515.2 Section 2

Axles shall be designed for infinite life.

Suitable design methods for conventional wheelsets include the following:

- Selecting from the standard dimensions given in AAR RP-632 paragraph 3.3.9 and RP-633 figures 4.1, 4.2, 4.4 & 4.12.
- EN 13103
- JIS E 4501
- AAR Modified Reuleaux method.

Alternate design methods may be used; however, such proposals shall be subject to approval by the CRN Manager.

4.2 Axle manufacture

Reference: AS7515.2 Section 2

The axle manufacturing process shall produce axles having:

- The material properties as required by Section 4,

- The dimensions as required by the axle design.
- Specifications for axle manufacture geometrical and dimensional tolerance limits can be found in AAR RP-633, ISO 1005/9, EN 13261 and JIS E 4502-2.
- The surface finish and corrosion protection as required by the axle design.
- The internal and surface defects within the limits as prescribed by AAR Specification M-101, or EN 13261, or other equivalent standard.

4.3 Axle remanufacture

Reference: AS7515.2 Section 11

Reclamation or modification of AAR-based axles shall be in accordance with AAR Specification S-659 Rules 1.1, 1.2 and Recommended Practice RP-631 Section 2.1.

Any other proposal for the reclamation of axles must first be approved by the CRN Manager.

4.4 Axle material

Reference: AS7515 Section 3

Bar for steel axles shall be produced from one of the following recommended grades of steel.

Australian Standard grades of steel suitable for axles are:

- AS 1448/K5 (fine grain size)
- AS 1442/5FG
- AS 1444/4340 FG
- AS 1444/4340 should exhibit the following properties:
- Min. Yield Strength 770 MPa
- Min. Tensile Strength 980 MPa
- Min. Elongation 14%
- Min. Reduction in Area 40%
- Izod Impact Value (20ºC) 40 J

Overseas grades of steel suitable for axles are prescribed in AAR Specification M-101, ISO 1005/3, EN 13261 and JIS E 4502-1.

4.5 Axle identification

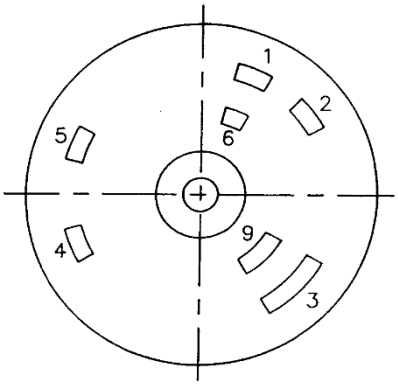
Reference: AS7515.2 Section 5.1 for new axles and Section 5.2 for existing axles.

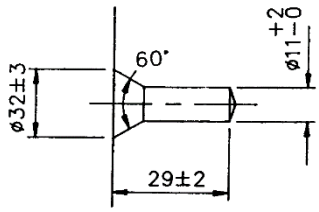
Operators shall ensure that each of their rolling stock axles has a unique identification.

After machining of the ends, axles should be distinctly branded at one end with the manufacturer's name or initials and the heat number.

A unique serial number should be stamped at both ends of the axle.

The marking arrangements shown in Figure 6 are suitable examples for solid axles.





DETAIL OF CENTRE

1. OWNER'S INITIALS.
2. MANUFACTURER'S NAME OR INITIALS.
3. AXLE SERIAL NUMBER. (ALLOTTED BY SYSTEM OR MANUFACTURER)
4. HEAT NUMBER
5. YEAR ULTRASONICALLY OR MAGNETICALLY TESTED.
6. WHEEL MOUNTING FIRM'S NAME OR INITIALS.
7. SIZE OF BRANDING 5mm MIN. TO 8mm MAX.
8. THE AXLE NUMBER SHALL BE STAMPED ON BOTH, THE LEFT AND RIGHT HAND ENDS OF THE AXLE. ALL OTHER BRANDINGS SHALL BE ON THE RIGHT HAND END OF THE AXLE ONLY.
9. L AND R TO BE STAMPED ON THE LEFT AND RIGHT HAND ENDS OF EACH AXLE.

NOTE: TO FACILITATE ULTRASONIC TESTING ALL BRANDING TO BE DRESSED FLUSH.

Figure 6 - Recommended axle Identification Method

The Operator shall keep records of chemical and physical test results for each batch of steel used in axle manufacture.

The axle steel batch records should be retained until axle disposal.

The axle steel batch test results should be traceable to the serial numbers marked on the axles.

4.6 Axle minimum operating requirements

The following describes the minimum allowable conditions under which solid forged steel axles may continue in service.

4.6.1 Axle condemning diameters

Reference: AS7515.2 Section 10

Vehicle owner/operators shall develop and comply with criteria that define when an axle should be condemned.

No axles shall be permitted to enter service if the axle size falls below the condemning diameter specified for that part of the axle.

Refer to Clause 4.3 above for axle remanufacture requirements.

4.6.2 Welding on axles

Reference: AS7515.2 Section 10

An axle is a component subject to fatigue loading due to cyclic bending and torsional reversals during normal operation, therefore under no circumstances is welding permitted on any part of an axle.

4.6.3 Axle defects

Reference: AS7515.2 Section 8

CRN Requirement:

The following axle defects will require a freight vehicle axle to be immediately removed from service. Defects may consist of scoring, grooves, scratches, flame cutting marks, welding, grinding, chisel marks or similar indentations.

- Any axle defect greater than 3 mm deep which has a sharp edge or base, no radius evident on either side or at the base of the imperfection, has a pronounced lip adjacent to the imperfection, or any doubt exists as to the depth of the defect.
- Any axle defect greater than 5 mm deep.
- Any axle with visible cracks in the axle body, either between the wheel seats or adjacent to the wheel hub.
- Any axle which is bent, suspected of being bent, damaged due to overheating through bearing failure, or otherwise distorted.

Where the following defect is detected on an operational freight vehicle axle, the freight vehicle is to be worked out of service for repairs:

- Any freight vehicle with an axle defect greater than 3 mm deep, but less than 5 mm deep which has smooth even wear, is well radiused, and does not have any other imperfection such as a lip or roll over on the edge of the damaged area. If any doubt exists as to the severity of this defect, the freight vehicle shall be immediately removed from service.

4.6.4 Action following derailment

Reference: AS7515.2 Section 9

Operators shall develop and comply with criteria that define when an axle should be checked following a derailment.

In the absence of specific criteria, axles which have been involved in a derailment where a wheelset is derailed for more than 60 metres, or at greater than 15 km/h, or other abnormal conditions, shall be checked.

Post-derailment axle checks shall involve an assessment of bending or distortion using a three point test of the rim to rim distance, or by measuring the run-out as the axle is revolved between centres or on its own bearings.

Post-derailment axle checks shall involve a detailed inspection for surface damage and cracking.

4.6.5 Service life of existing axles

Reference: AS7515.2 Section 12

Operators shall develop and implement auditable assessments regarding whether existing axles are safe to remain in service.

The use of an existing axle shall be based on an assessment of the risk of failure for that axle.

Elements that should be considered in the axle risk assessment include:

- available manufacturing information,
- proposed service duty,
- service history of the particular axle,
- non-destructive testing information, and
- history of axle failure with this or similar axle designs.

5 Axle bearings

Reference: AS7516.2 Axle Bearings

With the design and selection of freight vehicle roller bearings, due regard shall be given to the fatigue life of the bearing assembly, taking into account all the factors relevant to the application.

Axle roller bearing assemblies shall be operated within their designed load capacity.

5.1 Approved axle roller bearings

Reference: AS7516.2 Section 3.1

Only roller bearings, including package unit bearings, with a proven reliability in an Australian mainline railway operating environment, for a particular bearing application, shall be used.

Where bearings are proposed which fall outside that specified above, the owner/operator shall advise the CRN Manager and indicate the proposed method of testing/evaluation of such bearings to substantiate their reliability and suitability for the application.

5.2 Approved package unit bearings

Reference: AS7516.2 Section 3.2

Package axle bearings should comply with either AAR Specification M-934, or an internationally recognised rail industry equivalent.

Package axle bearings should be of the no field lubrication (NFL) type.

All component parts of NFL package axle bearing assemblies shall have the design capability of completing the service period without maintenance attention.

5.3 Sealing of axle bearings

Reference: AS7516.2 Section 3.4

Seals shall be provided on axleboxes and axle bearings to exclude contaminants and retain lubricant under the full range of service and workshop conditions.

Package axle bearings shall be fitted with seals complying with AAR Specification M-959, or equivalent, unless an axlebox with sealing is fitted.

5.4 Axleboxes and adaptors

Reference: AS7516.2 Section 3.5

Axleboxes and adaptors shall:

- Locate the wheelset throughout the full service period.
- House and transfer the loads to the axle bearing without any damaging misalignment or concentrated loading.
- Withstand the peak and fatigue loads applied throughout the full service period.

Package axle bearing adaptors, where used with AAR or equivalent type side frames, shall have the bearing mating surface in accordance with AAR Specifications M-924 and suiting the axle bearing being used.

5.5 Axle roller bearing maintenance

Reference: AS7516.2 Section 9

The owner/operator shall follow proven industry standards and have procedures in place for the following maintenance activities:

- Installation and removal of roller bearing assemblies to and from axles.

- Lubrication of axle roller bearing assemblies.
- Remanufacture of axle roller bearing assemblies, where applicable.
- Requalification of axle journals, axle boxes and bearing adaptors.
- Regular field inspection of axle roller bearing assemblies for defects.
- Field adjustment of axle roller bearing assemblies where applicable.

5.6 Axle roller bearing defects detected in the field

Reference: AS7516.2 Section 6

Axle roller bearing assemblies with any defects as listed below shall not enter service or if found in service, shall be removed from service for maintenance attention.

- Loose, misaligned, visibly damaged or distorted seals or where there is evidence of recent leakage or loss of grease
- Damaged or distorted end cap or locking plate (where applicable)
- Loose or missing cap screws or locking plate (where applicable)
- Visible evidence of overheating or a temperature at inspection considerably greater than that of the other bearings in the same bogie or freight vehicle.
- Visible evidence of water damage, submersion or penetration
- Visible evidence of damage caused by arc welding, flame cutting, etc.
- Any other visible evidence or Indication of external damage
- Loose or damaged backing ring or back cover and/or fixings (where applicable)
- Loose, missing or damaged end plugs or grease nipples (where applicable)

5.7 Action required following derailments for axle roller bearings

Reference: AS7516.2 Section 7

The owner/operator shall have procedures in place for bearing inspection and requalification following any derailment, in order to mitigate the risk of future premature in-service failure of bearing components.

5.8 Axlebox plain bearing assemblies

Reference: AS7516.2 Section 3.3

Plain axle bearings should not be used for new designs.

CRN requirements:

Plain bearing applications shall be limited to heritage freight vehicles and such vehicles shall not operate on the CRN without the approval of the CRN manager.

Plain bearing assemblies, where used, shall be operated within their design capacity.

5.8.1 Plain bearing maintenance

Reference: As7516.2 Section 9.2

The owner/operator shall follow proven industry standards and have procedures in place for the following maintenance activities:

- Installation of plain bearing assembly and axlebox.
- Lubrication of plain bearing assembly, including maintenance of oil at the correct level, and prevention of water ingress.

- Operational life, and replacement of bearing brass.
- Operational life, preparation and replacement of lubricator or wick.
- Operational life of wedge.
- Operational life of axle journal.
- The regular inspection of plain bearing axlebox assemblies for defects.

5.8.2 Plain bearing axlebox assembly defects

Reference: AS7516.2 Section 6.3

The owner/operator shall not place or continue in service a freight vehicle with the following defects:

- A plain bearing axlebox containing no visible free oil.
- A plain bearing axlebox which has a lid missing, broken or open, except to receive servicing.
- A plain bearing axlebox containing foreign matter, such as dirt, sand, or coal dust that can reasonably be expected to damage the bearing, or have a detrimental effect on the lubrication of the journal and the bearing.

5.8.3 Plain bearing journal lubrication system defects

Reference: AS7516.2 Section 6.3

The owner/operator shall not place or continue in service a freight vehicle with the following defects:

- Lubricating pads with a tear extending half the length or width of the pad or more.
- Lubricating pads showing evidence of being scorched, burned or glazed.
- Lubricating pads which contain decaying or deteriorated fabric impairing proper lubrication of the pad.
- Lubrication pads contaminated by grease.
- Lubricator pads with an exposed centre core, except by design.
- Lubricator pads with metal parts contacting the journal.
- Lubricator pads which are missing or not in contact with the journal

5.8.4 Plain bearing defects

Reference: AS7516.2 Section 6.3

The owner/operator shall not place or continue in service a freight vehicle with the following defects:

- A plain bearing which is missing, cracked or broken.
- A plain bearing liner which is loose, or has a piece broken out.
- A plain bearing showing signs of having been overheated, as evidenced by melted babbitt, smoke from hot oil, or journal surface damage

5.8.5 Plain bearing wedge defects

Reference: AS7516.2 Section 6.3

The owner/operator shall not place or continue in service a freight vehicle with the following defects:

- A plain bearing wedge that is missing, cracked or broken.

- A plain bearing wedge that is not located in its designed position.

6 Wheelsets

Reference: AS7517.2 - Wheelsets

6.1 Wheel and axle assembly

Reference: AS7517.2 Section 2

Wheels may be press fitted or shrink fitted onto axles.

The method for assembling wheels onto axles should address the following:

- Required wheel type to be fitted to the axle
- Confirmation of wheel bore and wheel seat geometric requirements
- Required temperature of components
- Lubricants to be used {if press fitted}
- Measurement equipment requirements
- Avoiding damage to wheelset component surfaces
- Wheel mounting peak press force limits {if press fitted}
- Wheel mounting press force curve characteristics {if press fitted}
- Proof load testing (if shrink fitted)

Methods of achieving a suitable assembly of wheels and axles for specific applications include the following:

- BS 5892 Part 6 Sections 4 and 5.
- EN 13260
- ISO 1005/7
- JIS E 4504
- AAR S-659 Rule 1.4 and RP-631 Section 2.3

Components other than wheels should be fitted onto wheelsets in accordance with the component manufacturer's instructions.

6.2 Wheel press-on lubricant

CRN requirement:

A proven wheel mount lubricant shall be used for wheelset assembly. Where a proposed lubricant is unproven under Australian conditions the application shall be subject to the approval of the CRN Manager.

WARNING

Some wheel mounting lubricants are affected by increased wheel temperatures due to braking, which may result in relative movement between wheel and axle.

Also some wheel mounting lubricants may affect electrical conductivity between wheel and axle and thus may compromise signal shunting

NOTE: Wheel mounting lubricant, Rocol Wheelmount Compound, has been used successfully, but approved alternatives may be used provided the wheel interference force on the axle wheel seat is not compromised.

6.3 Permissible Variation in Wheel Diameter

Reference: AS7517.2 Section 3.

CRN Requirement:

On freight vehicles, the diameter variation between wheels on the same axle shall be in accordance with freight vehicle manufacturer's requirements, but they shall not exceed that specified in Table 3.

Freight Vehicle Wheel	Maximum Variation in Wheel Tread Diameters
per axle (new or re-turned)	0.5mm
per bogie	25mm
per vehicle	60mm

Table 3 - Permitted variations in wheel diameter

6.4 Wheel back to back measurement

Reference: AS7517.2 Section 3

- Minimum 1357 mm
- Maximum 1360 mm

6.4.1 Measurement of loose wheelsets

The wheel back to back dimension shall be measured at three (3) points, equidistant around the back of the wheel rims at a point 40 mm below the outer circumference of the wheel flange. The measurements # between the two (2) wheels shall be within the following range.

The difference between any two (2) dimensions shall not exceed 1 mm.

6.4.2 Measurements of in-service wheelsets

Whilst wheelsets are in service, beneath a freight vehicle and the wheels are sitting on the rails under load, the wheel back to back dimension shall be measured where possible at four (4) points representing the 3 o'clock, 6 o'clock, 9 o'clock and 12 o'clock positions around the wheel, at a point 40 mm below the outer circumference of the flange. The dimensions measured at the 3 o'clock and 9 o'clock positions should be within the limits specified above whilst the dimensions measured at 6 o'clock and 12 o'clock may be outside the above limits. Note: This discrepancy is normal and is due to the axle deflection under load, resulting in the 12 o'clock dimension being larger than the 6 o'clock dimension.

When the freight vehicle is moved such that the wheelset is rotated 180 degrees, and the back to back is measured again at four (4) points representing the 3 o'clock, 6 o'clock, 9 o'clock and 12 o'clock positions, there shall not be more than 3 mm variation between the two (2) measurements taken at 6 o'clock and 12 o'clock, respectively.

6.4.3 AAR wheelsets with reduced back to back

The AAR wheelset design with a thick flange profile and reduced back to back dimension does not comply with AS 7517.2 Section 3. These wheelsets are not compatible with the NSW rail network and thus will not be permitted to operate on the CRN.

6.5 Wheelset assembly records

Reference: AS7517.2 Section 6

Operators shall ensure that each of their wheelsets has a unique identification.

The unique axle identification required by AS 7515.2 may be used as the unique identification for the assembled wheelset.

The outer hub of one or both wheels should be marked with the following:

- Wheelsets assembly facility unique identity code
- Wheelset assembly month and year
- Unique wheelset identity number

Operators shall ensure that wheelset assembly records are retained until wheelset disposal.

Wheelset assembly records shall include the following:

- Wheelset assembly facility
- Assembly date
- Wheelset unique identity
- Axle unique identity
- Wheels unique identity
- Wheel to axle interference fits if appropriate
- Wheel pressing on force curves if press fitted
- Lubricant used if press fitted and a choice permitted by the design
- Wheel test loads if shrink fitted
- Package bearing numbers if fitted

7 Bogie structural requirements

Reference: AS7519.2 Bogie Structural Requirements

Bogie frame components, in relation to freight vehicles, include, but are not limited to side frames, bolsters, spring planks, swing links, control rods, frame adaptors and other structural bogie components.

Bogies and their associated components shall be operated within their original design capacity and not overloaded.

7.1 Design and manufacture

Reference: AS7519.2 Section 3

Bogie designs which have been proven to be reliable under Australian operating conditions are recommended.

Designs for new unproven concepts, substantially modified bogies or bogies intended to be used in an alternate application where they will be subjected to higher loads, shall be designed in accordance with AS 7519.2.

7.1.1 Load cases

Load cases shall be developed for all loads acting independently or in combination on the bogie in the vertical, lateral and longitudinal directions, and reacted at suitable points as determined by the bogie design. The load cases shall be in the form of a force magnitude and number of cycles

reflecting the severity of the intended application. The loads shall have due regard for the track condition and geometry, intended bogie service life, operating speed, vehicle mass, and any other factors considered relevant.

7.1.2 Stress analysis

A stress analysis shall be performed using the developed load cases to ensure that all stresses on the bogie frame and associated components are within the safe working stress for the material used for construction.

In addition, a fatigue analysis shall be performed, using the relevant load case combinations to ensure that all stresses in the bogie frame and associated components do not exceed the endurance limit stress for the intended service life of the bogie.

7.1.3 Fatigue analysis

Fatigue analysis may be carried out in accordance with AAR Specification M-1001, Volume one, Chapter seven, Fatigue design of freight cars, Sections 7.1, 7.2, and 7.4.

This fatigue analysis shall use the AAR nominal stress method taking into account all relevant welded details as per the AAR Manual. Bogie dynamic fatigue testing shall be carried out, analysed and verified in accordance with Appendix A10 in the AAR Manual.

Alternate fatigue analysis methods which are rail industry accepted may be proposed.

7.1.4 Safe working stress

As a minimum requirement, the safe working stress shall be taken as follows:

- The maximum combined (principal) stress in the bogie structure shall be taken as one half (1/2) of the yield strength or one third (1/3) of the ultimate strength of the materials, whichever is the lesser.
- The maximum uni-axial stress shall be taken as one half (1/2) of the yield strength or one third (1/3) of the ultimate strength of the material, whichever is the lesser.
- The fatigue limit stress is the endurance limit stress for the specific component or joint being considered.

7.1.5 Load testing.

Load testing on a test rig may be used to validate any numerical stress analysis, or may be used as an alternative to numerical stress analysis. Fatigue testing on a test rig may be used to validate, or as an alternative to, numerical fatigue analysis.

7.2 Bogie frame component maintenance

Reference AS7519.2 Section 7

Operators shall establish and comply with criteria that define when and how bogies are to be checked and maintained so that they remain fit for purpose.

Typical maintenance activities include:

- Trammelling of bogie frames (where applicable).
- Non-destructive testing for cracks.
- Monitoring of cracks with due regard to their propagation rate and critical crack dimension.
- Repair of bogie frames and associated componentry including welding, straightening and heat treatment.
- Maintenance of pedestal opening and other component interface dimensions (where applicable).

- Failure mode and effect analysis to determine appropriate tests and schedules for detection and rectification of in-service defects.
- Maintenance of records for usage and remaining life of components.

7.3 Bogie frame/component defects

Reference AS7519.2 Section 8

Operators shall establish and comply with criteria that define when a vehicle has to be removed from service due to bogie defects.

In the absence of other specific criteria a vehicle shall be removed from service if any of the following defects are found:

- Bogie frames and associated components which have cracks which exceed their critical crack dimension.
- Bogie frames and associated components which are bent or distorted causing an imbalance in wheel loads, and/or incorrect tracking of the bogie.
- Loose, missing, or broken, rivets or Huck bolts which connect bolsters, transoms, headstocks, W-guards or other major bogie frame components.
- Timber bogie components which have split, or are rotted, compromising their integrity.

The owner/operator shall follow proven industry standards and have procedures in place for the regular monitoring of frame/component cracks with due regard to their propagation rate to ensure that the components are removed from service before the crack reaches a critical dimension.

7.4 Bogie frame/components, action required following derailments

Reference AS7519.2 Section 9

An Operator shall establish and comply with procedures that describe how bogies and associated structural components are to be inspected and requalified following a derailment or collision.

8 Bogie suspension

Reference: AS7518.2 - Suspension

This section covers the requirements applicable to freight vehicle suspension systems, including steel helical and friction snubbers and other damping devices. It specifies the design, manufacture, maintenance and operating conditions where appropriate.

8.1 Suspension coil springs design and manufacture

Reference: AS7518.2 Section 3.1.1

Springs shall be designed and manufactured in accordance with accepted industry standards for maximum fatigue life, without exceeding maximum stress when fully compressed. Acceptable standards are set out in AS 7518.2 Section 3.

8.2 Suspension spring defects

Reference: AS7518.2 Section 3.1.2

Inspection and maintenance procedures for coil springs typically include identification of any of the following that are likely to affect suspension performance or operating safety:

- Suspension springs are not missing, cracked or broken, misaligned or displaced within the spring seat.
- Coils are not heavily bruised or showing flat spots caused by coil binding, nicks, gouges, indentations or any corrosion with pit marks.

- Springs are of the correct number, type and capacity appropriate to the bogie model, vehicle class and maximum axle load.
- There is clearance between all adjacent coils in any load spring when loaded to the nominal maximum gross mass on rail.

Consideration is also typically given to (where applicable):

- Checking of suspension heights.
- Inspection of spring seats, suspension beams, liners or adaptors, etc. for wear or damage.
- Inspection of spring pockets for accumulations of dirt and debris that retains moisture.
- Inspect condition of resilient pads located in spring pockets.
- Replacement of springs in matched sets.

8.3 Resilient (rubber) suspension components

8.3.1 General

Reference: AS7518.2 Section 5.1

Resilient components include:

- Bushes as used in anti-roll bar drop-links, axlebox pivot bushes, damper end mountings, lateral control rods, traction links, etc.;
- Primary suspension springs, linear or conical laminated types;
- Air spring pedestals as auxiliary or emergency springs;
- 'Hourglass'-type secondary suspension springs;
- Progressive-rate bump stops including as used in constant-contact sidebearer components.

The design of resilient suspension components shall take into account the requirement for compliance with the twist test requirements in CRN RS 010, Section 4.

8.3.2 Resilient suspension design and manufacture

Reference: AS7518.2 Section 5.2

Resilient components shall be designed and manufactured in accordance with industry standards.

Acceptable standards are set out in AS 7518.2 Section 5.2.

8.3.3 Resilient suspension maintenance

Reference: AS7518.2 Section 5.3

Inspection and maintenance procedures for resilient components typically include identification of any of the following that are likely to affect suspension performance or operating safety:

- Resilient components that are missing, excessively worn, deformed, damaged, cracked or perished;
- Tearing or delamination between the resilient material and the backing plate;
- Distortion or deterioration of the resilient material due to excessive heat or contact with damaging chemicals or other substances;
- Proper clearances as per the bogie manufacturer instructions.

Where applicable, resilient components may need to be replaced in matched sets.

Resilient steel/rubber laminated springs are used in freight vehicle primary suspensions on passive steering bogies. In the majority of applications the resilient component provides minimal vertical

and lateral resilience but provides longitudinal suspension flexibility to permit the axle passive steering. Therefore the rubber element is a critical component for safe operation. The owner/operator shall follow proven industry standards and have procedures in place to ensure that resilient suspension components are periodically inspected and tested to prevent in-service failure and to maintain their required performance.

8.3.4 Resilient suspension defects

Reference: AS7518.2 Section 5.3

The owner/operator shall not place into service, or continue in service, resilient suspension components with the following defects:

- De-lamination between resilient material and any backing plate, which is likely to compromise suspension performance or operating safety.
- Distortion of resilient material due to the application of excessive heat or contact with detrimental chemical or other substances which is likely to compromise suspension performance or operating safety.
- Resilient material which is cracked or perished and thus likely to compromise suspension performance or operating safety.
- Resilient material which has incorrect characteristics for the application.
- A suspension element with any indication of buckling under vertical loading.

8.4 Suspension damping

Reference: AS7518.2 Section 4

The owner/operator shall follow accepted industry standards for the design and selection of damping devices to control suspension stability, whilst ensuring that track twist safety requirements are not compromised, for all conditions of loading and all serviceable states of freight vehicle wear.

Damping devices include but are not limited to vertical and lateral dampers as well as constant contact side bearers and axlebox/pedestal guides (coulomb damping).

8.4.1 Hydraulic damper inspection & maintenance

Reference: AS7518.2 Section 4.1.2

8.4.2 Friction damper inspection & maintenance

Reference: AS7518.2 Section 4.2.2

A damper is an important component of a freight vehicle suspension and requires regular inspection and replacement. Owner/operators shall have maintenance procedures which cater for the regular maintenance and re-qualification of suspension dampers to ensure optimum and safe freight vehicle ride performance.

Friction wedges shall not be reclaimed by welding.

Where friction wedge pockets are reclaimed by welding:

- All welding shall be ground to form a flat surface with no pronounced ridges.
- Undressed weld beads shall not be permitted in wedge pockets.

8.4.3 Friction damper defects

Reference: AS 7518.2 Section 4.2.3.

For all friction damping devices, the friction surfaces or wear plates shall not be lubricated or painted (except by design) under any circumstances. Dampers with lubricated or painted friction surfaces (except by design) shall not be permitted to enter service.

Friction dampers should not be permitted to enter service, and should be removed from service, for the following defects:

- Wear plates which are loose, missing (except by design), or worn beyond the manufacturer's condemning limit;
- Broken or missing friction dampers activating spring;
- Broken friction dampers unit;
- Seized friction wedge assembly;
- For axlebox / pedestal guide assemblies, loose wear plates that will allow foreign matter to lodge behind the wear plate, or missing wear plates on either the axlebox or the bogie pedestal.

A bogie shall not continue in service when any friction wedge worn beyond the manufacturer's condemning limit.

Freight vehicles exhibiting instability such as bogie hunting, bouncing or pitching shall have their suspension dampers checked for possible damage or failure.

8.4.4 Operation of vehicles with defective suspension damping.

If it is desired to continue moving vehicles with the defects specified above the load must be transhipped and the empty vehicle may proceed to the nearest repair location at the prevailing track speed limit not exceeding 50 km/h.

9 Bogie side bearers

All freight vehicles are fitted with side bearers which assist in controlling body rock. There are gapped side bearers and constant contact side bearers with the latter providing bogie rotational resistance.

9.1 Gapped side bearers

Whilst the role of a side bearer is to provide freight vehicle body roll of rock stability it is important that the gap provided, be sufficient to allow the freight vehicle to safely accommodate track twist.

The owner/operator shall have procedures in place to monitor and maintain the correct side bearer gap of 10-14 mm, with the combined side bearer clearance within 17 mm to 31 mm.

9.2 Constant contact side bearers

Constant contact side bearers are fitted to freight vehicles to enhance their lateral stability at speeds typically greater than 80 km/h. They consist of a resilient suspension element mounted to the bogie bolsters, typically at 1270mm centres, such that the wearing surface is in constant contact with the wagon underframe side bearer bracket to provide increased bogie rotational resistance via sliding friction.

Constant contact side bearers are designed to support a portion of the freight vehicle load and at the same time permit bogie rotation. Whilst bogie rotational resistance will control bogie hunting tendencies, a too higher rotational resistance will result in excessive wheel flange wear and increase the risk of wheel climb derailment. It is important that the constant contact force and friction coefficient be designed and controlled to maintain the rotational resistance at the correct level.

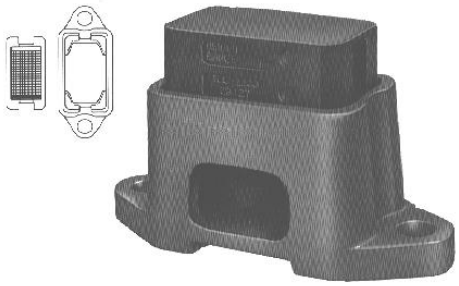


Figure 7 - Miner TCC 2600 constant contact side bearer

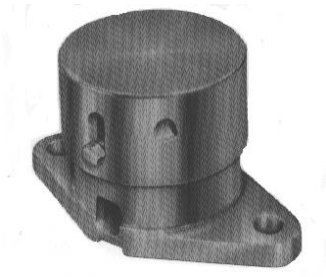


Figure 8 - Miner TCC 1135 long travel constant contact side bearer.

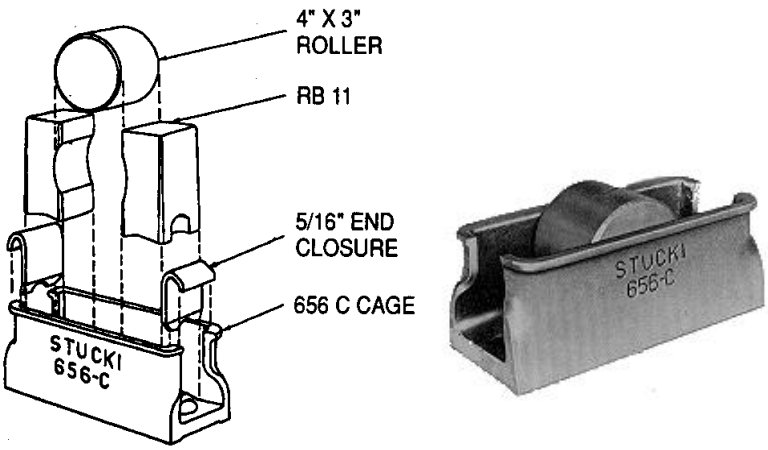


Figure 9 - Stucki model 656 C constant contact side bearer

The owner/operator shall have procedures in place to monitor and maintain the constant contact side bearer characteristics.

Common types of constant contact side bearers include those manufactured by Stucki and Miner, although other non-generic types also exist. Examples are shown in the figures 7, 8 and 9 .

9.3 Design and selection of CCSB's

The selection of constant contact side bearer for a particular vehicle type, shall be such that the following criteria are met:

The CCSB's shall comply with the requirements of AAR Standard M948, in particular the requirements for rotational resistance, maximum preload and curve negotiation.

In summary, the lateral/vertical wheel force ratio should not exceed 0.82

That is L/V Max. = 0.82

Where L = Lateral wheel force

V = Vertical wheel force

Therefore the Max. Allowable Bogie Rotational Torque T = 0.82 x B/2 x W/4 (kNm)

Where B = Bogie wheelbase (m)

W = Tare body weight supported by one (1) bogie (kN)

The recommended maximum preload for CCSB's per bogie is 85% of the supported tare vehicle body weight per bogie. Therefore:

The Maximum Allowable Pre-load per CCSB = (W x 0.85)/N (kN)

Where N = the number of CCSB's per bogie

The bogie rotational resistance torque shall be determined for both tare and gross load conditions taking into consideration the load supported by the bogie centre pivot together with the friction coefficients at the centre pivot and side bearers.

For vehicle safe operation the dimensionless bogie X-Factor calculated by the equation below, shall not exceed 0.15 for rolling stock fitted with standard gauge three-piece bogies and constant contact side bearers.

$$\text{X Factor} = \frac{T}{A \times B}$$

Where T = Bogie total rotational torque (centre pivot and side bearers) (kNm)

A = Average axle load (kN)

B = Bogie wheelbase (m)

The vehicle must comply with the requirements of the static vehicle twist test and the ride performance test, refer to CRN Standard CRN RS 010.

9.4 Inspection for defects and wear of CCSB's

Resilient elements of CCSB's shall be inspected at regular intervals and replaced if any of the following conditions are detected:

- Separation (horizontal split)
- Excessive gouging (indentations from housing due to shear)
- Excessive top surface wear
- Over compressed resilient block
- Loss of, or insufficient free height (ie clearance between CCSB case or roller and underframe side bearing surface.
- Damage to resilient blocks due to friction generated heat.
- Misaligned rollers

Rollers, top caps and housings shall be regularly inspected for physical damage and wear, and shall be replaced as required.

10 Braking Systems

References : AS7510.2 Braking Systems – Hauled Rolling Stock
AS7510.6 Braking Systems – Train

10.1 General train requirements

Reference: AS7510.6 Section 2.1

All Trains must be fitted with a Continuous, Automatic Brake system.

If a Train is made up of Vehicles equipped with AAR Emergency devices such as AAR vent valves, then all Vehicles should be fitted with vent valves to ensure the reliable activation throughout the Train.

10.2 Automatic brake control

10.2.1 Automatic air braked trains

Reference: AS7510.6 Section 4.2

The Standard Brake Pipe Pressure of Locomotive Hauled Trains operating on the DIRN shall be 500 kPa.

The Control Valve of each of the Vehicles making up an air braked Train shall be compatible with the Automatic Brake control systems of the other Vehicles in the Train.

10.2.2 ECP braked trains

Reference: AS7510.6 Section 4.3 and AS7510.2 Section 6

The Standard Brake Pipe Pressure of an ECP braked Train shall be 500 kPa.

The Control Valve of each of the Vehicles making up an ECP braked Train shall be compatible with the ECP Brake control systems of the other Vehicles in the Train.

The installation of an ECP Brake System on a hauled Vehicle shall be in conformance with all applicable requirements of the AAR Manual of Standards as modified by the RISSB ECP Guideline.

The functional properties of ECP brake equipment shall be such that it is interoperable with an ECP Brake System that conforms with the requirements of the AAR Manual of Standards, Section E-II as modified by the RISSB ECP Guideline.

10.3 Brake equipment compatibility

The braking systems and equipment fitted to freight vehicles must be compatible with the brake systems and equipment of the hauling locomotive.

10.3.1 Pneumatic coupling between vehicles

Reference: AS7510.2 Section 2.6

With the exception of Vehicles coupled together with fixed drawbars, pneumatic couplings between Vehicles shall be designed to provide connections that are secure but easily parted without damage in the event of Train or Locomotive separation.

Pneumatic couplings between Vehicles shall be arranged to avoid damage to or kinking of flexible hoses.

All hauled rolling stock for use on the CRN network shall be fitted with pneumatic couplings that are compatible with those of all other rolling stock in use on that Network. (Refer to AS7510.2 Appendix A for details of couplings.)

Pneumatic couplings between Vehicles shall be arranged to permit stored compressed air to be vented prior to disconnection.

If a single Brake Pipe coupling is installed at the end of a vehicle it should be positioned as shown in Figure 2 of Appendix A of AS 7510.2.

If the Brake Pipe installation has been bifurcated on a Vehicle the brake pipe branches should be positioned as shown on Figure 3 of Appendix A of AS 7510.2.

10.3.2 Coupling cocks

Reference: AS7510.2 Section 2.6

Brake pipe end cocks shall comply with the requirements of AS7510.2 Section 2.6.2.

Other end cocks for Main Reservoir, Independent Control Pipe shall comply with the requirements of AS7510.2 Section 2.6.3.

10.3.3 Identification and marking of cocks and brake equipment

Reference: AS7510.2 Section 2.1

All cut-out or isolation cocks, operating handles and embossed letters of the air brake equipment shall be painted white. An inverted “U” or the word release shall be painted on the vehicle underframe on each side of the attachment of the release cable.

10.3.4 Dummy couplings

Reference: AS7510.2 Section 2.6.2

All freight vehicles shall be fitted with dummy couplings for safely storing the unused coupling hose heads clear of the track.

In the case of stand-alone ECP braked trains this requirement may be waived.

10.3.5 Grade control equipment

Reference: AS7510.2 Section 3.1

All freight vehicles operating on the CRN shall be fitted with grade control valves or fixed exhaust chokes.

- Regulations regarding the use of grade control valves are contained under Train Operations in the General Instruction Pages of the CRN Train Operating Conditions manual. Vehicles with fixed exhaust chokes are counted as having operable grade control valves.
- If a train has 80% or more of vehicles/load with fixed exhaust chokes then a HP grade examination is not required.
- Vehicles with stand-alone ECP brake equipment do not require grade control equipment.

10.4 Freight vehicle requirements

10.4.1 Automatic air brake general

Reference: AS7510.2 Section 3.1

Every Vehicle shall be fitted with an Automatic Air Brake.

The Automatic Air Brake control system shall permit an Emergency Application of the Stopping Brake at any time when in running.

A Control Valve should be of the diaphragm type.

A Control Valve shall be suitable for use in Trains up to 2250 metres long.

The spacing between Control Valves or other venting devices shall:

- be not more than 38 metres or;

- may be separated by up to 50 metres subject to there not being more than 76 metres of Brake Pipe between any three consecutive Control Valves or other venting devices.

Each Vehicle shall be fitted with a Control Valve (or its Brake System shall be connected to a Control Valve) arranged to respond to braking commands transmitted via the Brake Pipe.

10.4.2 Automatic air brake functions

Reference: AS7510.2 Section 3.2

The Automatic Air Brake of any new or substantially modified Vehicle shall incorporate the functions as listed in AS 7510.2 Section 3.2.

10.4.3 Brake pipework

Reference: AS7510.2 Section 2.2

The size of the Brake Pipe and its fittings shall be 32 mm nominal bore.

The Brake Pipe should be of metal.

The minimum Brake Pipe bend radius should be 300 mm.

The cross-sectional area of Brake System piping should not be restricted by the application of fittings or from other causes.

10.4.4 Brake rigging

Reference: AS7510.2 Section 2.3

Spring loaded type brake rigging pin securing devices such as ‘R’ clips, Grip clips, or Lynch pins shall not be applied in positions below axle centrelines.

Below axle centrelines, split cotter pins shall be applied to secure brake rigging pins.

Vehicles shall be fitted with safety straps, or similar, to contain all pin-connected body and bogie mounted brake rigging to prevent it from dropping to rail level if a single pin connection fails.

CRN requirements:

All brake gear shall be securely mounted or supported and brake blocks shall be centred laterally on the wheel tread.

Freight vehicles with brake blocks which overhang the edge of the wheel tread will not be accepted for operation on the CRN.

Split cotter pins shall be split to a minimum angle of 60 degrees.

10.4.5 Pressures, Timings and Travels

Reference: AS7510.2 Section 3.3.1

10.5 Park brake

Reference: AS7510.2 Section 7

Each Vehicle shall be equipped with at least one Park Brake that complies that may be manual, power operated or automatic park brake.

A Park Brake shall hold the Vehicle stationary on a 1:30 gradient under all conditions of loading of the uncoupled Vehicle.

For its intended operation a Park Brake should not be reliant upon the Coefficient Of Adhesion exceeding 0.085 between the wheel and rail.

The Park Brake shall be able to maintain the required braking forces indefinitely.

The Park Brake of a Vehicle shall be designed to achieve a minimum Net Braking Ratio when fully loaded of 28% when fitted with low friction Composition Brake Blocks, 20% with medium friction

Brake Blocks or 13% when fitted with high friction Composition Brake Blocks or with cast iron Brake Blocks.

A manually applied Park Brake on a Vehicle shall be able to achieve the required braking forces with a manual force not exceeding 420 N.

10.6 Brake performance

10.6.1 General

Reference: AS7510.2 Section 3.4.1

Refer to CRN Standard CRN SD 026 Signalling Design Principles - Rolling Stock Interface Requirements, Section 8 for required train braking performance.

10.6.2 Net braking ratio

Reference: AS7510.2 Section 3.4.2

When the Brake System of a Vehicle is designed to utilise Brake Blocks these should be high friction Composition Brake Blocks.

The Automatic Air Brake of a Vehicle fitted with high friction Composition Brake Blocks shall be designed to achieve a Net Braking Ratio of 13% to 16% with a Brake Cylinder pressure of 350 kPa.

The Automatic Air Brake of a Vehicle fitted with high friction Composition Brake Blocks shall be designed to achieve a Net Braking Ratio of 30% or less when in the empty condition with emergency Brake Cylinder pressure.

The Automatic Air Brake of a Vehicle fitted with low or intermediate friction Composition Brake Blocks or cast iron Brake Blocks shall be designed to achieve a maximum Net Braking Ratio of 55% when empty and a minimum of 28% (except 20% for medium friction Brake Blocks) when fully loaded.

10.7 Brake block requirements

Refer to CRN Standard CRN RS 008, Section 7 for brake block friction, recommended brake blocks and brake block alternatives.

10.8 Brake equipment maintenance

Reference: AS7510.2 Section 11

Operators should ensure the effective implementation of inspections, routine Function Checks, overhaul procedures and acceptance criteria to maintain specified Brake System performance throughout the period between successive services.

The content and periodicity of the inspection, testing and maintenance of brake equipment should be based on the recommendations of the brake equipment manufacturer and data derived from in-service experience and testing.

11 Body and underframe

Reference: AS7520.2 – Body Structural Requirements

The freight vehicle body and underframe shall be designed to the following design loads and stresses.

Some earlier designs of freight vehicles may not fully comply with these requirements but will be assessed considering the equipment fitted and the proposed use of the freight vehicle.

New special purpose designed freight vehicles may not need to meet the requirements below, but due regard shall be given to the application and the operation in which these freight vehicles are proposed to be used.

11.1 Design loads and stresses

11.1.1 Shock loads

Reference: AS7520.2 Section 15.2

The following accelerations applied individually to components and their mountings to the body should not cause the critical design stress to be exceeded in any member:

- Longitudinally 4g
- Laterally 2g
- Vertically 2g

11.1.2 Proof loads

Reference: AS7520.2 Section 7

The vehicle shall be designed to withstand the longitudinal and vertical loads set out in AS7520.2 Section 7.

11.1.3 Fatigue loads

Reference: AS7520.2 Section 8

The vehicle shall be designed to withstand the fatigue loads set out in AS7520.2 Section 8.

11.2 Towing fixtures, jacking and lifting points

Reference: AS 7520.2 Section 14

Freight vehicles shall be fitted with facilities for towing in emergencies. Two (2) emergency towing fixtures as shown in CRN Standard CRN RS 008 Section 14 shall be attached to each headstock.

Suitable jacking points shall be supplied at the junction of the underframe side sill and body bolster adjacent to each bogie centre and also under the drawgear pocket.

Vehicles shall have suitable lifting points or brackets to insert lifting hooks and shackles.

The lifting brackets shall consist of pairs of vertical plates preferably mounted at the ends of the body bolsters and located to align with bolster web plates. Features to be incorporated in each lifting bracket are shown in CRN Standard CRN RS 008, Section 14.

11.3 Doors

Reference: AS7520.2 Section 12

All doors, (including bottom discharge doors), on freight vehicles shall be fitted with a positive latching system to prevent accidental or premature opening in service.

All bottom discharge doors of bulk commodity wagons shall be designed and maintained to prevent leakage of the commodity onto the track.

All bottom discharge doors, when open, shall remain within the rolling stock outline at all times, including all states of loading, wheel wear, etc.. Refer to CRN Standard CRN RS 008 for rolling stock outline requirements.

Outward opening side doors are not recommended, however if fitted, the minimum height above rail of the bottom of the door should be 1250 mm at tare in new condition in order to clear existing loading platforms when opened.

11.4 Container fixings

Reference: AS7520.2 Section 17

The container anchor system shall provide longitudinal, lateral and vertical restraint at the four (4) lowest corner fittings of the container.

The container securing device may be permanently fixed in position on the vehicle or be removable/adjustable. Devices fitted so as to provide for various lengths of containers must be capable of being retracted to be flush with the deck or removed and stowed on the vehicle.

Longitudinal and lateral restraint shall be provided by engagement with the aperture in the base of the container at each bottom comer fitting, while vertical restraint is provided by a rotating spigot engaging the inner surface of the corner fitting. This type is referred to as an Internal Locking Device.

A spigot engaging the aperture in the base of the bottom corner fittings without provision for vertical restraint may be used on vehicles where the vehicle structure provides substantial vertical engagement, eg well wagons.

Removable and retractable devices must be designed to be installed, removed, retracted and operated by one person without mechanical assistance or special tools.

That part of the vehicle structure supporting the securing devices shall be designed to accommodate the forces arising from the following accelerations when the vehicle is loaded to its maximum capacity:

- 2 g longitudinally
- 1 g laterally
- 1 g vertically up
- 1 g vertically down

The resultant forces in each case will be assumed to be taken by two (2) securing devices only. The support structure shall withstand these forces without exceeding the yield stress of the material in any component.

Any proposed alternate container fixings or fixing methods must not be used unless first approved by the CRN Manager.

11.4.1 Automatic twist locks

Reference: AS7520.2 Section 17.2

Automatic twist locks shall be designed to comply with AAR Specification M-952 - Intermodal Container Support and Securement Systems for Freight Cars

11.5 Marking and identification

11.5.1 Code and number

Each freight vehicle shall have a unique identification code/number clearly marked on each side as close as possible to the left hand diagonal corners. The minimum height of lettering shall be 125

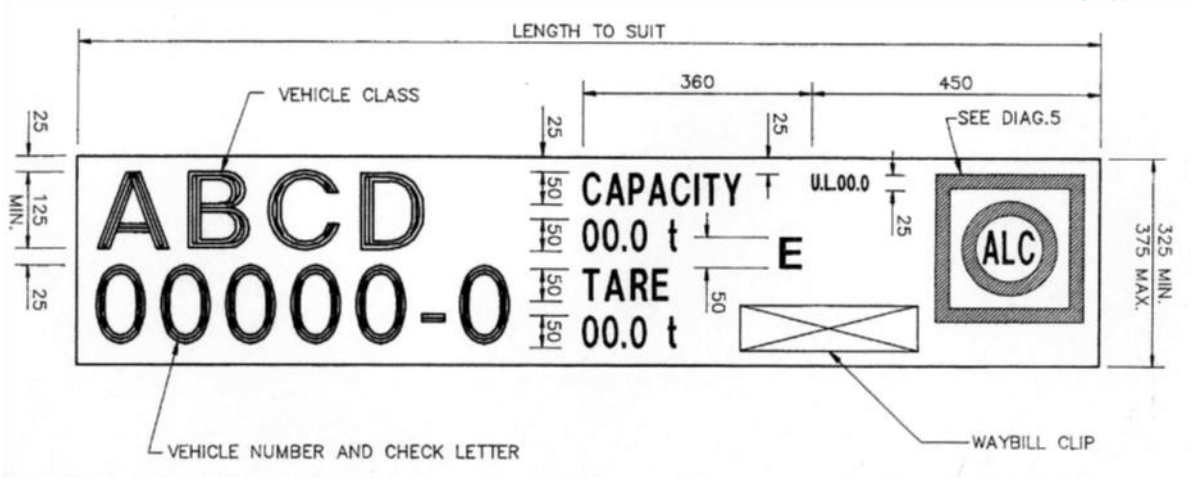


Figure 14 - Sample freight vehicle data plate

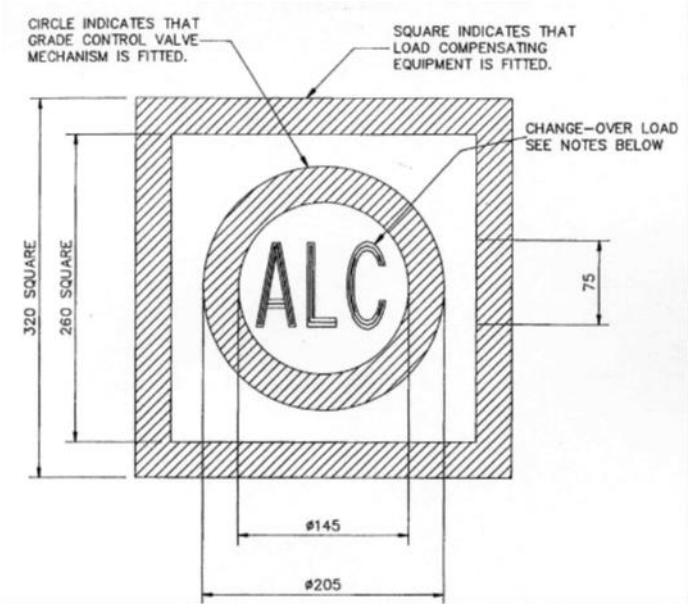


Figure 15 - Load indication symbols on the data plate

Notes applicable to the data plate:

- For vehicles fitted with a fixed exhaust choke, the circle is replaced with a triangle.
- The letters “ALC” indicate that the vehicle is fitted with automatic load compensation equipment.
- If the “ALC” is replaced with figures representing the changeover load, the vehicle is fitted with manual load compensation equipment. The load compensation handle is moved from the “EMPTY” position to the “LOADED” position when the vehicle net tonnage is greater than or equal to the value shown inside the square.
- If the square has no figures shown, the changeover load shall be deemed to be 20 tonnes.
- No other information, other than the changeover load or “ALC”, shall be displayed inside the square, circle or triangle.

11.5.2 Markings

Sufficient information shall be placed on freight vehicles and bogies to clearly identify the vehicle owner and/or operator.

Freight vehicles shall have a data panel painted onto a metal plate which is permanently secured to the vehicle or the data panel shall be stencilled directly onto the vehicle body.

The background and format of data panels shall contrast with the body colour of the vehicle, the colour of the markings applied to the panels shall give maximum contrast for legibility.

Data panels shall contain the following information;

- Vehicle code
- Vehicle number
- Vehicle length
- Symbols indicating the fitment of load compensation, grade control valve and/or fixed exhaust choke.

A sample data plate is shown in Figure 14.

Details of the loading symbols on the data plate are shown in Figure 15.

It is recommended that data panels also contain the following information;

- Vehicle capacity or gross mass
- Gross mass/speed for class 1 track (eg 76/115 and 84/100, 92/80 in the case of multi-capacity vehicles)
- Vehicle tare mass

11.5.3 Reflective delineators

To enhance visibility of freight vehicles from the side at level crossings, they shall be fitted with reflective delineators (reflectors) in accordance with CRN Standard CRN RS 008.

11.5.4 AEI Tags

All freight vehicles shall be fitted with standard AEI tags as specified in CRN Standards CRN RS 008 and CRN RS 014.

11.5.5 Maintaining visibility

Owner/operators shall have maintenance procedures in place and conduct regular maintenance covering the cleaning and preservation of the reflective qualities of reflective delineators.

12 Drawgear

Reference: AS7524.2 Drawgear

Couplers, coupling systems, coupler lengths and draftgear shall be designed to comply with the requirements specified in CRN Standard CRN RS 008, Section 6

Freight vehicle coupler heights shall be within the following limits:

- New or overhauled condition 870 to 915 mm.
- In service condition 780 to 915 mm.

The width of the opening in the striker casting/end sill shall be sufficient to accommodate the maximum coupler angular movement calculated under the conditions specified above.

13 Freight vehicle performance

The performance of freight vehicles shall be in accordance with the requirements of this standard and CRN Standard CRN RS 008. The performance specified in these standards relates to the operation of a freight vehicle on the CRN. For performance testing refer to CRN Standard CRN RS 010.

13.1 Freight vehicle ride performance

Refer to CRN Standard CRN RS 008 Section 19 for ride performance requirements.

13.2 Freight vehicle noise

Freight vehicle noise is an important performance consideration in terms of brake squeal on descending grades and may require endorsement by the DECCW before the vehicle will be approved to operate on the CRN. For noise requirements refer to CRN Standard CRN RS 008, Section 14.

13.3 Freight vehicle mass and mass distribution

Freight vehicles shall be type tested to determine the wheel and axle load distribution and to confirm any even load distribution.

It is in the interest of freight vehicle owner/operators that their vehicle mass, axle and wheel load distribution be within acceptable limits for optimum on-track performance. The axle and wheel load distribution shall therefore be within the limits specified in CRN Standard CRN RS 012.

The maximum freight vehicle mass for unrestricted operation on the CRN is 76 tonnes (19 tonne axle load). Freight vehicles with a higher gross mass (axle loads) are permitted to operate but will be subject to restricted operations. The maximum permitted axle load on Class 1 track is 25 tonnes.

13.4 Braking performance

Braking performance is specified to ensure that a freight vehicle is compatible with current CRN signalling systems and can safely contribute to the overall train braking performance.

13.4.1 Static brake performance

Refer to CRN Standards CRN RS 008 for static brake performance requirements and CRN RS 010 for static brake performance tests.

13.5 Vehicle structural strength

Refer to CRN Standard CRN RS 008 for vehicle structural requirements.

14 Specialised freight vehicle requirements

This section covers specialised and non-conventional freight vehicles.

14.1 Articulated or permanently coupled vehicles

These vehicles include:-

- Permanently coupled conventional vehicles with separate air brake equipment and handbrakes for each vehicle.
- These vehicles shall meet the requirements of conventional vehicles with the exception of vehicle coupling and air brake connections between vehicles within the permanently coupled rake. Terminal vehicles shall have conventional couplings and air brake connections on terminal ends.
- Permanently coupled conventional vehicles with shared air brake equipment and handbrakes.
- Permanently coupled articulated vehicles with shared air brake equipment and handbrakes.

14.1.1 Vehicle configuration

For new proposed articulated vehicles with three or more platforms, no platform shall be employed which has a male articulated connector at each end. That is, each intermediate platform shall be fitted with a male and female connector at each end, respectively.

14.1.2 Air brake equipment

The air brake shall operate on all axles on the vehicle.

14.1.3 Parking brake/handbrake

The parking brake or handbrake shall operate on not less than 40% of the total number of axles.

The force applied by the parking brake/handbrake shall be reasonably evenly distributed over each of the hand braked axles.

14.2 Tank wagons

Tank wagons can be used to carry various commodities, some of which are under pressure. Special conditions apply to the design and operation of tank wagons.

14.2.1 Design

Tank wagons shall be designed to the requirements specified in the ROA Manual of Engineering Standards and Practices, Section 15.

14.2.2 Tank inspections

Tank wagons shall be inspected to the requirements specified in Australian Standard 3788.

Appendix 1 CRN Rolling Stock Glossary

This appendix defines words that are used in the CRN Rolling Stock Standards

Agreed	Agreed between the Owner/Operator and the CRN Manager.
Approved	Approved by the CRN Manager.
Authorised person	Person authorised to travel in the cab of an infrastructure maintenance vehicle/train and stop the vehicle/train in the event of an emergency.
Cant deficiency	The difference in superelevation between: - that required to balance the actual vehicle centrifugal force due to curve negotiation such that there is equal wheel loading on the high and low rail, (equilibrium or balancing speed), and - the actual superelevation existing in the curve. Cant deficiency is a function of superelevation, curve radius and vehicle speed.
Continuous tractive effort	The tangential force that can be applied at the wheel/rail interface by a self powered vehicle for an indefinite period without causing wheel spin or overheating of the traction equipment.
CRN Manager	UGL Regional Linx Pty Ltd (UGLRL) Manager of the Country Regional Network
Curved wheel web	Wheel web or plate which is domed such that its cross section is curved.
Design speed	The maximum speed at which a vehicle is expected to operate on the CRN.
EPA	Environmental Protection Authority
Flat top trolley or trailer	A small non-powered infrastructure maintenance vehicle which is used for conveying tools and equipment along the track and which can be easily removed from the track.
Freight Train	A train predominantly consisting of freight vehicles.
Full supplies, Fully provisioned	Locomotive with all equipment and full of fuel, oil, water, coolant and sand.
Handbrake	A mechanical device provided on a train/vehicle in order to secure the train or an individual vehicle so as to prevent it from moving. Note: Where the term “handbrake” is used, it will also mean “parking brake”.
Heritage vehicle	Locomotive, passenger vehicle, freight vehicle or trolley that has historical significance and/or is not used in regular revenue service but used in special interest operations, such as steam tours.
Infrastructure maintenance vehicle	A rail bound self propelled vehicle which is used to carry out inspection and/or maintenance on railway infrastructure. Some of these vehicles may be removed from the railway track by the use of special take-offs or portable turnouts.

Light locomotive	One or more locomotives coupled together without hauled vehicles attached.
Locomotive	A self propelled vehicle, powered by any form of energy, which does not convey passengers or freight but which is used to move one or more other vehicles thus forming a train.
Multiple unit train	A distributed power train made up of similar electric or diesel powered vehicles and non-powered vehicles operating as a unit.
Net brake ratio	The ratio of the sum of the actual measured brake block forces divided by the total vehicle weight.
On-track infrastructure maintenance vehicle	Any infrastructure maintenance vehicle which operates exclusively on railway track.
ONRSR	Office of the National Rail Safety Regulator
Overhead wiring vehicle	An infrastructure maintenance vehicle with an elevating platform or equipped for maintenance of the overhead traction wiring system.
Power car	A self propelled vehicle, which may or may not convey passengers and/or freight, and operates in conjunction with similar vehicles in a multiple unit consist.
Quadricycle	A small self propelled rail-bound track vehicle which can be easily removed from the track.
Qualified worker	A worker certified as competent to carry out the relevant task.
Rail-bound infrastructure maintenance vehicle	An on-track infrastructure maintenance vehicle that cannot be removed from track without the use of a heavy crane. These vehicles are transferred around the network by rail.
Road/rail vehicle	Any type of track vehicle which can travel on either road or rail and can readily transfer from one mode of operation to the other.
Rolling Stock Exemption Certificate	A Certificate issued to a vehicle owner/operator covering vehicle non-conformances which are technically acceptable. These certificates remain in place for the life of the vehicle.
Rolling Stock Standards Waiver	A Waiver issued for a vehicle covering non-conformances that are deemed acceptable for a limited time period, until corrected.
Starting tractive effort	The tangential force applied at the wheel/rail interface that can be applied by self powered vehicle, to move itself and its trailing load from a stationary state without causing excessive wheel slip.
Straight wheel web	Wheel web consisting of a flat plate with no curvature such that its cross section is straight. Used primarily with wheel cheek mounted disc brakes
S-plate wheel	Wheel with a web such that its cross section forms an S shape, designed to provide low wheel rim stresses

Substantially modified vehicle	Vehicle modified to accommodate its use for a different purpose. Vehicle undergoing major refurbishment with updated equipment which can alter the braking, traction or suspension system performance. Vehicle being moved with equipment removed resulting in a reduction of vehicle mass that could alter the vehicle performance. Vehicle modified such that it may be incompatible with the infrastructure.
TOC Waiver	An authority issued for the movement of a vehicle for which there are no published operating conditions, or for which the operating conditions are different from those published in the CRN Train operating Conditions Manual.
Track maintenance vehicle	Infrastructure maintenance vehicle used for the maintenance, construction or inspection of track.
Train	One or more rail vehicles operating singularly or coupled together, hauled or self powered and capable of operating track signal circuits