UGL REGIONAL LINX

MINIMUM OPERATING REQUIREMENTS FOR RAIL- BOUND INFRASTRUCTURE MAINTENANCE VEHICLES

CRN-STD-ROL-713026361-456

CRN RS 005

LINKING COMMUNITIES. CONNECTING CUSTOMERS.

Table of Contents

Document Control

Function	Position	Name	Date
Approver	A&E Manager	Lucio Favotto	29.12.2021

Revision	Issue Date	Revision Description
1.1	29.12.2021	UGLRL Operational Standards Template applied
2.0	29.12.2021	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 an infrastructure maintenance vehicle interface standard, covering the minimum technical requirements for the operation of rail-bound infrastructure maintenance vehicles on the NSW Country Regional Rail Network (CRN).

UGL Regional Linx (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 rail-bound infrastructure maintenance vehicles and rail-bound infrastructure maintenance vehicles that have not operated previously on the CRN. Rail-bound infrastructure maintenance vehicles that have operated on the CRN prior to 30 January 2022 will be considered as deemed to comply with this standard. Older infrastructure maintenance vehicles with a historical background may not comply completely with this standard but will be assessed, considering the design and proposed use of the infrastructure maintenance 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

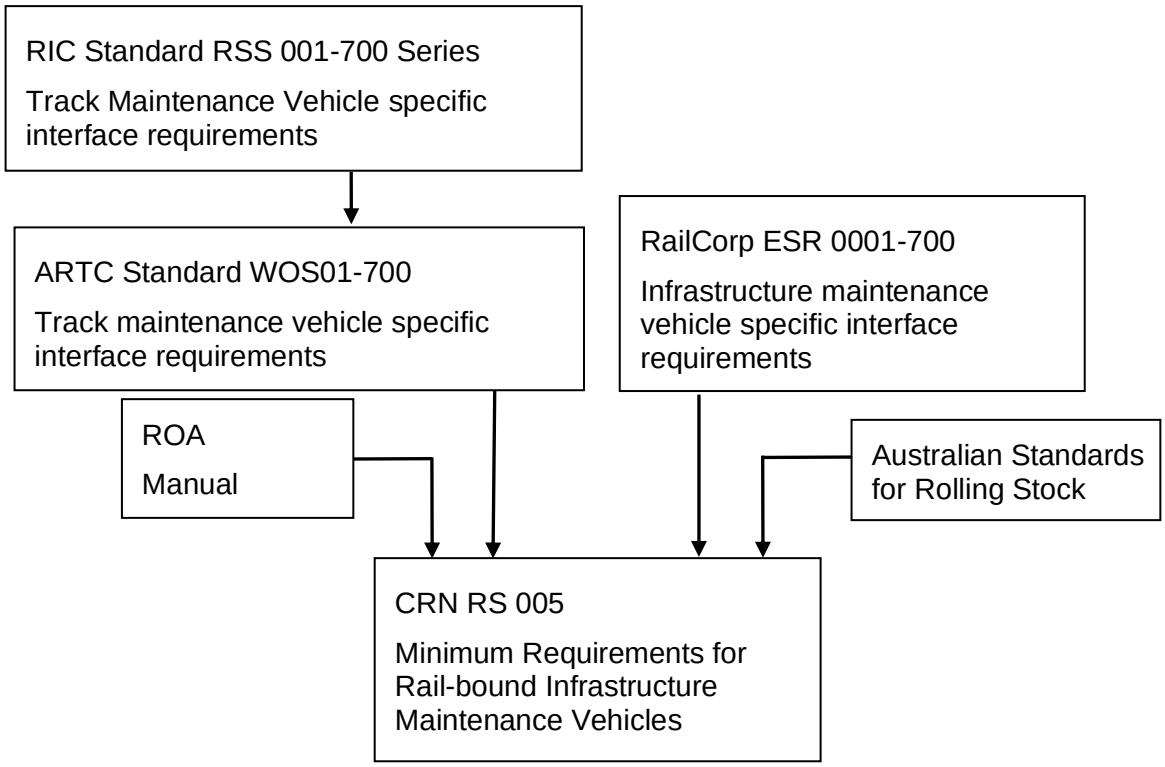
This standard is a part of a suite of rolling stock standards covering the interface between rolling stock and the CRN operating environment. The following documents form the core standards suite.

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.



1.4 Australian Standards for Railway Rolling Stock

The RISSB (Rail Industry Safety and Standards Board), a part of the Australasian Railway Association, 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”.

To obtain access to the published Australian Standards for Railway Rolling Stock, an organisation must be a full or an associate member of the Australasian Railways Association.

1.5 Definition of a rail-bound infrastructure maintenance vehicle

For the purposes of interpretation of this standard a rail-bound infrastructure maintenance vehicle is a vehicle confined to operate on rail only and specifically designed to carry out maintenance and construction of railway infrastructure.

1.6 Rail-bound infrastructure maintenance vehicle design

Rail-bound infrastructure maintenance 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 the Occupational Health and Safety Act, however this standard does not specifically cover Occupational Health and Safety requirements, which fall within the responsibility of the vehicle owner/operator.

The design of any rail-bound infrastructure maintenance vehicle shall take into account and demonstrate compliance with the requirements of all environmental legislation, in particular those requirements relating to noise, vibration, exhaust emissions and waste discharge.

Existing rail-bound infrastructure maintenance vehicle designs authorised to operate within New South Wales as at 30 January 2022, will be permitted to operate on the CRN under existing vehicle approvals.

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

Rail-bound infrastructure maintenance 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 Rail-bound infrastructure maintenance vehicles authorised to operate on the NSW Country Regional Network

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

Rail-bound infrastructure maintenance vehicle owner/operators shall be responsible for registering each vehicle type they wish to operate with ONRSR, the Office of the National Rail Safety Regulator,.

Rail-bound infrastructure maintenance vehicle owner/operators shall be responsible for obtaining vehicle acceptance from the CRN Manager.

Rail-bound infrastructure maintenance vehicle owner/operators must consult with the Environmental Protection Authority (EPA) and the CRN Manager on the environmental standards that do or will apply to a vehicle type, and shall demonstrate compliance with the appropriate standards and regulations thereby nominated, prior to operation of the locomotive on the CRN.

The same environmental standards will apply to the same rail-bound infrastructure maintenance vehicle type, irrespective of the owner/operator, except where a rail-bound infrastructure maintenance vehicle type has been substantially modified from its original configuration.

Rail-bound infrastructure maintenance 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.)

Rail-bound infrastructure maintenance 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 vehicles undergoing tests.

Rail-bound infrastructure maintenance vehicles with a defect as specified herein, sufficient for that 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 rail-bound infrastructure maintenance 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 rail-bound infrastructure maintenance 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 vehicle roadworthiness has been reinstated.

1.8 Acceptance of new rail-bound infrastructure maintenance vehicles

To apply for new rail-bound infrastructure maintenance vehicle acceptance the owner/operator shall complete the appropriate Vehicle Information Pack, CRN RF 005 and submit it to the CRN Manager.

Where testing is to be conducted on the rail-bound infrastructure maintenance vehicle/s refer to section 1.10 below.

Once a vehicle/s has been approved, details of the vehicle/s will then be published in Section 11 of 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 rail-bound infrastructure maintenance vehicle design or operating conditions

Where a rail-bound infrastructure maintenance 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 rail-bound infrastructure maintenance vehicles

Testing of any rail-bound infrastructure maintenance 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 rail-bound infrastructure maintenance 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 rail-bound infrastructure maintenance 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 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 rail-bound infrastructure maintenance 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 rail-bound infrastructure maintenance 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 Vehicle Information Pack listed above.

2 Rail-bound infrastructure maintenance vehicle components

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

3 Wheels

All rail-bound infrastructure maintenance vehicle wheels shall be designed, generally in accordance with the standard dimensions shown in AAR Specification M 107, Figures 6, 7 and 8 for wrought steel wheels, or AAR Specification M 208 figures 6, 7 and 8 for cast steel wheels, with the following additional requirements:

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 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 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

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 axle loads of 25 tonnes and above.

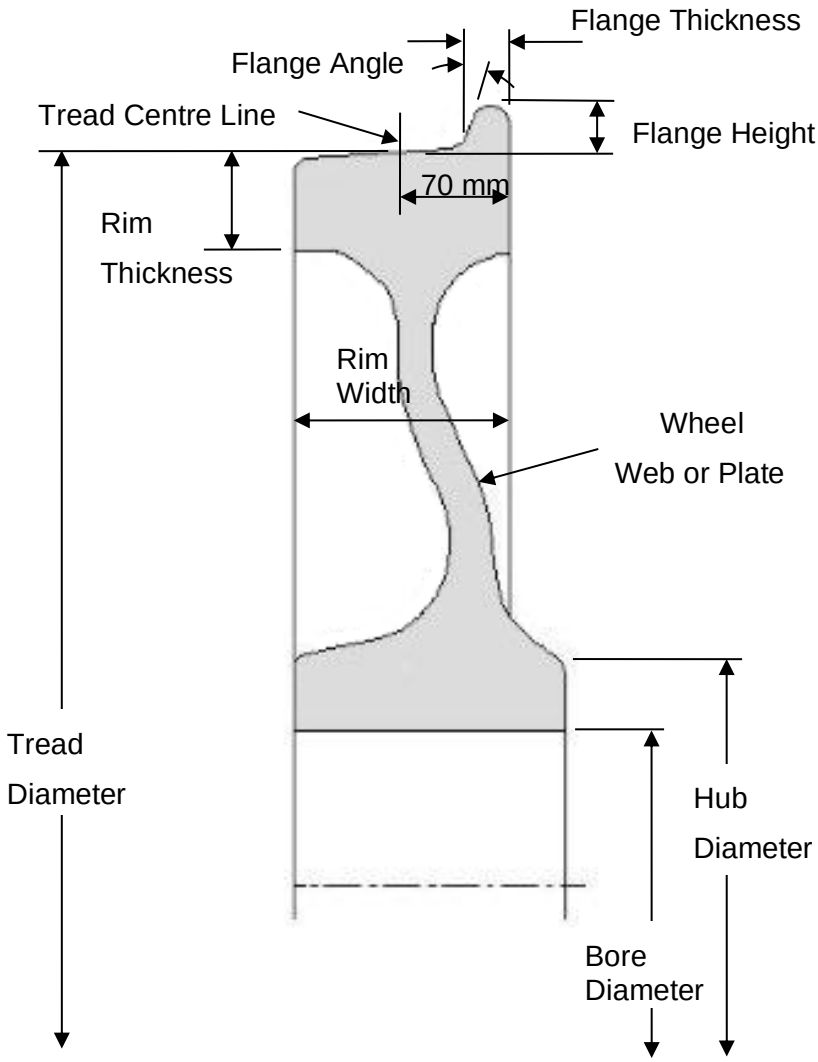


Figure 1 - Wheel parts and principal dimensions

3.3 Wheel web shape

S-Plate, low stress wheels are preferred for all rail-bound infrastructure maintenance vehicles where tread braking is performed, and shall be used on all rail-bound infrastructure maintenance vehicles where AAR Class C wheel material is used in conjunction with tread braking. Refer to Section 3.6 herein for brake block compatibility.

Conventional curved plate wheels are acceptable for AAR Class A and B wheel material applications. Refer to Section 3.6 herein for brake block compatibility.

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

Wheels shall be either cast steel or wrought steel, and manufactured in accordance with the following standards or CRN approved standards:

The CRN Manager has adopted the technical requirements referred to in AAR M-107/M-208 Wheels, Carbon Steel as being suitable for application to rail-bound infrastructure maintenance vehicles operating or intended for operation on the CRN.

3.6 Wheel material and brake block compatibility

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	Class of wheel
Low friction	AAR Class A or equivalent
Medium friction	AAR Class A or equivalent
High friction	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 RS 008, Section 7 for brake block friction characteristics.

3.7 Wheel identification

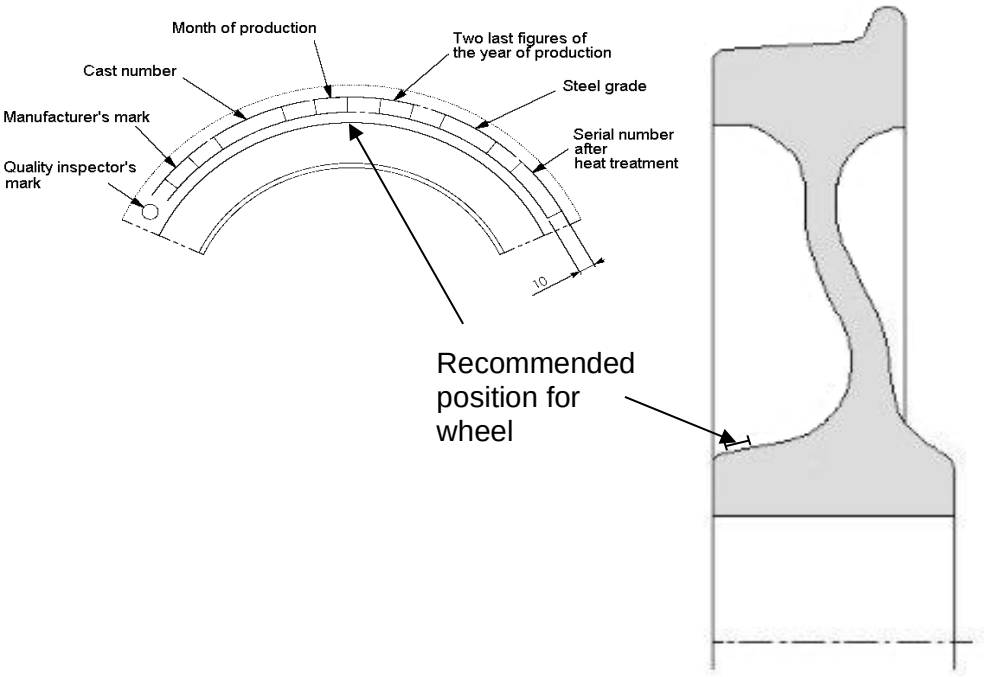


Figure 2 - Wheel identification

The serial numbers on all wheels must be traceable back to the manufacturer and the specific heat batch.

The method and location specified in Figure 2 above is common practice and is recommended.

3.8 Wheel profiles

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

3.8.1 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 CRN Standard CRN RS 008, Appendix 2 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 vehicles are sensitive to the higher conicity produced at the root radius resulting in bogie hunting instability. If vehicles are prone to hunting with the WPR2000 profile, the ANZR1 profile may be used as a substitute.

3.8.2 Test profile

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

3.8.3 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.

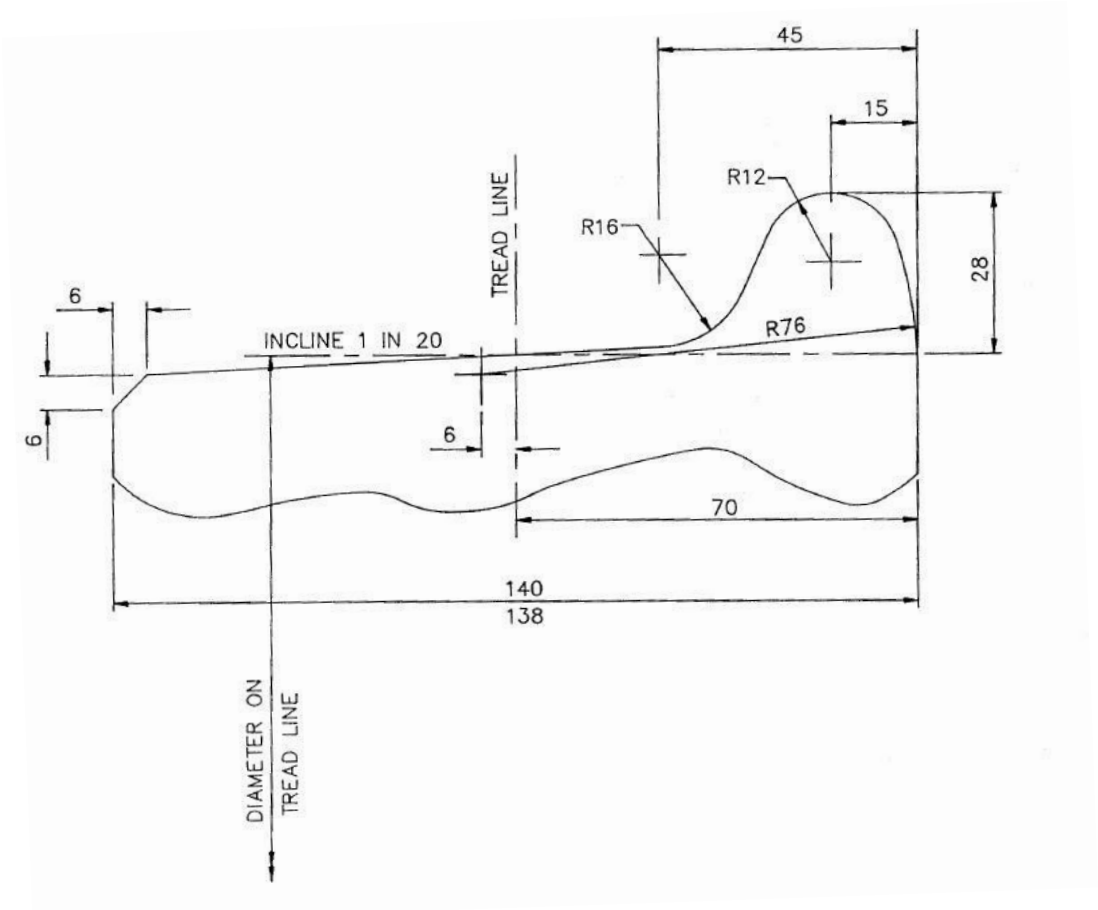


Figure 3 - ANZR1 Wheel Tread Profile

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

3.8.4 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.

3.9 Wheel profile machining

3.9.1 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).

3.9.2 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.

3.9.3 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 6 mm in width.

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.

Figure 4 - An unacceptable witness mark

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

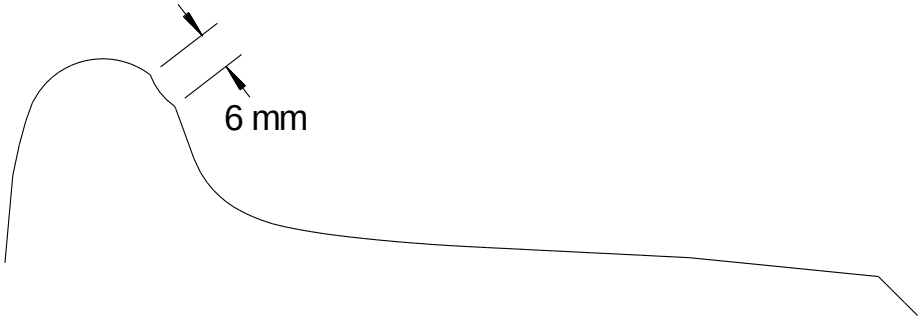


Figure 5 – Witness mark dimensional limit

3.10 Tyred wheels

3.10.1 Rail-bound infrastructure maintenance vehicles fitted with tyred wheels

The use of tyred wheels will only be permitted on historical rail-bound infrastructure maintenance vehicles where such vehicles were originally equipped with tyred wheels. Owner/operators of vehicles with tyred wheels shall have in place adequate maintenance procedures to ensure that tyred wheels are inspected regularly to prevent the possibility of loose tyres.

All other rail-bound infrastructure maintenance vehicles must be equipped with integral steel wheels unless otherwise approved by the CRN Manager.

3.10.2 Brake block compatibility with tyred wheels

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

3.11 Wheel generated noise

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.

3.12 Wheel minimum operating requirements

The following describes the minimum dimensional limits under which rail-bound infrastructure maintenance 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.

3.12.1 Wheel rim thickness limits

A rail-bound infrastructure maintenance vehicle shall not remain in service if it has a wheel rim thickness less than the limit specified in Table 2, with reference to Figure 1.

Vehicle Type	Minimum wheel rim thickness
Rail-bound infrastructure maintenance vehicles up to 25 tonne axle load	20 mm (See Note)
Rail-bound infrastructure maintenance vehicles over 25 tonne axle load	22 mm (See Note)

Table 2 - Minimum wheel rim thickness

Note: The minimum wheel rim thickness on vehicles may be dictated by bogie component clearances, such as gearboxes, above the rolling stock outline.

3.12.2 Permissible Variation in Wheel Diameter

On rail-bound infrastructure maintenance vehicles, the diameter variation between wheels on the same axle shall be in accordance with vehicle manufacturer's requirements, but they shall not exceed the following:

Rail-bound infrastructure maintenance vehicle wheel	Maximum Variation in Tread Diameter
Per axle (new or re-turned)	0.5 mm
Per axle (in service)	1 mm
Per bogie	25 mm
Per vehicle	60 mm (see Note)

Table 3 - Permitted variations in wheel diameter

NOTE: Applies to vehicles that are required to or can be coupled together for self propelled operation as a train, or be hauled by a locomotive, as part of a train.

3.12.3 Wheel defects and defect limits

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

4 Axles

Rail-bound infrastructure maintenance vehicle axles shall be designed in accordance with one of the following standards:

- Standard dimensions given in AAR Specification M-101, for the load ratings given on page G-II-30.
- UIC 515-3
- British Rail T 72
- Modified Reuleaux method.

The design method and the material grade of the axle shall be selected with due regard for its application.

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

4.1 Axle manufacture

Rail-bound infrastructure maintenance vehicle axles shall be forged steel and be manufactured in accordance with AAR Specification M-101, or approved equivalent.

4.2 Axle remanufacture

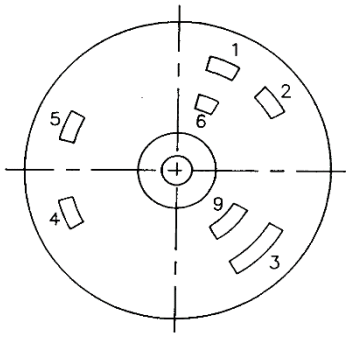
All reclamation and/or modification of axles shall be in accordance with AAR M-101, Section G part 2, rules 2A4 and 2A5. Rail-bound infrastructure maintenance vehicle axles that are unable to be reused for their normal application due to dimensional limits may be cascaded to a lesser duty for an alternate axle application provided the re-machined axle has no defects.

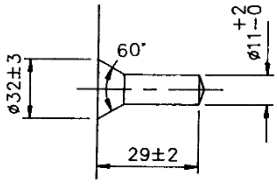
Any other proposal for the reclamation of axles must first be approved by the CRN Manager.

4.3 Axle identification

The serial numbers on axles must be traceable back to the manufacturer and their specific heat batch.

The method specified in Figure 6 below or AAR Specification M-101, Figure 2 are the recommended alternatives.





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

4.4 Axle minimum operating requirements

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

4.4.1 Axle condemning diameters

Rail-bound infrastructure maintenance vehicle owner/operators shall have proven industry standards clearly specifying the condemning diameters for the axle component parts.

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 4.2 above for axle remanufacture requirements.

4.4.2 Welding on axles

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.

4.4.3 Axle defects

The following axle defects will require a rail-bound infrastructure maintenance 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.

In cases where the following defect is detected on an operational rail-bound infrastructure maintenance vehicle axle, the vehicle is to be worked out of service for repairs:

Any rail-bound infrastructure maintenance 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 vehicle shall be immediately removed from service.

4.5 Wheel and axle assembly

The following applies to wheelsets comprising both integral steel wheels and tyred steel wheels.

4.5.1 Wheel and axle assembly

Rail-bound infrastructure maintenance vehicle owner/operators/manufacturers shall follow proven industry standards for the assembly of vehicle wheels onto axles. These standards may allow either a conventional wheel press-on assembly using a suitable approved lubricant, or a shrink fit assembly. In each case the wheel clamping force shall be provided by the required interference fit.

4.5.2 Wheel press-on lubricant

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.

4.5.3 Wheelset assembly records

The following information shall be recorded and retained for the life of each wheelset assembly, for audit purposes and for tracking purposes in the event of an in-service wheelset failure investigation:

- Individual wheel and axle identification.
- Axle wheelseat diameter, measured at 90 degree intervals around the circumference, and in two (2) planes on the wheelseat.
- Wheel bore diameter, measured at 90 degree intervals around the circumference, and in two (2) planes of the wheel bore.
- Method of assembly; whether press-on or shrink fit
- Analogue record of press-on tonnage verses displacement, achieved for each wheel pressed on, where applicable.
- Results of a back pressure test load on wheels, where it is necessary to confirm wheel interference fit security.
- Wheelset back to back dimension, measured at three (3) points equidistant around the back of the wheel rim at a point 40 mm below the outer circumference of the wheel flange.

4.5.4 Wheel back to back measurement

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.

Minimum	1357 mm
Maximum	1360 mm

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

4.5.5 In-service back to back dimension

Whilst wheelsets are in service, beneath a rail-bound infrastructure maintenance 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 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.

4.5.6 AAR wheelsets with reduced back to back

The AAR wheelset design with a thick flange profile and reduced back to back dimension is not compatible with the NSW rail network and thus will not be permitted to operate on the CRN.

5 Axle bearing assemblies

With the design and selection of rail-bound infrastructure maintenance 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

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 Axle roller bearing maintenance

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.

5.3 Axle roller bearing defects detected in the field

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 locomotive.
- 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)

5.4 Action required following derailments for axle roller bearings

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.

5.5 Axle package unit bearing adaptors

Axle package unit bearing adaptors, where applicable, shall be designed in accordance with the standard dimensions for the particular bearing size.

Any evidence of bearing adapter misalignment or distortion of the adaptor seating radius, shall be cause for the locomotive not entering service or being immediately removed from service.

The use of an incorrect adaptor size for a package unit bearing application can cause premature bearing failure and that shall be cause for adaptor replacement or the locomotive being immediately removed from service.

5.6 Axlebox plain bearing assemblies

Plain bearing assemblies shall be operated within their design capacity.

5.6.1 Plain bearing maintenance

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.

5.6.2 Plain bearing axlebox assembly defects

The owner/operator shall not place or continue in service a rail-bound infrastructure maintenance 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.

Plain bearing journal lubrication system defects

The owner/operator shall not place or continue in service a rail-bound infrastructure maintenance 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

5.6.3 Plain bearing defects

The owner/operator shall not place or continue in service a rail-bound infrastructure maintenance 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

5.6.4 Plain bearing wedge defects

The owner/operator shall not place or continue in service a rail-bound infrastructure maintenance 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 Bogie frame components

Bogie frame components include, but are not limited to side frames, bolsters, spring planks, swing links, control rods, frame adaptors, swing arm axleboxes, equaliser beams and other structural bogie components.

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

6.1 Design and manufacture

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 the following methodology:

6.1.1 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.

6.1.2 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.

6.1.3 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.

6.1.4 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.

6.1.5 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.

6.2 Bogie frame component maintenance

The owner/operator shall follow proven industry standards and have procedures in place for all rail-bound infrastructure maintenance vehicle maintenance activities. These maintenance activities shall include but not be limited to the following:

- Trammelling of bogie frames (where applicable)
- Non destructive testing of critical joints and connections
- Repair of bogie frames and associated components, including welding, straightening and heat treatment.
- Maintenance of pedestal openings and other important component interface dimensions (where applicable)

6.2.1 Bogie frame/component defects

The owner/operator shall not place into service, or continue in service, bogie frames, including associated components, with the following defects:

- Critically cracked bogie frame/components and associated components.

- 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 fixings and connections, locating bolsters, transoms, headstocks or other major bogie frame components, where applicable.

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.

6.2.2 Bogie frame/components, action required following derailments

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

7 Bogie suspension

This section covers the requirements applicable to rail-bound infrastructure maintenance vehicle suspension systems, including steel helical, flexicoil and leaf springs, hydraulic and friction snubbers and other damping devices. It specifies the design, manufacture, maintenance and operating conditions where appropriate.

7.1 Suspension coil and leaf springs

Springs shall be designed and manufactured in accordance with accepted industry standards for maximum fatigue life, without exceeding maximum stress when fully compressed.

7.1.1 Suspension spring defects

The owner/operator shall not place into service, or continue in service, vehicles with any configuration of defective, broken, misplaced, or incorrectly fitted springs which could results in the vehicle failing to meet the requirements for track twist negotiation.

The owner/operator shall follow proven industry standards and have procedures in place which set safe operational limits for vehicles with missing, broken springs or incorrectly fitted springs.

Possible locomotive spring defects/anomalies are:

- Adjacent springs in any concentric coil spring nest at risk of binding due to being wound the same hand.
- Coil springs missing, cracked or broken, misaligned or displaced within the spring seat.
- Leaf springs with cracked or broken, misaligned or displaced leaves within the spring group.
- Spring coils are heavily bruised or show flat spots caused by coil binding
- There are nicks, gouges, indentations or any corrosion with pit marks greater than 1 mm long in coils or leaves.
- Spring groups that don’t have the correct number, type and capacity of springs appropriate to the bogie model, vehicle class and maximum axle load.
- There is insufficient clearance between adjacent steel coils in load bearing springs to accommodate the necessary dynamic deflection without the spring bottoming or going solid.
- There is excessive corrosion between spring leaves.

7.2 Resilient (rubber) suspension components

Resilient suspension components, including axlebox pivot bushes, Alsthom Link bushes, lateral control rod bushes, traction rod bushes, and rubber element suspension springs shall be designed and manufactured, and fatigue tested in accordance with accepted industry standards, with due regard to the service conditions to be experienced by the vehicle over the life of the component. In

addition, 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.

7.2.1 Resilient suspension maintenance

Resilient steel/rubber laminated springs have become common place in secondary suspensions. In the majority of applications the resilient component provides the vertical, lateral and rotational suspension flexibility and thus the spring 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.

7.2.2 Resilient suspension defects

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.

7.3 Suspension damping

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 vehicle wear.

Damping devices include but are not limited to vertical, lateral and yaw snubbers, hydraulic dampers as well as axlebox/pedestal guides (coulomb damping) and leaf spring interleaf friction.

7.3.1 Suspension damper maintenance

A damper is an important component of a 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 vehicle ride performance.

7.3.2 Suspension damper defects

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.

Hydraulic dampers exhibiting signs of fluid leakage or physical damage to the body or end connections shall be requalified for correct operation.

Friction dampers shall not be permitted to enter service and shall be removed from service for the following defects.

- Wear components which are loose, missing, or worn beyond their condemning limit.
- Broken or missing snubber/damper end connections.
- Damaged or missing rubber end connection bushings

- Excessive hydraulic fluid loss.
- Oil contaminated or unauthorised lubrication on leaf springs.

Rail-bound infrastructure maintenance vehicles exhibiting instability such as bogie hunting, bouncing or pitching shall have their suspension dampers checked for possible damage or failure.

Axlebox/pedestal guide assemblies and leaf springs, which rely on coulomb (random friction) damping, shall not be lubricated, under any circumstances.

8 Bogie side bearers

Some 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.

8.1 Gapped side bearers

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

The owner/operator shall have procedures in place to monitor and maintain the correct side bearer gap.

8.2 Constant contact side bearers

Constant contact side bearers are designed to support part of the 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.

For the application of freight type constant contact side bearers refer to CRN Standard CRN RS 002 - Minimum Operating Requirements for Freight Vehicles.

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

9 Bogie brake equipment

Rail-bound infrastructure maintenance vehicles may be fitted with a clasp brake lever and pull rod system applying braking effort through tread brakes acting on both sides of each wheel.

Alternatively, modern rail-bound infrastructure maintenance vehicles may be fitted with unit brakes operating on the wheel tread on one side of each wheel.

9.1 Securing of brake gear

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

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

Spring loaded type pin securing mechanisms such as ‘R’ clips, grip clips, or lynch pins shall not be used below the axle centreline. Only split cotter pins shall be used in this area. Spring loaded type mechanisms may be approved for specific applications.

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

All bogie mounted brake rigging shall have safety loops or other means of security, in case of loss of brake rigging support.

Rail-bound infrastructure maintenance vehicles with brake blocks which overhang the edge of the wheel tread will not be accepted for operation on the CRN.

9.2 Spring parking or hand brake

All rail-bound infrastructure maintenance vehicles shall be fitted with a parking brake system capable of securing the vehicle (fully provisioned) on a 1 in 30 gradient, indefinitely.

There should be detection on the spring parking or handbrake system to indicate that the brake is applied or released. This indication should be train lined, where possible, to ensure the leading vehicle has indication covering all vehicles in a self propelled consist.

The parking brake shall operate on more than one axle per vehicle

A spring parking brake shall be maintained in the released position by main reservoir pressure. There shall be a means of manually releasing the brake.

9.3 Rail-bound infrastructure maintenance vehicle brake block force

As a guide the following minimum net brake ratios are recommended for a full service application of an automatic brake system (brake cylinder pressure 350 kPa).

Notwithstanding the net brake ratios quoted the brake performance shall comply with that specified in Clause 13.4.

The net brake ratio is the sum of measured brake block loads divided by the vehicle weight expressed as a percentage.

Brake Block Type	Minimum Net Brake Ratio	
	Automatic Brake	Independent Brake
High friction composite	13 %	20 %
Medium friction composite	20 %	34 %
Low friction composite	28 %	45 %
Cast Iron	28 %	45 %

Table 4 - Minimum Net brake ratios

The above net brake ratios shall be measured with a 150 kPa brake pipe reduction for the automatic brake and a full application for the independent brake.

9.4 Brake block requirements

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

10 Brakes and pneumatic equipment

On-track vehicle brake systems shall have at least two (2) separate brake systems:

Rail-bound infrastructure maintenance vehicles are usually self propelled vehicles with braking controlled by the operator.

Some vehicles are capable of operating coupled together with the straight air brakes controlled from the leading vehicle. In this case trailers must have the brakes operated from the towing vehicle.

Some vehicles have automatic air brake and are capable of being attached to a train and the brakes operated from the train brake pipe.

All vehicles that are required to operate within a train or as a train shall be fitted with a failsafe automatic brake system which is compatible with that required for locomotive hauled vehicles. Specific provisions apply to hauled vehicles fitted with stand alone ECP brake systems.

Where a vehicle does not have an automatic air brake, the parking brake must meet the braking performance requirements in Section 13.4.

The braking on some vehicles use the hydraulic drive motors for retardation purposes however this must not be relied upon as a parking brake.

Some vehicles also have an automatic brake.

10.1 Automatic air brake requirements

In general, rail-bound infrastructure maintenance vehicle brake systems shall consist of pneumatic control equipment to provide for an automatic air brake system.

The brake control system on new or substantially modified rail-bound infrastructure maintenance vehicle shall ensure that the brake pipe pressure is maintained at the demanded pressure reduction whilst the train brake system is subject to a train brake pipe leakage of 50 kPa per minute.

Older rail-bound infrastructure maintenance vehicles may not comply with the above requirement.

The standard rail-bound infrastructure maintenance vehicle brake pipe pressure shall be 500 kPa. The automatic brake shall be fitted with a minimum reduction feature which reduces the brake pipe pressure by 50 kPa on initial application.

A full service brake application of the automatic brake shall reduce brake pipe pressure by 150 to 175 kPa.

The driver's control stand shall have a separate emergency cock which is connected directly to the brake pipe and when opened it will exhaust the brake pipe external to the cab.

The automatic brake valve shall:-

- charge the brake pipe when the driver’s brake valve handle is placed in the release position.
- reduce the brake pipe pressure when the driver’s brake valve handle is placed in the application position
- fully exhaust the brake pipe when in the driver’s brake valve handle is placed in the emergency position.

The auxiliary reservoir shall have sufficient capacity so that at a full service reduction of 175 kPa from 500 kPa brake pipe pressure, the brake cylinder pressure shall be:-

- 370 kPa maximum at zero stroke
- 300 kPa minimum at full stroke.

Some earlier rail-bound infrastructure maintenance vehicle designs may not fully comply with these requirements but will be assessed considering the type of brake equipment fitted and the proposed use of the vehicle.

Alternate brake systems, such as electronically controlled pneumatic (ECP) brake, will be permitted provided the vehicle is pneumatically compatible to operate in conjunction with older vehicle types and the owner/operator has procedures in place for the rescue of disabled trains fitted with the alternate brake system.

10.2 Brake equipment maintenance

The owner/operator shall follow proven industry standards and have procedures in place to ensure that brake and pneumatic components are periodically inspected and tested to prevent in-service failure and to maintain the required performance.

11 Brake and control equipment compatibility

The braking systems and equipment fitted to rail-bound infrastructure maintenance vehicles required to be hauled by a locomotive must be compatible with the brake systems and equipment

of the locomotive, to ensure that the brakes apply and release as required, otherwise skidded or scaled wheels could occur.

11.1 Location of end brake equipment

Rail-bound infrastructure maintenance vehicles with conventional knuckle couplings and an automatic brake system shall have end coupling cocks and hoses, where relevant, as shown in Figures 7 and Figure 8 below.

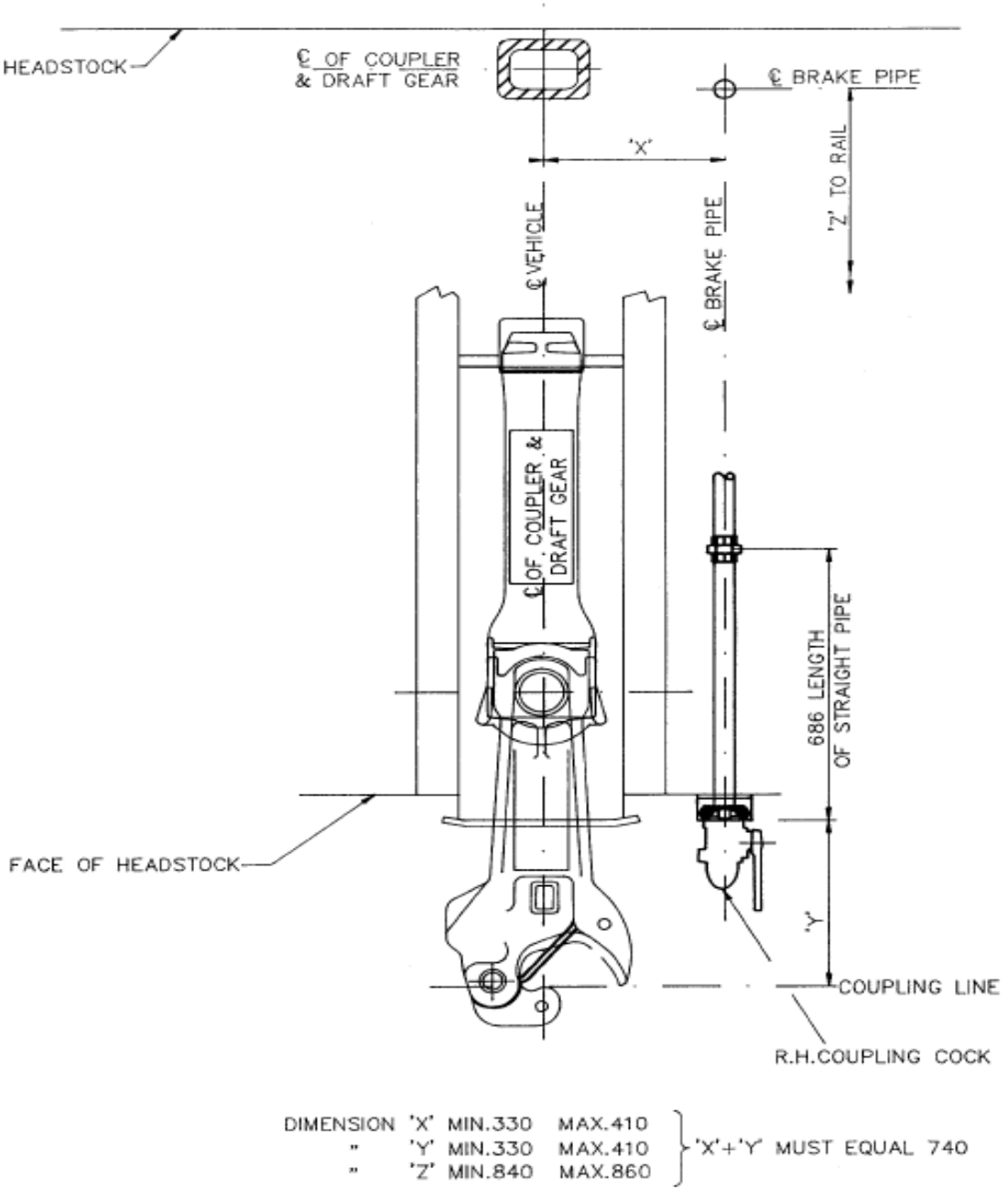


Figure 7 - Single brake pipe layout

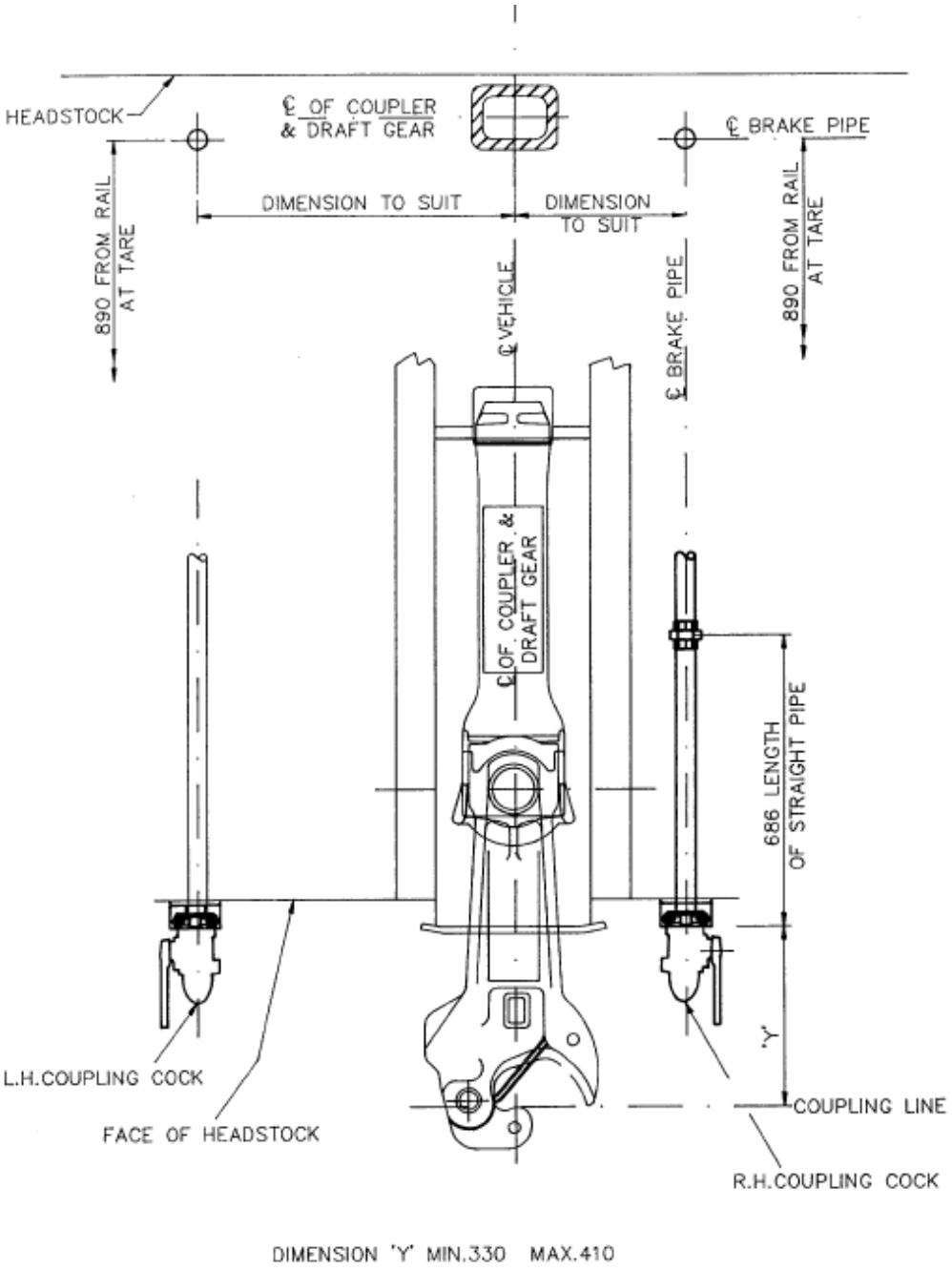


Figure 8 - Bifurcated brake pipe layout for a long vehicle

11.2 Coupling hoses

Flexible coupling hoses shall comply with the requirements of Australian Standard AS 2435 Elastomeric Hose for Railway Air Brake Hose.

Internal diameters (nominal bore) shall be:	
Brake pipe	32 mm
Main reservoir (where fitted)	25 mm
Coupling heads shall be:	
Brake pipe	32 mm coupling hose head

Main reservoir (where fitted)	25 mm coupling hose head

Brake hose coupling heads shall be in accordance with Figure 9

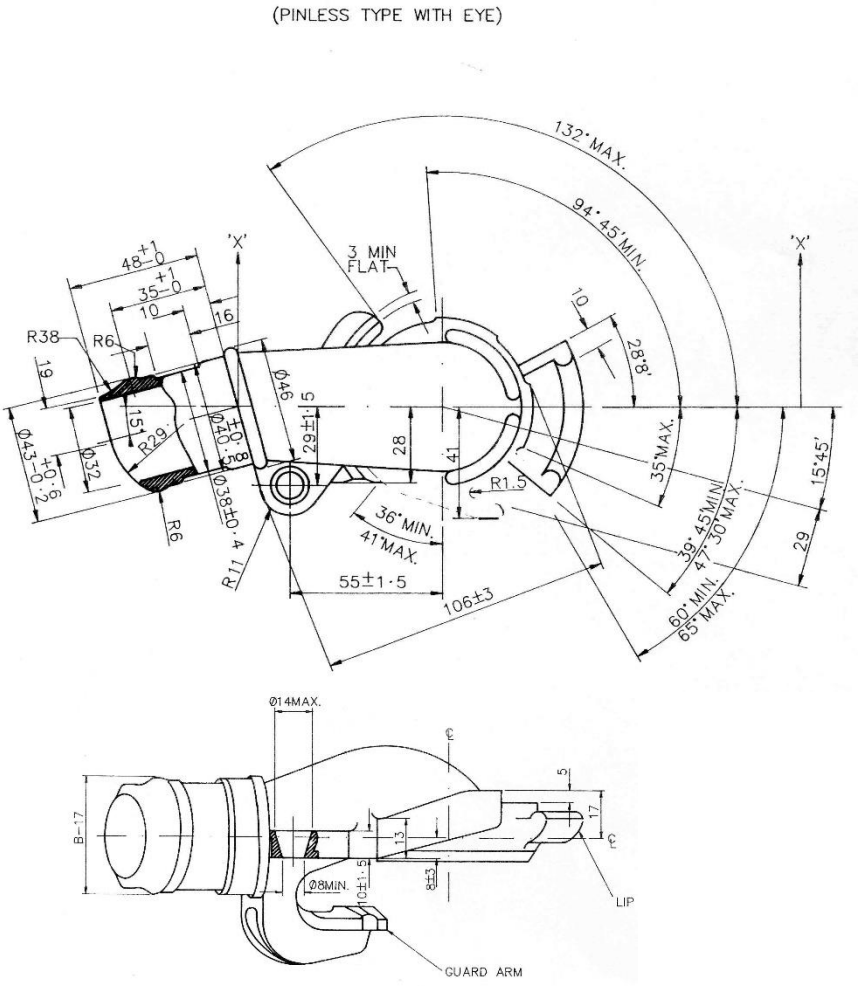


Figure 9 - Air brake coupling hose head

11.3 Brake pipe coupling cocks

Brake pipe coupling cocks shall be 32 mm nominal bore (NB) and shall be of such design as to ensure that the cock will remain in the desired position whilst the vehicle is in motion.

The cock shall be designed to prevent accidental closure which may be achieved by providing:

- a detent to ensure the cock remains in the open position and,
- a ramp to ensure the cock remains closed.

Movement of the handle shall be by the application of force in the direction of rotation only. All coupling cocks shall be vented on the flexible coupling hose side when closed. The cock shall generally conform to the drawing shown in Figure 10.

Brake pipe coupling cocks shall be mounted in front of the Cowcatcher (pilot).

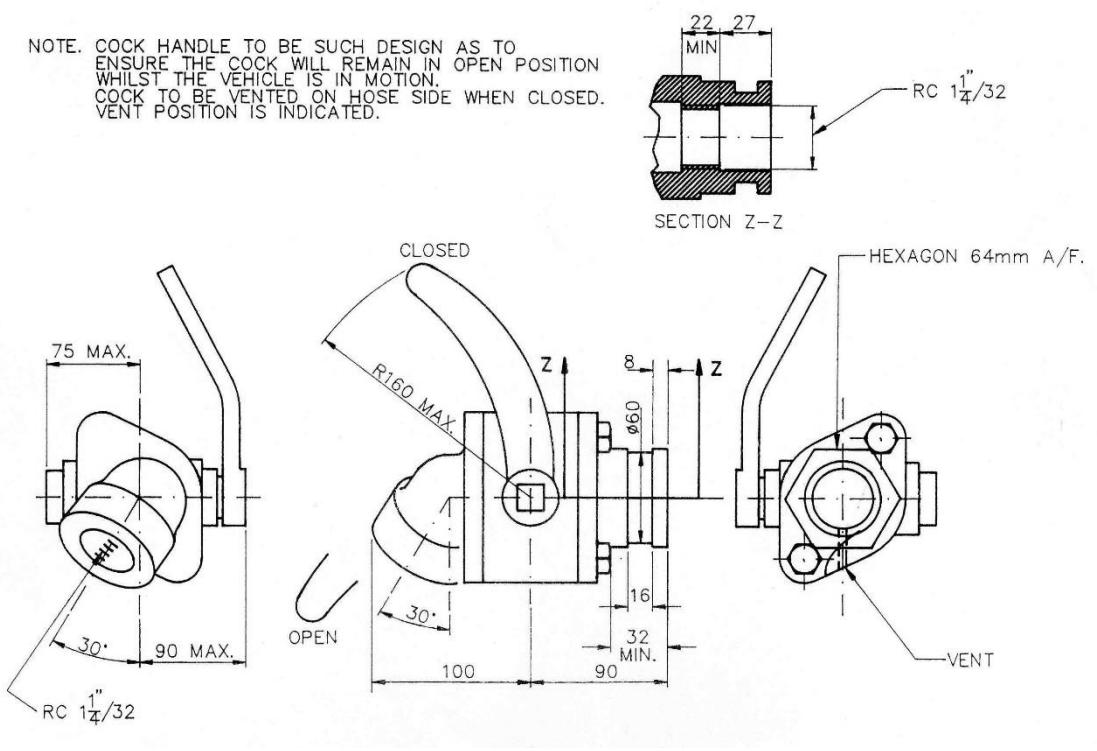


Figure 10 - Brake pipe coupling cock

11.4 Identification and marking of cocks

All equipment cut-out, isolation and end cocks shall be clearly identified and have their handles painted white.

11.5 Dummy couplings

All locomotives shall be fitted with dummy couplings or provided with a suitable receptacle for safely storing the unused coupling hose heads clear of the track.

11.6 Standard brake pressures and timings

For compatibility with other rolling stock and locomotives standard pressures shall comply with the following:

11.6.1 Pressure settings:

The standard pressure settings for an automatic brake system are as follows:

Main reservoir safety valves	900 kPa
Brake pipe	500 kPa
Brake cylinder pressure:	
Automatic and emergency application	Vehicle type dependent
Brake cylinder pressure warning light	10 kPa cut out, 40 kPa cut in
Additional settings	
Vigilance suppression (b/c pressure)	170 kPa

Spring parking brake release pressure not less than	420 kPa

All pressure governors (pressure switches) shall meet the following requirements:

	Contacts Close	Contacts Open
Compressor Governor	750 kPa	850 kPa
Control Governor (power out)	350 kPa	250 kPa
Parking brake	420 kPa	480 kPa

All the above governor pressures are subject to a tolerance of ±15 kPa
All governors shall be able to withstand a pressure of 1050 kPa.

11.6.2 Brake timings

The standard timings are as follows:

Automatic brake:		
Full service application:		
Equalising	500-350 kPa	4.5-7 seconds
Brake cylinder	0-350 kPa	8-10 seconds
Emergency application:		
Brake cylinder	0-350 kPa	8-10 seconds
Brake pipe	500-30 kPa	3-4 seconds
Equalising reservoir	500-100 kPa then to zero	20 seconds
Release:		
From full service:		
Brake cylinder	350-30 kPa	6-9 seconds
Equalising and brake pipe pressure	350-500 kPa	2 seconds
From emergency:		
Brake cylinder	350-30 kPa	6-9 seconds
Spring parking brake		
Off to fully applied		6-8 seconds

11.7 Air dryers

It is recommended that air dryers be fitted to reduce the damage caused by water on brake equipment.

It is recommended that silencers be fitted to the air exhaust of air dryers and that the exhaust is directed such that dust is not blown up around the vehicle.

12 Body and underframe

The rail-bound infrastructure maintenance vehicle body and underframe shall be designed to the following design loads and stresses.

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

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

12.1 Design loads and stresses

12.1.1 Shock loads:

Longitudinal	4 g #
Transverse	2 g #
Vertical	2 g #
For axle mounted components:	
Vertical	20 g #
Other directions	4 g #

g being the acceleration due to gravity of 9.81 m/s2

The underframe shall be designed to withstand the following conditions, with the locomotive fully equipped and provisioned:

- A static end force of at least 2 times the required drawgear capacity but not less than 1MN in both tension and compression, applied at and acting along the centreline of the draft gear without exceeding the safeworking stress for any member.
- The vehicle complete with bogies (running gear) being lifted with one jack placed centrally near the drawgear carrier plate or from the coupler at either end of the vehicle without exceeding the critical design stress for any member with the vehicle supported on the other bogie.
- The vehicle, complete with bogies, being lifted from the jacking pads and lifting brackets at the sides of the vehicle, without exceeding the safeworking stress for any member.
- A longitudinal shock load, as specified above, applied to any component attached to the underframe without exceeding the critical design stress for any member.
- A vertical live load as specified above comprising the weight of all fully serviced components supported by the underframe, without exceeding the critical design stress on any member.
- A vertical load of 225 kN applied to the coupler at the coupling line, both upwards and downwards, without exceeding the safe working stress for any member.

12.1.2 Collision protection and energy absorption

Rail-bound infrastructure maintenance vehicles shall be fitted with collision protection and energy absorbing elements to provide vehicle end structural protection as well as crew and passenger protection in the event of a collision.

Vehicles shall be fitted with end structural columns or other satisfactory means of preventing vehicle body telescoping in the event of collision.

12.2 Couplers and draftgear

Automatic couplers and draftgear shall comply with the requirements specified in CRN Standard CRN RS 008, Section 7

Vehicle coupler heights shall be within the following limits:

- New or overhauled condition with full provisions 880 to 890 mm.
- In service condition 840 to 900 mm.

12.3 Cowcatcher or pilot

Rail-bound infrastructure maintenance vehicle shall be fitted with a cowcatcher, pilot and/or wheel guard irons to deflect and prevent beasts or other objects on the track from passing under the vehicle.

The minimum height of the cowcatcher or pilot shall be 80 mm above rail with solid springs and wheels at condemn diameter. If spring packing is proposed at wheel turnings to compensate for reduced wheel diameter, then the minimum height shall be 80 mm with solid springs.

The height for wheel guard irons above rail under any condition of wear and dynamics shall not be less than 30 mm.

12.4 Vehicle driver/operator cab security

All rail-bound infrastructure maintenance vehicles should be fitted with a means of locking the driver's/operator's cab/s when the cab or vehicle is unattended. This is mandatory for rail-bound infrastructure maintenance vehicle used or proposed for driver only operation.

12.5 Rail-bound infrastructure maintenance vehicle toilets

Toilets installed on rail-bound infrastructure maintenance vehicles shall not discharge to the track. Self contained chemical toilets are acceptable provided the owner/operator has facilities for decanting or removal of waste products.

Toilet facilities shall meet the environmental requirements specified in CRN Standard CRN RS 008.

12.6 Marking and identification

12.6.1 Code and number

Each rail-bound infrastructure maintenance vehicle shall have a unique identification code/number clearly marked on each side and each end of the vehicle. The minimum height of lettering shall be 125 mm. The colour of marking shall contrast with the background colour of the vehicle.

12.6.2 Markings

Rail-bound infrastructure maintenance vehicles shall have the fully provisioned mass, the tare mass, allowable trailing load and the coupled length stencilled on each side of the vehicle at or about underframe/solebar level.

12.6.3 Rail-bound infrastructure maintenance vehicle end colours

For on-track visual safety, the frontal area of new or substantially modified rail-bound infrastructure maintenance vehicles shall have an area of high visibility colour preferably with the colour yellow, orange, orange-red, white or an approved combination of those colours.

Existing rail-bound infrastructure maintenance vehicles shall have sufficient frontal area painted in one or more of the proposed colours, sufficient to enable the approaching vehicle to be seen from a safe distance.

12.6.4 Reflective delineators

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

12.6.5 AEI Tags

All rail-bound infrastructure maintenance vehicles shall be fitted with standard AEI tags as specified in CRN Standards CRN RS 008 and CRN RS 014.

12.6.6 Maintaining visibility

Owner/operators shall have maintenance procedures in place and conduct regular maintenance covering the cleaning and preservation of illumination and reflective qualities of lighting, end contrasting colours and reflective delineators.

13 Rail-bound infrastructure maintenance vehicle performance

The performance of the rail-bound infrastructure maintenance vehicle 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 the vehicle on the CRN. For performance testing refer to CRN Standard CRN RS 010.

13.1 Rail-bound infrastructure maintenance vehicle noise

Rail-bound infrastructure maintenance vehicle noise is an important performance consideration as it requires endorsement by the EPA before the vehicle will be approved to operate on the CRN. Normally infrastructure maintenance vehicles are exempt from EPA noise requirements however that exemption should be sought officially. For noise requirements refer to CRN Standard CRN RS 008.

13.2 Rail-bound infrastructure maintenance vehicle mass and mass distribution

Rail-bound infrastructure maintenance vehicles shall be type tested to determine the fully provisioned mass, as well as the loads on individual axles.

It is in the interest of rail-bound infrastructure maintenance vehicle owner/operators that their vehicle mass, axle and wheel load distribution be within acceptable limits for optimum adhesive tractive effort. The axle and wheel load distribution shall therefore be within the limits specified in CRN Standard CRN RS 012.

The maximum vehicle mass per axle for unlimited operation on the CRN is 19 tonnes. Vehicles with a higher mass per axle may be considered but they may be subject to restricted operations.

13.3 Traction performance

Traction performance tests shall be carried out for each type of rail-bound infrastructure maintenance vehicle to establish that the vehicle can haul itself and any required support vehicles under all weather conditions without tendency for wheel slip.

Traction tests shall be conducted in accordance with CRN Standard CRN RS 010. The fuel level shall be recorded before conducting traction performance tests.

13.3.1 Sand

Rail-bound infrastructure maintenance vehicles generally do not use sand to enhance their adhesion capabilities in poor weather conditions however, where such vehicles require sand for operation on the CRN they shall have adequate measures in place to correctly control sand dispersal and prevent sand leakage and abnormal/excessive sanding.

Vehicles with malfunctioning sanding equipment or without sand supplies will not be permitted to operate on the CRN.

vehicles with sanding capability shall be equipped with an approved system for removing sand from the rails immediately behind the last wheel of the trailing bogie, in each direction of travel. The system shall be controlled by and operate concurrently with the sand application system.

13.3.2 Wheelslip control

All rail-bound infrastructure maintenance vehicles shall be fitted with a suitable traction control system to prevent uncontrolled wheelslip.

Rail-bound infrastructure maintenance vehicle types that demonstrate consistent wheelslip problems shall have their CRN operating approval withdrawn.

13.4 Braking performance

Braking performance is specified to ensure that a rail-bound infrastructure maintenance vehicle is compatible with current CRN signalling systems and can safely control and stop itself and attached vehicles.

The vehicle shall brake on dry level track within the following limits. Tests shall be conducted with the operator applying the brake and not releasing until the vehicle is stationary. The vehicle shall be tested at normal operating speed (typically 30 km/h, and up to the maximum allowable speed. The wheels must not skid during the test.

Trailers shall be tested with the hauling vehicle and the combination hauling vehicle plus trailer shall comply with the deceleration requirements below.

Measured average deceleration rates shall be.

Vehicle Configuration	Measured average deceleration
All vehicles	0.9 m/s2 minimum in all conditions

Table 5 Brake Requirements

Load compensating valves shall be required where the tare to gross mass ratio exceeds 1:3. The vehicle shall comply with the requirements in Table 5 above.

The parking brake must operate to provide a minimum deceleration on level track of 0.8 m/s2 minimum in loaded condition.

For vehicles that are restricted to operations within protected worksites, the vehicle must be able to stop from 15 km/h in less than 20 metres. If the maximum speed of the vehicle is less than 15 km/h, then the vehicle shall stop from the maximum speed within 20 metres.

13.4.1 Rail-bound infrastructure maintenance vehicles hauled within a train

Rail-bound infrastructure maintenance vehicles that are to be hauled on the rear of a train or within a train consist but not marshalled against the train locomotives shall be single car tested for sensitivity of the brake equipment and its compatibility with other hauled rolling stock. Refer to CRN Standards CRN RS 008 and CRN RS 010 for single car air test requirements.

14 Rail-bound infrastructure maintenance vehicle safety equipment

14.1 Driver's safety system

Each rail-bound infrastructure maintenance vehicle shall be fitted with driver's safety systems as specified in CRN Standard CRN RS 013.

14.2 Speed indicating device

Each driving position shall have an operating speed indicating device.

Any speed indicating devices which are displayed on a visual display unit shall display the speed to an accuracy shown below or better, when compared to the true vehicle speed at all times.

Speedometers should be recalibrated to compensate for wheel wear/wheel turning.

If the speedometer does not have wheel diameter compensation, the speedometer should be calibrated to a diameter midway between the new wheel diameter and condemning diameter.

	Existing (at 1 March 2011) vehicles	New vehicles from 1 March 2011
Speedo with wheel diameter compensation	+/- 7%	+/- 5 %
Speedo without wheel diameter compensation	+/- 10 %	+/- 7 %

Verification of the speed indicating devices on new or substantially modified rail-bound infrastructure maintenance vehicles compared to the true vehicle speed shall be measured by suitably accurate equipment. Verification shall be carried out at 10 km/h intervals up to the maximum design speed.

The design of any speed indicating devices shall take into account variation in wheel diameters and wheel slip / slide events.

14.3 Data logger/recorder

Each rail-bound infrastructure maintenance vehicle, except those specified below, shall be fitted with a functioning, reliable and accurate data recording/logger system.

The system shall meet the requirements of ONRSR, the Office of the National Rail Safety Regulator Compliance Code for Data Loggers. This Guidance Material is available via the ONRSR website at:

http://www.onrsr.com.au/__data/assets/pdf_file/0013/5260/Data_loggers_rail_safety_compliance_code_2011-3-May-2013-2.pdf

The system shall record the information as specified in the ONRSR Guidance for Train Data Loggers.

Vehicles with a maximum speed capability not exceeding 30 km/h and meet one or more of the following may be exempted from requiring a data recording device:

- Vehicles that are transhipped to a possession area and are intended for use within a designated worksite.
- Other vehicles as determined by the CRN Manager.

14.4 Pressure indication

Each rail-bound infrastructure maintenance vehicle shall have a means of indicating pressure of the main reservoir, brake pipe, spring brake and brake cylinder, where applicable.

Gauges shall be clearly labelled and calibrated in kPa.

14.5 Driver's emergency cock

Rail-bound infrastructure maintenance vehicles shall be fitted with an emergency cock or failsafe emergency brake pipe dump control near each driving position. The cock when opened shall directly vent the brake pipe to a position outside the cab.

14.6 Emergency equipment

Each rail-bound infrastructure maintenance vehicle, except those specified below, shall be supplied with the emergency equipment as specified in the CRN Train Operating Conditions Manual, General Instruction Pages, Section 3, Train Operations, Emergency Equipment.

14.7 Communications

Rail-bound infrastructure maintenance vehicles shall be fitted with a train radio system. Radio frequencies shall be approved by the CRN Manager. Refer to CRN Standard CRN RS 018.

14.8 Lights

Each rail-bound infrastructure maintenance vehicle shall be fitted with headlights, tail lights, marker lights, visibility lights in accordance with CRN Standard CRN RS 008, Section 8.3.

Some earlier designs of rail-bound infrastructure maintenance vehicles may not fully comply with, or may be exempt from, these requirements. In such cases, the design will be assessed considering the equipment fitted and the proposed use of the vehicles.

14.9 Horns

Refer to CRN Standard CRN RS 008, Section 8.4, for horn noise level requirements.

15 Road transportable infrastructure maintenance vehicles

Some infrastructure maintenance vehicles are rail-bound in the sense that they cannot operate off rail however, for convenience and operating efficiency they are transported to and from worksites by road vehicle. Notwithstanding the fact that the vehicles are portable, they still must comply with the requirements specified herein on the basis that they are rail-bound and therefore shall meet the performance requirements of a rail-bound vehicle.

16 Elevating Work Platform (EWP)

OHS Regulations require that high risk plant, including boom-type EWPs and scissor lifts with a platform movement greater than 2.4 meters, be design registered in NSW before use. Once a design registration has been obtained, alterations that affect the safety of the vehicle must not be made until the alteration has been approved by WorkCover. For EWPs such alterations include anything that affects the stability, centre of gravity, speed of travel, and/or safety features such as brakes, level indicators and motion-limiting switches. Attaching an EWP to the back of a flat top vehicle affects all of the above and could lead to failure of the EWP.

Elevated work platform equipment chained to a flat top rail vehicle will not be design registered, and therefore is PROHIBITED for use on the CRN.

Vehicles fitted with EWPs must comply with the requirements of AS 1418.10 and be design registered with WorkCover NSW.

17 Infrastructure maintenance vehicles operating as a locomotive

17.1 General

A limited number of rail-bound infrastructure maintenance vehicles have the capacity to operate as a locomotive and haul freight vehicles.

Rail-bound infrastructure maintenance vehicles are usually used as single units or marshalled with other infrastructure maintenance vehicles and operated in a train consist. The braking system in the latter case must be compatible between all vehicles in the consist.

Some rail-bound infrastructure maintenance vehicles may be used to tow a trailer. Refer to CRN Standard CRN RS 007 - Minimum Operating Requirements for Infrastructure Maintenance Trolleys and Trailers.

Some rail-bound infrastructure maintenance vehicles may tow freight vehicles when operating in work mode, but only and within protected worksites. This section covers the requirements for such vehicles operating as a locomotive.

17.2 Vehicle identification

Infrastructure vehicles authorised to operate as a locomotive must have the maximum allowable trailing train mass that can be hauled marked on the sides of the vehicle and in the vehicle drivers cab.

Infrastructure vehicles authorised to operate as a locomotive shall be clearly identified in the CRN Train Operating Conditions (TOC) Manual, Section 11 - Infrastructure Maintenance Vehicle Data.

17.3 Authorisation of the vehicle

Infrastructure vehicles must be authorised for operation on the CRN, as specified in Section 1.7 herein.

For an infrastructure vehicle to be authorised to operate as a locomotive, the vehicle must comply with the following requirements for locomotives as detailed in CRN Standard CRN RS 001:

17.3.1 Brakes and pneumatic equipment

The automatic air braking system on the infrastructure vehicle must be compatible with the braking system of vehicles to be hauled. The brake pipe must be regulated to 500 kPa and the driver's automatic brake valve shall be capable of charging the brake pipe when in release, reducing the brake pipe pressure when applying the brakes and fully exhausting the brake pipe when in emergency. The compressor and airbrake supply reservoir capacity must be sufficient to allow for the brakes to be applied and released a number of times while maintaining a 500 kPa brake pipe pressure between applications.

If the vehicle is hauling vehicles that may use main reservoir air for auxiliary equipment, such as ballast wagons with air operated discharge doors, the reservoir sizes must take into account the use of the main reservoir air. The length of train may need to be reduced to meet main reservoir limitations.

The operator's cab shall be fitted with a main reservoir and a brake pipe pressure gauge. All cut-out or isolation cocks must be clearly identified and handles painted white.

17.3.2 Couplers

The couplers and draftgear shall be suitable for the maximum loads hauled by the infrastructure vehicle. The coupler height shall be within the limits 840 to 900 mm above rail.

17.3.3 Traction performance

Testing shall be conducted or evidence provided that the infrastructure vehicle is capable of hauling the specified maximum loads on various grades.

17.3.4 Braking performance

Tests shall be conducted on the infrastructure vehicle with the maximum number of loaded vehicles to ensure the satisfactory operation of the braking system.

Stopping distance tests shall be conducted to ensure the train consist stops within the requirements of CRN Standard CRN RS 001, Section 14.4.2.

17.3.5 Safety equipment

Infrastructure vehicles operating as locomotives must be fitted with the following safety equipment as specified in CRN Standard CRN RS 001.

- Driver's safety system
- Speed indicating device
- Data logger/recorder
- Driver's emergency cock
- Flowmeter
- Emergency equipment
- Communications equipment
- Lights
- Horns.

The timings for the vigilance control system must be in accordance with reduced timings for driver only operation as specified in CRN Standard CRN RS 013.

17.3.6 Operation of infrastructure vehicle as a locomotive

Before an infrastructure vehicle is to be used to haul a train, the infrastructure vehicle and train must be marshalled together and all air brake coupling hoses coupled and coupling cocks between vehicles opened.

The train must be inspected in accordance with the CRN Train Operating Conditions (TOC) Manual, General Instruction Pages, Section 6 Train Inspection.

17.3.7 Driver safety system

Infrastructure vehicles used to haul a train must be fitted with a driver safety system in accordance with CRN Standard CRN RS013 - Driver Safety System Requirements for Rolling stock, and the following requirements.

Where the infrastructure vehicle is crewed by a driver and a second Qualified Worker, the vehicle must be fitted with a vigilance control system.

Where the vehicle is crewed by a single driver, the vehicle shall be fitted with a vigilance control system AND an Operator Enable system. Refer to CRN Standard CRN RS 013.

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.
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.
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.
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