UGL REGIONAL LINX

MINIMUM OPERATING REQUIREMENTS FOR LOCOMOTIVES

CRN-STD-ROL-713026361-2295

CRN RS 001

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
2.1	30.01.2022	UGLRL Operational Standards Template applied
3.0	30.01.2022	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 locomotive interface standard, covering the minimum technical requirements for the operation of locomotives on the NSW Country Regional Rail Network (CRN).

UGLRL (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 locomotives and locomotives that have not operated previously on the CRN. Locomotives that have operated on the CRN prior to 30th January 2022 will be considered as deemed to comply with this standard. Older locomotives with a historical background may not comply completely with this standard but will be assessed, considering the design and proposed use of the locomotive(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

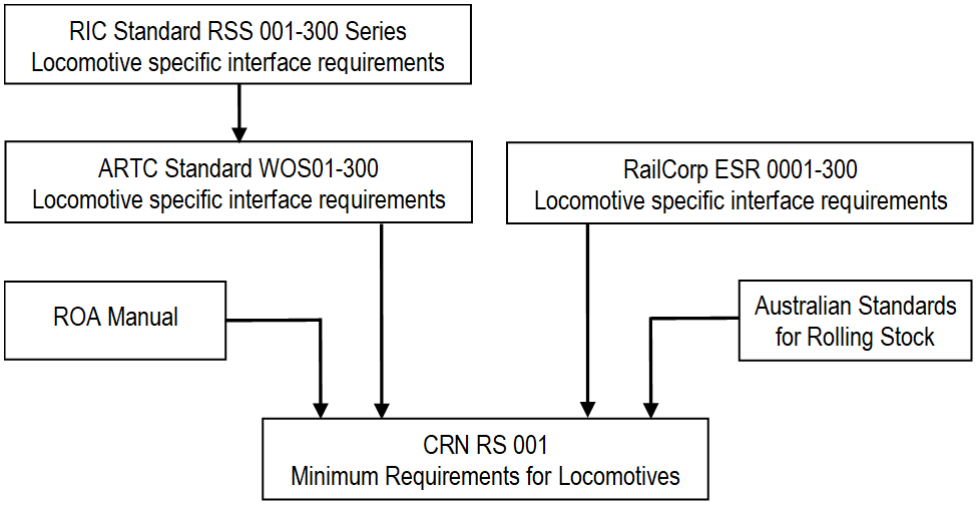
CRN RS 006 Minimum Operating Requirements for Road/Rail Infrastructure Maintenance Vehicles

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) 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 locomotive

For the purposes of interpretation of this standard a locomotive is a rail-bound prime mover designed to haul rail-bound rolling stock. Power cars which operate in multiple unit trains and do not carry passengers shall be treated as a locomotive and meet the requirements specified in this standard. Dedicated trailer cars that carry passengers and operate in conjunction with the above mentioned power cars shall be treated as locomotive hauled passenger cars and meet the requirements of the relevant standard covering those vehicles.

1.6 Locomotive design

Locomotive 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 locomotive 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 locomotive designs authorised to operate within New South Wales as at 29th January 2022, will be permitted to operate on the CRN under existing vehicle approvals.

As of 29th January 2022, newly introduced or substantially modified locomotives shall be subject to review and assessment, by the CRN, for compliance with the relevant standards and legislation. Locomotive owner/operators will be required to submit the necessary documentary evidence to verify that their locomotive is compliant.

Locomotives 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 Locomotives authorised to operate on the NSW Country Regional Network

Only locomotives approved to operate on the New South Wales rail network, accepted by the CRN 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.

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

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

Locomotive owner/operators must consult with the Environmental Protection Authority (EPA) and the CRN on the environmental standards that do or will apply to a locomotive 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 locomotive type, irrespective of the owner/operator, except where a locomotive type has been substantially modified from its original configuration.

Locomotives, 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 locomotives undergoing tests.

Locomotives with a defect as specified herein, sufficient for that locomotive 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 locomotives 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 locomotive 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 locomotive roadworthiness has been reinstated.

1.8 Acceptance of new locomotives

To apply for new locomotive acceptance the owner/operator shall complete the appropriate Vehicle Certification Request Form, CRN RF 001 and submit it to the CRN Manager.

Where testing is to be conducted on the locomotive/s refer to section 1.10 below.

Once a vehicle/s has been approved, details of the vehicle/s 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 locomotive design or operating conditions

Where a locomotive 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 locomotives

Testing of any locomotive/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 locomotives 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 locomotive 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 locomotive 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 locomotive/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 locomotives tested on the CRN or tested on other rail systems, the test results shall be submitted to CRN Manager for assessment, using the appropriate Locomotive Information Pack listed above.

2 Locomotive components

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

3 Wheels

Reference: AS7514.1 Wheels.

All locomotive 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:

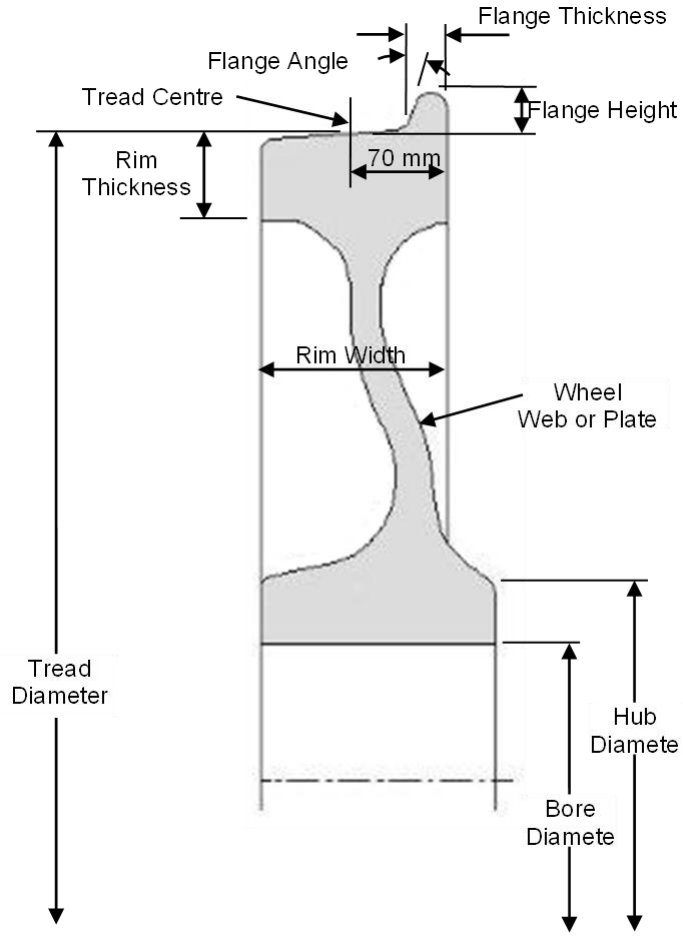


Figure 1 Wheel parts and principal dimensions

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 locomotive 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 locomotives 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 .1 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 locomotives.

3.3 Wheel web shape

Reference: AS7514.1 Section 3.3

S-Plate, low stress wheels are preferred for all locomotives where tread braking is performed, and shall be used on all locomotives 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

Reference: AS7514.1 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: AS7514.1 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 7514.1 Section 9.

3.7 Brake block compatibility

Reference: AS7514.1 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	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.

3.8 Wheel identification

Reference: AS7514.1 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..

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

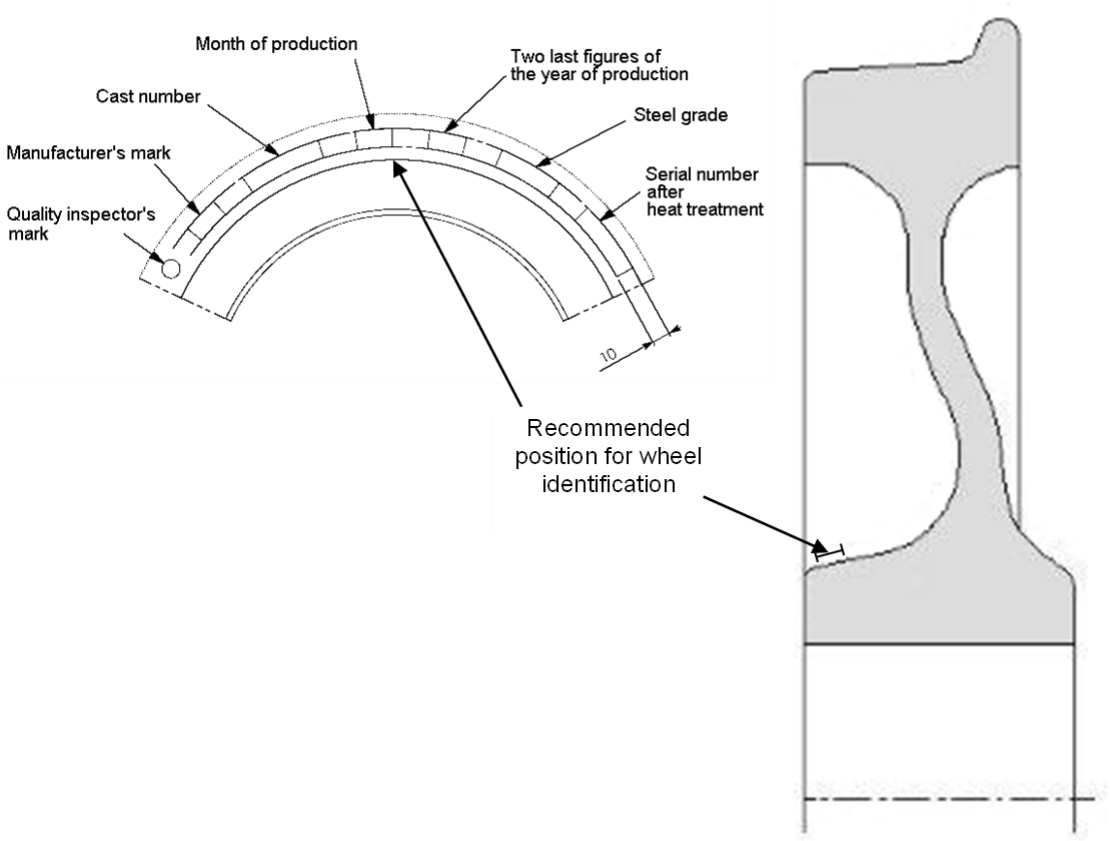


Figure 2 Wheel identification

3.9 Wheel profiles

Reference: AS7514.1 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 locomotives are sensitive to the higher conicity produced at the root radius resulting in bogie hunting instability. If locomotives 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.

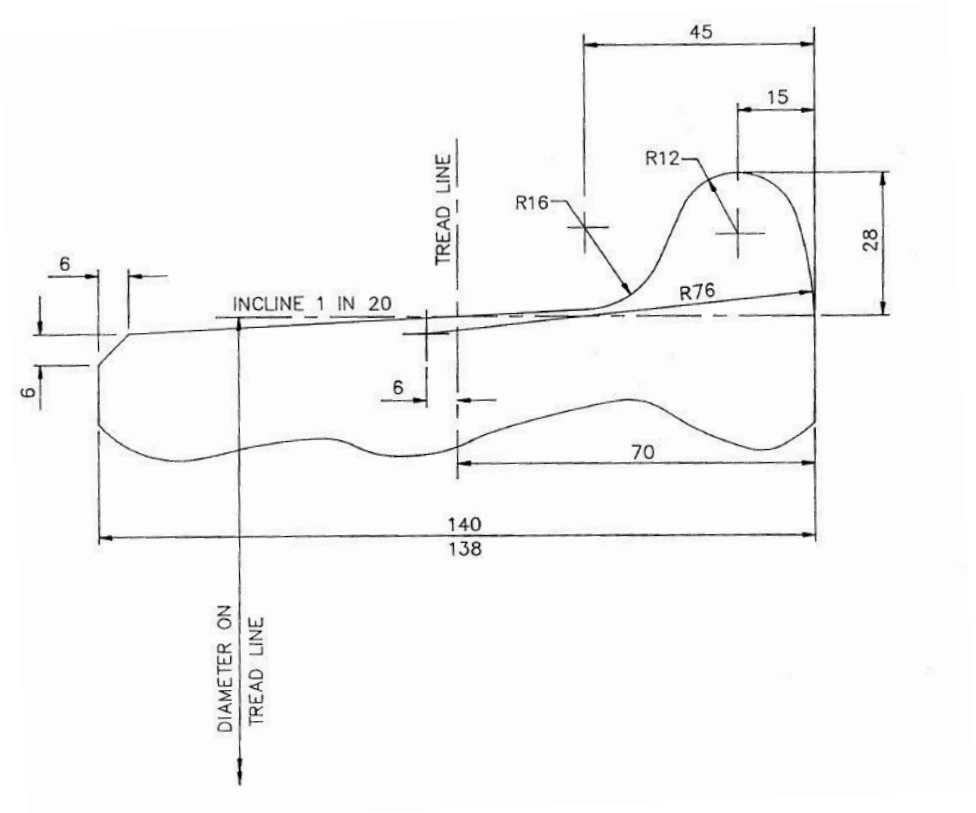


Figure 3 ANZR1 Wheel Tread Profile

The 7/8 flange variant of this 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.

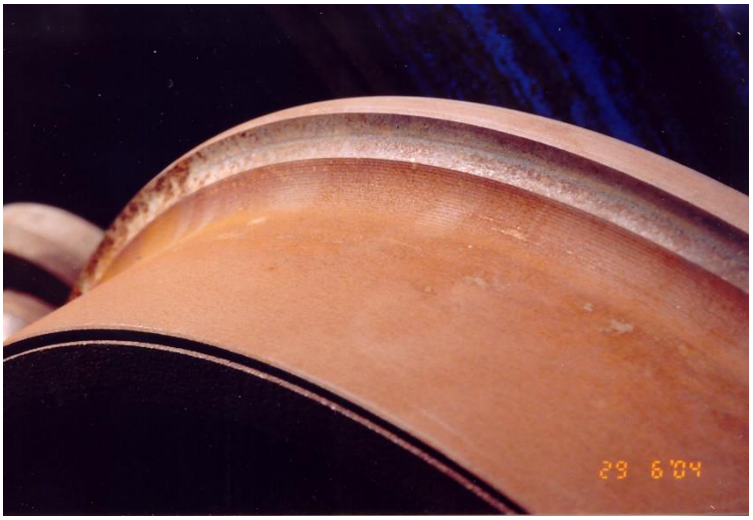
Undercutting, grooving or waviness of the tread surface between the flange back and the outer edge of the tread, is permitted but shall not exceed 0.25 mm in depth below the true tread profile.

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 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 Figure 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.



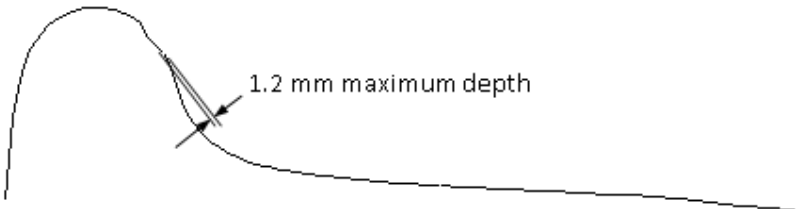


Figure 4 Witness mark dimensional limit

3.11 Tyred wheels

3.11.1 Locomotives fitted with tyred wheels

Reference: AS7514.1 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: AS7514.1 Section 11

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

3.12 Wheel generated noise

Reference: AS7514.1 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 locomotive 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: AS7514.1 Section 3.2

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

Vehicle Type	Minimum wheel rim thickness
Locomotives	22 mm (See Note)

Table 1Minimum wheel rim thickness

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

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: AS7515.1 Axles

4.1 Axle design

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: AS7515.1 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: AS7515.1 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: AS7515.1 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

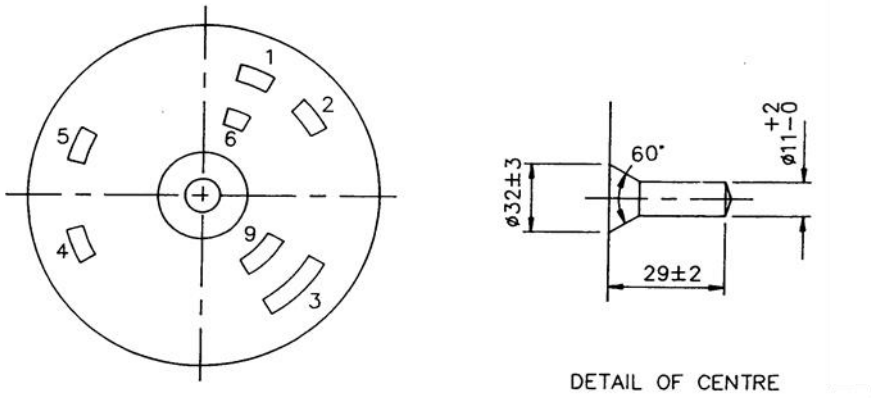
Reference: AS7515.1 Section 5.1 for new axles and Section 5.2 for existing axles.

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.



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 5 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: AS7515.1 Section 10

Locomotive 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: AS7515.1 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: AS7515.1 Section 8

The following axle defects will require a locomotive 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.

Whilst the major portion of a diesel electric locomotive axle is protected by the traction motor suspension tube there are portions of the axle outside the wheel boss which can be damaged. Also diesel hydraulic locomotives and steam locomotives have unprotected axles. Therefore in cases where the following defect is detected on an operational locomotive axle, the locomotive is to be worked out of service for repairs:

- Any locomotive 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 locomotive shall be immediately removed from service.

4.6.4 Action following derailment

Reference: AS7515.1 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: AS7515.1 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: AS7516.1 Axle Bearings

With the design and selection of locomotive 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: AS7516.1 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: AS7516.1 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: AS7516.1 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: AS7516.1 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: AS7516.1 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: AS7516.1 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: AS7516.1 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: AS7516.1 Section 3.3

Plain axle bearings should not be used for new designs.

Plain bearing applications shall be limited to heritage locomotives 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: AS7516.1 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: AS7516.1 Section 6.3

The owner/operator shall not place or continue in service a locomotive 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: AS7516.1 Section 6.3

The owner/operator shall not place or continue in service a locomotive 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: AS7516.1 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: AS7516.1 Section 6.3

The owner/operator shall not place or continue in service a locomotive 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: AS7517.1 - Wheelsets

6.1 Wheel and axle assembly

Reference: AS7517.1 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

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: AS7517.1 Section 3

On locomotives, the diameter variation between wheels on the same axle shall be in accordance with locomotive manufacturer's requirements, but they shall not exceed the following:

Locomotive Wheel	Maximum Variation in Tread Diameter per Axle
New or re-turned	**0.5 mm**
In service	**1 mm**

Table 2 Permitted variations in wheel diameter

6.4 Wheel back to back measurement

Reference: AS7517.1 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 Measurement of in-service wheelsets

Whilst wheelsets are in service, beneath a locomotive 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 locomotive 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 7517.1 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: AS7517.1 Section 6

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

The unique axle identification required by AS 7515.1 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: AS7519.1 Bogie Structural Requirements

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.

7.1 Design and manufacture

Reference: AS7519.1 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 7519.1.

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 AS7519.1 Section 7

Owner/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 AS7519.1 Section 8

Owner/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 AS7519.1 Section 9

An Owner/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: AS7518.1 - Suspension

This section covers the requirements applicable to locomotive suspension systems, including steel helical and flexicoil springs, hydraulic 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: AS7518.1 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.

8.2 Suspension spring defects

Reference: AS7518.1 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: AS7518.1 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;
- Traction motor nose suspension elements.

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: AS7518.1 Section 5.2

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

Acceptable standards are set out in AS 7518.1 Section 5.2.

8.3.3 Resilient suspension maintenance

Reference: AS7518.1 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 have become common place in locomotive 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.

8.3.4 Resilient suspension defects

Reference: AS7518.1 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: AS7518.1 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 locomotive wear.

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

8.4.1 Hydraulic damper inspection and maintenance

Reference: AS7518.1 Section 4.2.2

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

8.4.2 Friction damper inspection and maintenance

Reference: AS7518.1 Section 4.3.2

Owner/operators shall have maintenance procedures which cater for the regular maintenance and re-qualification of suspension friction dampers to ensure optimum and safe locomotive ride performance.

Friction dampers, friction surfaces or wear plates typically are not lubricated or painted (except by design).

8.4.3 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.

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

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

9 Bogie side bearers

Some locomotives 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 locomotive body roll of rock stability it is important that the gap provided, be sufficient to allow the locomotive to safely accommodate track twist.

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

9.2 Constant contact side bearers

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

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

10 Bogie brake equipment

Locomotives 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 locomotives are fitted with unit brakes operating on the wheel tread on one side of each wheel.

10.1 Securing of brake gear

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

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.

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

10.2 Spring parking or hand brake

All locomotives shall be fitted with a parking brake system capable of securing the locomotive 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 shall be train lined, using control wires 25 and 26, to ensure the leading locomotive has indication covering all locomotives in the consist.

10.3 Locomotive brake block force

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

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

Brake Block Type	Minimum Net Brake Ratio	
	Automatic Brake	Independent Brake
High friction composite	**30 %**	**50 %**
Cast Iron	**28 %**	**45 %**

Table 3 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.

10.4 Brake block requirements

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

11 Brakes and pneumatic equipment

All vehicles that are required to operate within a train or as a train shall be fitted with a failsafe automatic brake system.

The automatic brake system fitted to locomotives operating on the CRN shall be compatible with all existing locomotives and hauled vehicles. Specific provisions apply to hauled vehicles fitted with stand alone ECP brake systems.

11.1 General requirements

Reference: AS7510.1 Locomotive Braking Systems

Locomotive braking systems design and operation shall comply with this standard or AS 7510.1, whichever specifies the more stringent requirement.

In general, locomotive brake systems shall consist of pneumatic control equipment to provide for an automatic air brake system and a locomotive independent brake system.

The brake control system on new or substantially modified locomotive 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.

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

The standard locomotive 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.

Some earlier locomotive 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 locomotive.

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

11.2 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.

12 Brake and control equipment compatibility

Reference: AS7510.6 Train Braking

The braking systems and equipment fitted to locomotives must be compatible with the brake systems and equipment of vehicles being hauled by the locomotive, to ensure that the brakes apply and release as required, otherwise skidded or scaled wheels could occur.

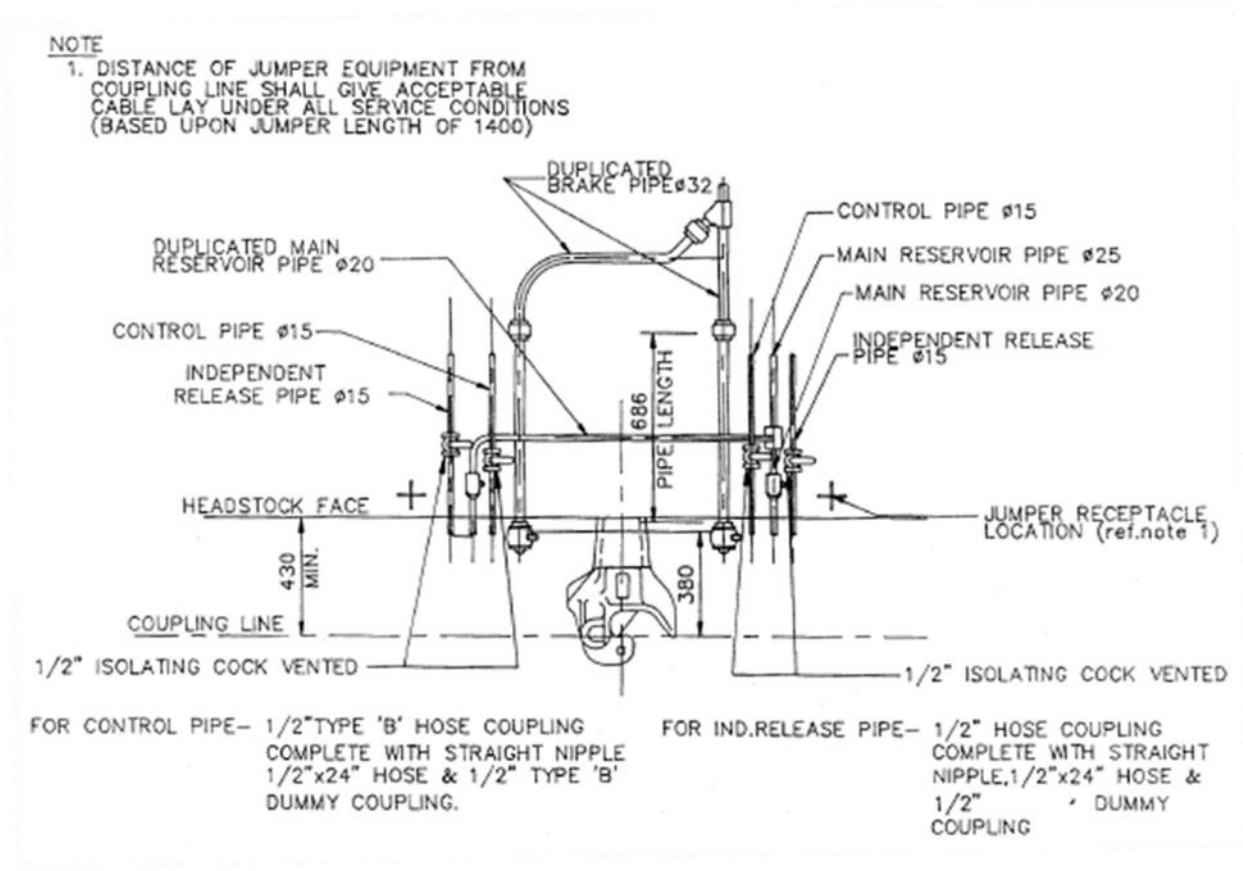


Figure 6 Bifurcated brake and control pipe layout

12.1 Location of end control equipment

Locomotives shall have end coupling cocks, hoses and jumper control cables located as shown in Figures 7 above and Figure 8 below.

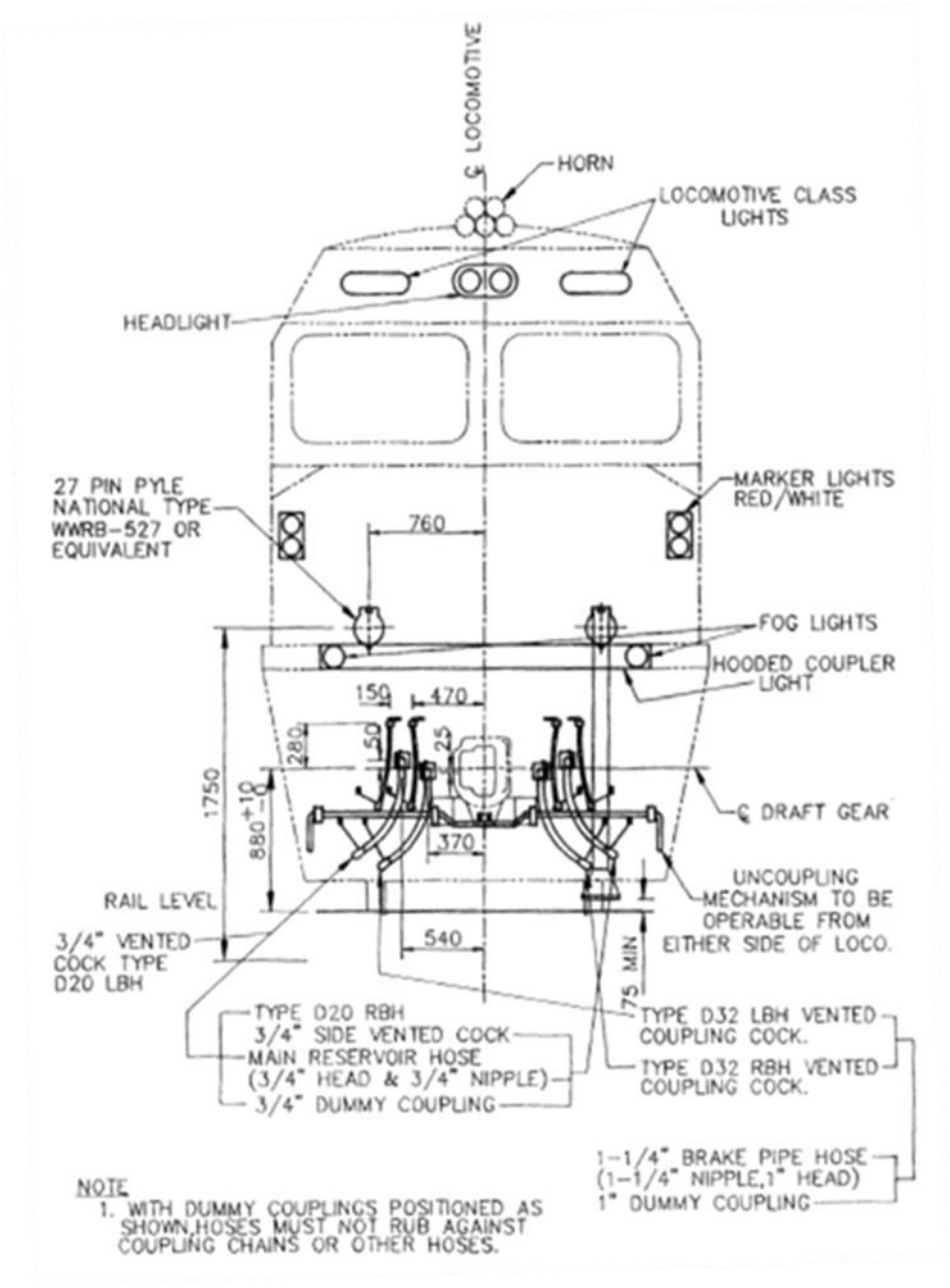


Figure 7 Location of locomotive end equipment

12.2 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 — 25 mm
- Locomotive control pipe — 12 mm
- Independent brake release — 12 mm

Coupling heads shall be:

- Brake pipe — 32 mm coupling hose head

- Main reservoir — 25 mm coupling hose head
- Locomotive control pipe — 19 mm coupling hose head
- Independent brake release — 12 mm coupling hose head.

Brake hose coupling heads shall be in accordance with Figure 9

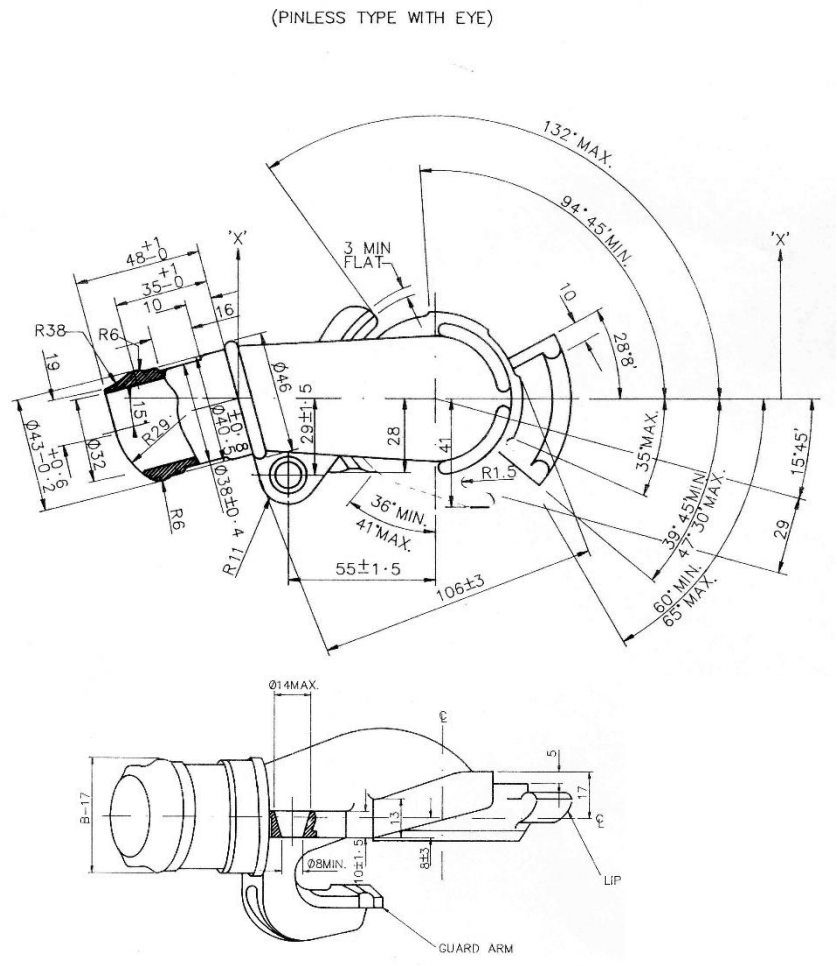


Figure 8 Air brake coupling hose head

12.3 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).

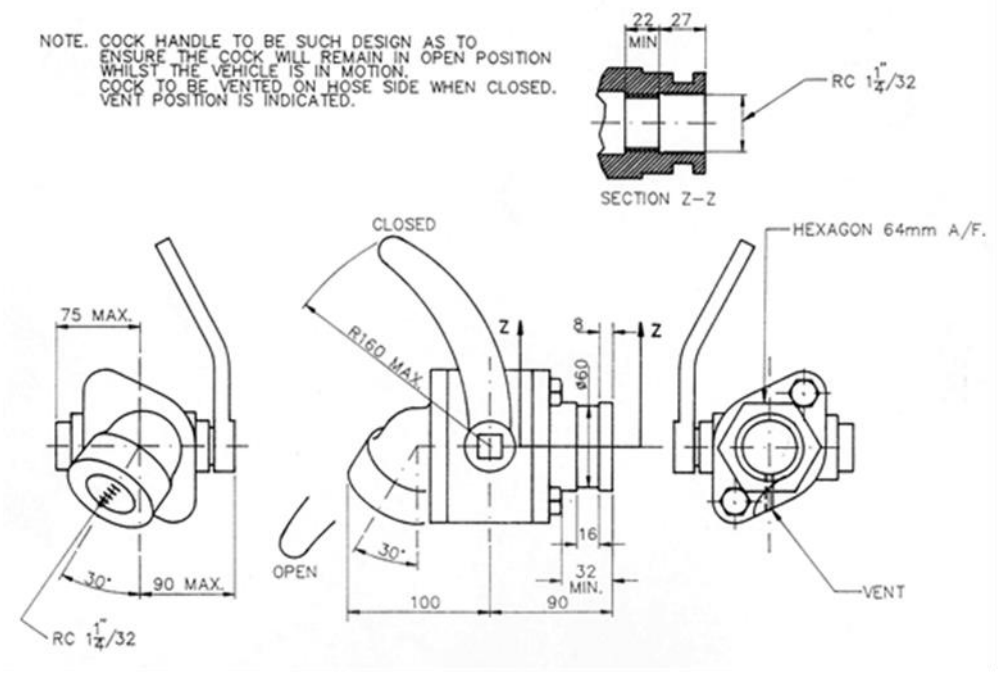


Figure 9 Brake pipe coupling cock

12.4 MR, No. 3 and No. 4 pipe coupling cocks

Main reservoir, No. 3 independent brake control pipe and No. 4 independent brake release pipe coupling cocks shall be approved ball type cocks with spring loaded or positively latching handles to prevent their accidental operation to the closed position. These coupling cocks shall be readily

accessible and adequately protected from damage in the event of a collision. Handles shall be straight.

12.5 Identification and marking of cocks

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

12.6 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.

12.7 Air reservoirs

Air reservoirs shall be designed and tested in accordance with Australian Standard AS1210 for unfired pressure vessels.

There shall be procedures in place covering the regular inspection, maintenance and testing of locomotive air reservoirs and drain valves.

12.8 Standard brake pressures and timings

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

12.8.1 Pressure settings:

The standard pressure settings are as follows:

- Main reservoir safety valves — Up to 965 kPa
- Brake pipe — 500 kPa

Brake cylinder pressure:

- Automatic and emergency application — Locomotive type dependent
- Independent application (control pipe) — Locomotive type dependent
- Independent (brake cylinder pressure) — Locomotive type dependent
- Brake cylinder pressure warning light — 10 kPa cut out, 40 kPa cut in

Additional settings

- Vigilance suppression (b/c pressure) — 170 kPa
- Dynamic brake interlock (b/c pressure) — 100 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.

12.8.2 Brake timings

The standard timings are as follows:

Independent brake:

- Application 0-500 kPa: 3 seconds
- Release 300 to 30 kPa: 4-5 seconds

Automatic brake:

Full service application:

- Equalising 500-350 kPa 4.5-7 seconds
- Brake cylinder 0-80% of full pressurekPa 5-10 seconds

Emergency application:

- Brake cylinder 0-350 kPa 5-10 seconds
- Brake pipe 500-30 kPa 3.5-6 seconds
- Equalising reservoir 500-100 kPa then to zero 20 seconds

Release:

From full service:

- Brake cylinder Full pressure-30 kPa 6-9 seconds
- Equalising and brake pipe pressure 350-500 kPa 3 seconds

From emergency:

- Brake cylinder 350-30 kPa 6-9 seconds

Spring parking brake

- Off to fully applied 6-8 seconds

12.9 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 locomotive.

12.10 ECP Brakes

Reference: AS7510.1 Section 6

The functional properties of ECP brake equipment on locomotives shall be inter-operable with an ECP brake system conforming to the requirements specified in AAR Manual of Standards, Section E-II.

The ECP brake system on the locomotive shall be compatible with ECP brake equipment fitted to vehicles being hauled.

ECP functionality shall be tested for correct operation on all train configurations for which it is intended to operate.

It is recommended that locomotives have the ability to switch between an ECP brake and a conventional automatic air brake control in order to provide locomotive versatility.

Locomotives without ECP fitted may be train wired to permit such locomotives to be used on ECP trains as support locomotives only.

Locomotives with ECP control shall be fitted with vent valves which functions to deplete brake pipe air locally at a rapid rate to assist in propagating an emergency brake application whenever the main line of brake pipe pressure is reduced at an emergency rate.

13 Dynamic brake

Reference: AS7510.1 Section 4

It is recommended that locomotives, where practicable, be equipped with extended range dynamic brake. The system shall make the maximum possible use of the energy transfer capability of the traction system in order to provide the maximum braking effort from this feature. The dynamic

brake shall provide a constant maximum braking effort over as wide a speed range as possible (nominally from 50 km/h to as near as possible to zero speed).

13.1 Inoperative dynamic brake

Locomotives without an operative dynamic brake may be subject to restrictions when operating as light locomotives steep descending grades in NSW. Refer to RailCorp's TOC Manual for dynamic brake restrictions between Katoomba and Valley Heights.

14 Body and underframe

Reference: AS7520.1 – Body Structural Requirements

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

Some earlier designs of locomotives 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 locomotives may not need to meet the requirements below, but due regard shall be given to the application and the operation in which these locomotives are proposed to be used.

14.1 Design loads and stresses

14.1.1 Shock loads:

Reference: AS7520.1 Section 15.2

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/s^2

14.1.1 Proof loads

Reference: AS7520.1 Section 7

The vehicle shall be designed to withstand the longitudinal and vertical loads set out in AS7520.1 Section 7.

14.1.2 Fatigue loads

Reference: AS7520.1 Section 8

The vehicle shall be designed to withstand the fatigue loads set out in AS7520.1 Section 8.

14.2 Couplers and draftgear

Reference: AS7524.1 Drawgear

Automatic couplers and draftgear shall comply with the requirements specified in CRN Standard CRN RS 008, Section 6

Locomotive coupler heights shall be within the following limits:

New or overhauled condition with full provisions 880 to 890 mm.

In service condition 780 to 915 mm.

14.3 Cowcatcher or pilot

Locomotives 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 locomotive.

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.

14.4 Locomotive control jumper couplings

For multiple unit operation, locomotives should be fitted with standard 27 pin jumper control couplings. Jumper coupling plug and socket connections shall be fitted to diagonally opposite corners at each end of the locomotive.

The standard jumper coupling is the Pyle National Type WWRB 527 coupling. The coupling shall not be more than 1750 mm above rail.

The locomotive should be fitted with dummy sockets to store the couplings when not in use.

The train wire allocation, designation and function shall be in accordance with Table 5

Pin Number	Standard Function	Standard Code
1	Spare	
2	Alarm signal	SG
3	Engine speed	DV
4	Negative	N
5	Manual power control set-up	
6	Generator field	
7	Engine speed	CV
8	Forward	FO
9	Reverse	RE
10	Wheel slip	WS
11	Manual power control	_
12	Engine speed	BV
13	Pos control	PC

Pin Number	Standard Function	Standard Code
14	Brake cylinder pressure	BCP
15	Engine speed	AV
16	Engine run	ER
17	Dynamic brake set-up	B
18	Select–a-power	_
19	Spare	
20	Brake warning light	BW
21	Dynamic brake	BG
22	Compressor synchronisation	CC
23	Sanding	SA
24	Brake control – dynamic brake excitation	BC
25	Park brake on	
26	Park brake off	
27	Spare	

Table 4 Standard locomotive control wire designations and functions

14.5 Locomotive cab security

All locomotives should be fitted with a means of locking the driver's cab/s when the cab or locomotive is unattended. This is mandatory for locomotives used or proposed for driver only operation.

14.6 Locomotive toilets

Toilets installed on locomotives shall not discharge untreated waste 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.

14.7 Fire and smoke control

All materials used in the construction of locomotives shall be selected so as to minimise the risk of fire and retard the spread fire by limiting the effect of the materials in supporting combustion.

Particular attention shall be given to the fire resistance, flammability and toxicity properties of materials used in the construction of rolling stock.

The vehicle design and construction shall minimise the potential for a fire to spread rapidly throughout the vehicle, into the roof space, or to adjoining vehicles or buildings and structures.

Locomotives shall have spark arresting equipment to prevent the egress of hot exhaust particles capable of causing track side fires. Refer to Clause 17.2 herein.

14.8 Marking and identification

14.8.1 Code and number

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

Locomotives shall be fitted with back illuminated number boxes at each leading end.

14.8.2 Markings

Locomotives shall have the fully provisioned mass, the tare mass and the coupled length stencilled on each side of the locomotive at or about underframe/solebar level.

14.8.3 Locomotive end colours

For on-track visual safety, the frontal area of new or substantially modified locomotives 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 locomotives shall have sufficient frontal area painted in one or more of the proposed colours, sufficient to enable the approaching locomotive to be seen from a safe distance.

14.8.4 Reflective delineators

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

14.8.5 AEI Tags

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

14.8.6 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 number lights, end contrasting colours and reflective delineators.

15 Locomotive performance

The performance of the locomotive 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 locomotive on the CRN. For performance testing refer to CRN Standard CRN RS 010.

15.1 Locomotive noise

Locomotive noise is an important performance consideration as it requires endorsement by the NSW Environment Protection Authority (EPA) before the locomotive will be approved to operate on the CRN. For noise requirements refer to CRN Standard CRN RS 008.

15.2 Locomotive mass and mass distribution

Locomotives shall be type tested to determine the fully provisioned mass, as well as the loads on individual axles.

It is in the interest of locomotive owner/operators that their locomotive 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 locomotive mass for operation on the CRN main line corridors is 134 tonnes (22.3 tonnes per axle). Locomotives with a higher gross mass may be considered but they may be subject to restricted operations.

For all branch line operations the maximum locomotive mass is 132 tonnes (22 tonnes per axle). Locomotives with a gross mass exceeding 132 tonnes may be accepted on branch lines with a reduced mass controlled by fuel loading.

15.3 Traction performance

Traction performance tests shall be carried out for each type of locomotive to determine the loads that the locomotive can be expected to haul under all weather conditions.

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

Following successful tests, the agreed locomotive loads and conditions, for operation on the CRN, will be published in the CRN Train Operating Conditions manual.

15.3.1 Sand

Locomotives generally use sand to enhance their adhesion capabilities in poor weather conditions.

Locomotives required for operation on the CRN shall have sanding equipment installed and have adequate measures in place to correctly control sand dispersal and prevent sand leakage and abnormal/excessive sanding.

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

Locomotives 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.

15.3.2 Wheelslip control

All locomotives shall be fitted with a suitable traction control system to prevent uncontrolled wheelslip.

Locomotive types that demonstrate consistent wheelslip problems shall have their ruling load reduced to provide a more manageable level of adhesion.

New or substantially modified locomotives shall be fitted with a suitable traction control system to prevent uncontrolled wheelslip. Notwithstanding the above requirements, wheelslip detection shall be train lined to ensure that wheelslip on any or all locomotives in a multiple unit consist is capable of being monitored by the driver.

15.4 Braking performance

Braking performance is specified to ensure that a locomotive is compatible with current CRN signalling systems and can safely control and stop itself or an attached train.

15.4.1 Static brake performance

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

15.4.2 On-track brake performance

Reference: AS7510.1 Brake systems

Braking performance of a locomotive with high friction composite brake blocks shall comply with the requirements in Table 6:

A full service application of the locomotive automatic brake shall be able to stop the locomotive on level tangent track, with dry rails, within the following maximum distances:

Speed (km/h)	Stopping distance (metres)
20	50
40	150
60	280
80	460
100	680
120	940
140	1240

Table 5 Minimum stopping distances with high friction brake blocks

Braking performance of the locomotive with low or medium friction composite brake blocks or cast iron brake blocks shall comply with the requirements in Table 7:

A full service application of the locomotive automatic brake shall be able to stop the locomotive on level tangent track, with dry rails, within the following maximum distances

Speed (km/h)	Stopping distance (metres) (GW16)
20	94
40	281
60	523
80	836
100	1229
115	1587

Table 6 Minimum stopping distances (not high friction brake blocks)

15.4.3 Locomotives hauled dead attached

Locomotives that are to be hauled dead attached 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.

16 Locomotive safety equipment

16.1 Driver's safety system

Each locomotive, except those specified below, shall be fitted with driver's safety systems as specified in CRN Standard CRN RS 013.

- Some locomotives, eg shunting locomotives and shunting tractors which are confined to shunting yards, may be exempt from this requirement for shunting use only. Where such a locomotive may possibly be used on a train or travel light engine on the CRN it shall comply with the above requirements or operate under special conditions as determined by the CRN.
- Steam and heritage locomotives may be exempt from this requirement and operate under special conditions as determined by the CRN Manager.
- Locomotives, such as "B units", which are not fitted with driver's cabs.

16.2 Speed indicating device

Each locomotive driving position shall have an operating speed indicating device.

Speed indicating devices which are displayed digitally on a VDU (Visual Display Unit) shall display the speed to an accuracy of +/- 0.5 km/h or better, when compared to the true vehicle speed, at all times.

Analogue (gauge type) speed indicating devices shall display speed to an accuracy of +/-2.5 km/h or better, when compared to the true vehicle speed, at all times.

Verification of the speed indicating devices on new or substantially modified locomotives 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.

16.3 Data logger/recorder

Each locomotive, except those specified below, shall be fitted with a functioning, reliable and accurate data recording/logger system.

The system shall meet the requirements of the Independent Transport Safety Regulator Rail Safety Compliance Code for Data Loggers. This Guidance Material is available via the ITSR website at:

http://www.transportregulator.nsw.gov.au/rail/rules-laws/rscc_data_loggers

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

Some locomotives, eg shunting locomotives and shunting tractors, which are confined to shunting yards, may be exempt from this requirement for shunting use only. Where such a locomotive may possibly be used on a train or travel light engine on the CRN it shall comply with the above requirements.

16.4 Driver's emergency cock

Locomotives 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.

16.5 Flowmeter

Locomotives shall have a reliable means of indicating both audibly and visually, that air is flowing to the brake pipe.

16.6 Emergency equipment

Each locomotive, 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.

Some locomotives, eg shunting locomotives and shunting tractors which are confined to shunting yards, may be exempt from this requirement for shunting use only. Where such a locomotive may possibly be used on a train or travel light engine on the CRN it shall comply with the above requirements.

16.7 Communications

Locomotives, except those specified below, shall be fitted with a train radio system. Radio frequencies shall be approved by the CRN Manager. Refer to CRN Standard CRN RS 018.

Some locomotives, eg shunting locomotives and shunting tractors which are confined to shunting yards, may be exempt from this requirement for shunting use only. Where such a locomotive may possibly be used on a train or travel light engine on the CRN it shall comply with the above requirements.

16.8 Lights

Reference: AS7531.1 Lighting & Rolling Stock Visibility

Each locomotive shall be fitted with headlights, tail lights, marker lights, visibility lights in accordance with CRN Standard CRN RS 008.

Some earlier designs of locomotives 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 locomotives.

16.9 Horns

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

17 Locomotive type specific requirements

This section includes specific requirements for diesel/electric, diesel/hydraulic and steam locomotives.

17.1 Hauling a dead diesel/hydraulic locomotive

The operator/owner shall have procedures in place for hauling a diesel hydraulic locomotive dead. These procedures shall include the brake sensitivity test requirements specify under what conditions the Cardan shaft must be removed and the allowable maximum speeds for such movements.

17.2 Spark arresters

All diesel locomotives shall be fitted with spark emission control devices (spark arresters) in accordance with AS 1019 Internal Combustion Engines – Spark Emission Control Devices.

NOTE: Refer to AS 1019, Section 9, for exhaust systems and turbochargers that are deemed to comply as spark emission control devices.

17.3 Steam locomotives

All steam locomotives shall comply with the requirements contained in this standard together with the following additional requirements relating to steam locomotives.

17.3.1 Boiler inspections

Each steam locomotive shall have a scheduled boiler inspection in accordance with the requirements of the WorkCover Authority.

17.3.2 Flangeless wheels

Some steam locomotives are fitted with flangeless driving wheels. Such wheels present a risk of striking raised check rails. Details of flangeless wheels must be provided to the CRN Manager for assessment.

17.3.3 Firebox servicing

Owner/operators shall not discharge the firebox or ash pan onto the CRN tracks.

17.3.4 Bushfire danger

The operation of steam locomotives during hot weather presents a high risk of bush fires particularly in country regions therefore the operation of steam locomotives may be restricted by seasonal weather and region. Such operations will be at the discretion of the CRN Manager.

17.4 Driver only operation

This section covers specific requirements relating to locomotives used in driver only operation.

17.4.1 Additional equipment

Lead locomotives of a Driver Only Operated train shall:-

- be fitted with a pressure maintaining brake valve.
- be fitted with working ‘on board’ communications equipment which provides direct communications with the Train Control Centre.
- have reduced vigilance control system timings in accordance with CRN Standard CRN RS 013.
- have a second driver safety system in accordance with CRN Standard CRN RS 013.
- not be operated with long end leading in the case of single cab locomotives.
- be fitted with door locks to prevent illegal entry of the cab while locomotive is unattended.
- have a Dump Valve Clamp (DVC) carried in the lead locomotive for tethering the locomotive brake pipe to the rail.

17.4.2 Operating approval

Approval must be obtained from the CRN Manager before commencing a Driver Only train operation.

17.5 Remote controlled locomotives

Remote control locomotives can be operated either from a ground based controller or from another locomotive under a distributed power train configuration.

17.5.1 Ground based remote control

Ground based remote control of locomotives is feasible and may be proposed in private sidings, but such a controlled operation is not permitted on the CRN.

17.5.2 Distributed power remote control

Remote control of locomotives may be achieved by distributing motive power throughout a train consist and/or at the rear of the train but such an operation will be subject to approval by the CRN Manager.

The remote locomotive must be controlled from the leading locomotive on the train. Such control can be obtained with hard wiring or by a radio signal.

Distributed power controlled train operation through a radio signal shall be subject to significant on-track testing to verify that the proposed operation is feasible and reliable.

Distributed power controlled train operations through the use of train wires, such as that fitted to an ECP train, is a more attractive proposal and therefore such an operation is possible with the approval of the CRN Manager.

Refer to Distributed Power in Locomotive Operations, General Instruction Pages of the CRN Train Operating Conditions manual.

17.5.3 Radio controlled remote control

All radio control equipment must be approved by the CRN Manager.

17.6 In-line Refuelling

Locomotives equipped with in-line refuelling equipment are permitted to operate on the CRN however the operation of locomotives utilising in-line refuelling are not permitted without prior authorisation from the CRN Manager.

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	UGLRL Pty Ltd, 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