

# UGL REGIONAL LINX



## VEHICLE ACCEPTANCE TEST AND INSPECTION REQUIREMENTS

CRN-STD-ROL-713026361-496

CRN RS 010

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## Document Control

Function	Position	Name	Date
<b>Approver</b>	A&E Manager	Lucio Favotto	29.11.2021

Revision	Issue Date	Revision Description
<b>2.1</b>	09.11.2021	UGLRL Operational Standards Template applied
<b>3.0</b>	29.11.2021	First approved and issued UGLRL version

## Summary of changes from previous version

Section	Summary of change
<b>20.2</b>	Minor grammatical correction
<b>All</b>	This document is based on the previous rail infrastructure maintainer (RIM). Full revision history is available on request from UGLRL

# 1 Vehicle acceptance test/inspection requirements

## 1.1 Introduction

This document is an Appendix to each of the following rolling stock minimum operating standards and covers the testing/inspection requirements necessary for vehicles to gain acceptance for operation on the NSW Country Regional Network (CRN).

- Locomotives CRN RS 001
- Freight vehicles CRN RS 002
- Locomotive hauled passenger vehicles CRN RS 003
- Multiple unit trains CRN RS 004
- On-track infrastructure maintenance vehicles CRN RS 005
- Road/rail infrastructure maintenance vehicles CRN RS 006

## 1.2 Test/inspection requirements

The following sections cover the common acceptance test requirements for vehicle compatibility with the CRN infrastructure, other rolling stock and the environment.

The following table provides a complete list of vehicle acceptance test/inspections and the reference to the appropriate Clauses within this standard.

Test Section No	Acceptance test/inspection	Reference	Static Test	Dynamic Test
2	Static rolling stock outline test	Section 2	X	
3	Static vehicle weigh test	Section 3	X	
4	Static vehicle twist test	Section 4	X	
5	Static vehicle/bogie swing test	Section 5	X	
6	Static vehicle/vehicle swing test	Section 6	X \$	
7	Static brake tests	Section 7	X	
8	Safety equipment functionality test	Section 8	X	
9	Signal visibility test	Section 9	X	
10	Personnel safety inspection	Section 10	X	
11	AEI tag installation inspection	Section 11	X	
12	Reflective delineator inspection	Section 12	X	
13	Vehicle recovery equipment inspection	Section 13	X	
14	Kinematic rolling stock outline test	Section 14	X	X \$
15	Environmental tests	Section 15	X	X
16	Signal compatibility test	Section 16		X

**Table 1 - List of vehicle compatibility tests**

Test Section No	Acceptance test/inspection	Reference	Static Test	Dynamic Test
17	Signal & communication system interference test	Section 17		X
18	Brake performance test	Section 18		X
19	Ride performance test	Section 19		X
20	Pitch & bounce performance test	Section 20		X \$
21	Traction performance test	Section 21		X
22	Vehicle structural tests	Section 22		X
23	P2 Force wheel impact test	Section 23		X
24	Curve stability test	Section 24		X

**Table 1 (Continued) - List of vehicle compatibility tests**

\$ This test may be conducted using a validated vehicle simulation package.

Test Section No.	Static Acceptance Test/Inspection	Reference	Pre-requisite Static Tests Reference. No.
2	Static rolling stock outline test	CRN RS 008, Section 2	
3	Static vehicle weigh test	CRN RS 008, Section 3	
4	Static vehicle twist test	CRN RS 008, Section 4	Section 3
5	Static vehicle/bogie swing test	CRN RS 008, Section 5	
6	Static vehicle/vehicle swing test	CRN RS 008, Section 6	
7	Static brake test	CRN RS 008, Section 7	
8	Safety equipment function test #	CRN RS 008, Section 8	
9	Signal visibility test #	CRN RS 008, Section 9	
10	Electrical safety inspection	CRN RS 008, Section 13	
11	AEI tag installation inspection	CRN RS 008, Section 14	
12	Reflective delineator inspection	CRN RS 008, Section 15	
13	Vehicle recovery equipment inspection	CRN RS 008, Section 16	
14	Environmental tests	CRN RS 008, Section 17	

**Table 2 - Sequencing of static tests**

# Tests 9 & 10 are for self-propelled vehicles only. These tests are not compulsory for the locomotive hauled movement of the vehicle.

### 1.3 Sequencing of tests

It is important that static tests be carried out in the above sequence to ensure that all necessary pre-requisite tests have been performed before subsequent testing is carried out.

Generally, static tests must be completed before any dynamic tests are undertaken.

Following successful completion of the above test/inspections, Parts A, B and C of the appropriate Vehicle Information Pack must be submitted as confirmation of vehicle's compliance.

### 1.3.1 Static test/inspections

The above static tests/inspections must be successfully carried out prior to any movements of the vehicle on the CRN:

### 1.3.2 Dynamic tests

The following dynamic tests are required before full operating approval is granted for the vehicle.

These tests can only be commenced after successful completion of all the static tests and a CRN TOC Waiver has been issued.

Test Section No.	Dynamic compatibility test	Reference	Pre-requisite dynamic tests reference No.	Tests where monitoring is required See Section 1.3.4
15	Kinematic rolling stock outline test	CRN RS 008, Section 18	16 and 17 unless test done in a possession	18, 19
16	Signal compatibility test	CRN RS 008, Section 19		15, 18, 19
17	Signal & communication system interference test	CRN RS 008, Section 20		15, 18, 19
18	Brake performance test	CRN RS 008, Section 21	16 and 17 unless test done in a possession	15, 19
19	Ride performance test	CRN RS 008, Section 22	16 and 17 unless test done in a possession	15, 18
20	Pitch & bounce performance test	CRN RS 008, Section 23	16 and 17 unless test done in a possession	15, 19
21	Traction performance test	CRN RS 008, Section 24		15, 18, 19

**Table 3 - Dynamic tests**

The following tests are optional.

Test Clause No.	Dynamic Compatibility Test	Reference	Pre-requisite Dynamic Tests Reference No.	Tests where monitoring is required See Section 1.3.4
22	Vehicle structural tests	CRN RS 008, Section 25		
23	P2 Force wheel impact test	CRN RS 008, Section 26	16 and 17 unless test done in a possession	
24	Curve stability tests	CRN RS 008, Section 27		

**Table 4 - Optional dynamic tests**

### 1.3.3 Movement of test vehicles on the CRN

The following requirements apply for the movement of test vehicles on the CRN until such time as the appropriate dynamic tests, for each vehicle type, have been completed and accepted:

- Self-propelled vehicle shall be locomotive hauled in the unpowered state.



- The maximum speed for the movement shall not exceed 70% of the maximum designed operating speed for the vehicle.
- The ride performance shall be monitored in real time to the requirements specified in Section 19 for each vehicle type involved.
- The maximum speed in curves shall be limited to 10% below the normal speed board.
- Except for freight vehicles, manual block working conditions shall apply for any movement of vehicles on the CRN.

Before any movement of a vehicle on the CRN, a CRN TOC Waiver must be issued. Where a set of vehicles are to be tested and individual vehicles in the set are different, such as motor and trailer cars, testing must be conducted for each vehicle type involved.

#### **1.3.4 Monitoring vehicle dynamic performance during tests**

When conducting dynamic on-track tests such as a brake performance test, a ride performance test or a kinematic rolling stock outline test, each of those vehicle performance parameters must be monitored to ensure that no one or more parameter/s exceeds their allowable limits.

Where a set of vehicles is to be tested and individual vehicles in the set are different, such as motor and trailer cars, the monitoring must be conducted on each vehicle type during the tests.

The allowable limits for each test parameter are the same as those which would apply for a particular performance parameter, if it were the principal test.

The principal test would be undertaken commencing at a low speed and increasing the speed in appropriate increments, whilst monitoring the other performance parameters, and only increasing the speed where all performance parameters remain within the allowable limits specified for each particular parameter.

Once the appropriate monitoring of tests has been undertaken for a particular vehicle configuration, successive testing can be undertaken without further monitoring of those test parameters. In this case the maximum vehicle speed for normal operation will be limited to 10/11ths of the maximum test speed at which the allowable limits were maintained during the ride performance monitoring tests.

For example, if a vehicle's ride is monitored to a maximum speed of 110 km/h, and its performance is within the limits specified in CRN Standard CRN RS 008, Section 22, then that vehicle's speed will be limited to a maximum of 100 km/h for operation without the need for further monitoring.

As an alternative to monitoring the kinematic rolling stock outline compliance, the vehicle speed can be limited to 10% below the normal speed boards, provided that the ride performance is satisfactory at 10% above this limited speed.

For example, a vehicle may be operated to a maximum speed of 90 km/h in an area where the posted speed sign is 100 km/h, and the kinematic rolling stock outline performance does not need to be monitored, provided the static part of the kinematic rolling stock outline test has been performed and meets the requirements of CRN Standard CRN RS 008 Section 18.

If the vehicle configuration has changed since the last monitored test, then further monitoring of tests will be required, to establish that the configuration change has not compromised the vehicle's performance and it remains within allowable limits for all parameters. Further monitoring of tests is only required where a particular performance parameter has been adversely affected by the configuration change.

## **2 Static rolling stock outline test**

### **2.1 Introduction**

This test is required to ensure that the vehicle is constructed within the confines of the particular static rolling stock outline specified for that vehicle type and the corridor/s along which the vehicle is to operate. Refer to CRN Standard CRN RS 008 Section 2.

No part of the vehicle shall infringe the static rolling stock outline, for unrestricted operation, under any condition of loading and wear.

An infringement on the rolling stock outline is not acceptable unless specifically authorised in writing by a CRN Rolling Stock Standards Waiver or Exemption Certificate.

When an existing vehicle design has been modified, such that the modification results in an infringement of the rolling stock outline, the vehicle shall be re-assessed.

### **2.2 Test configuration**

The vehicle shall first be measured in the free standing tare condition on level straight track with new wheels. Vehicles which carry provisions such as fuel, sand and water shall be measured in the un-provisioned state.

The vehicle shall then be assessed with simulated solid load bearing springs, fully worn wheels and any other fully worn wear surfaces that could result in reduced vehicle height.

Vehicles with attachments such as cranes and elevated platforms shall be measured in the travelling condition.

Vehicle length over headstocks/body and bogie centres shall also be measured.

Open and closed hopper discharge doors shall not infringe the rolling stock outline when the vehicle has a solid suspension and fully worn wheels.

All measurements shall be taken in relation to the track centreline and rail head level.

### **2.3 Test site configuration**

The test shall be carried out on a level track plane or simulated track on level flooring. The vehicle shall be measured to ensure that it is of equal width about its own centreline as well as the track centreline. The vehicle should be standing upright and not leaning in favour of any one side.

## **3 Static vehicle weigh test**

### **3.1 Introduction**

This test is covered in CRN Standard CRN RS 012 and is designed to ensure that the vehicle is constructed within the allowable axle load limits and axle load distribution for the particular type of rolling stock and the corridor/s along which the vehicle is to operate.

The mass distribution of a vehicle shall be within the limits specified in CRN Standard CRN-RS-012.

For maximum axle loads refer to CRN Standard CRN-RS-008, Section 3.3

### **3.2 Weighing test procedure**

For consistency in the method of weighing vehicles, a recommended procedure for performing the weigh test is given in the CRN Standard, CRN-RS-012.

## **4 Static vehicle twist test**

### **4.1 Introduction**

This test is designed to ensure that the vehicle is compatible with the track twist limits of the CRN, without exceeding an acceptable level of wheel unloading.

### **4.2 Twist test requirements**

The vehicle, and in particular, the bogie or suspension shall be capable of accommodating the track twist conditions specified herein with the loss of absolutely no more than 60% of the static wheel load on the rail for any wheel. For vehicles fitted with a centre plate pivot, the body centre plate shall have no less than 14 mm engagement with the bogie centre casting at any point, under the twist configuration specified in this Standard.

### **4.3 Vehicle configuration for twist test**

The track twist test shall be conducted using a certified weighbridge, or other approved load measuring device, and adopting the test procedures detailed below, to verify compliance with the above requirements.

Vehicles shall be twist tested in the operating configuration tending to give the highest wheel unloading.

This will require the test to be undertaken with the vehicle at minimum tare condition. For locomotives this means minimum fuel and sand. For passenger vehicles, symmetrically located tanks shall be empty. For eccentrically located tanks, the worst loading case shall be tested.

For vehicles which are not fully symmetrical, the twist test shall be performed such that the wheel unloading is measured at each of the four outer wheels in turn, (ie all four corners of the vehicle.)

For vehicles equipped with air springs, the twist test shall be performed with air springs in both the inflated and the deflated condition.

For vehicles with moveable gantries, buckets, cranes or other plant, the twist test shall be performed with that plant positioned to give the maximum wheel unloading, for the operating configuration when set up for travel mode.

### **4.4 Test site configuration**

The twist test shall be conducted on a level section of track or simulated track firmly supported by a concrete bed or by sleepers on hard packed soil or gravel. The ground support will depend on the mass of the vehicle being tested. The essential requirement is adequate ground support to permit the vehicle to be safely jacked without jack settlement. It may be necessary to use large base plates to assist in distributing the jacking loads.

A variety of steel/aluminium packing will be required to support the wheels on the rails.

### **4.5 Twist test criteria**

A local twist of 1 in 77 over 2.7 metres, in combination with a general twist of 1 in 250, shall be applied to the vehicle overall wheelbase, as shown in the Figures below. All ramps are relative to the horizontal.

The maximum permitted wheel unloading is 60%. Where the wheel unloading exceeds 58%, a sample of other vehicles of the same type of build shall be tested to ensure consistency of result.

Vehicle wheels shall be packed and wheel loads measured as shown in the Figures below:

For articulated vehicles, the combined twist shall be applied in accordance with figures 3, 4 and 5 below.

For vehicles with other wheel configurations, such as steam locomotives, the twist parameters shown in Figure 2 shall be used.

Refer to Appendix 2 of this standard for twist test packing requirements.

#### 4.5.1 Four wheel vehicle

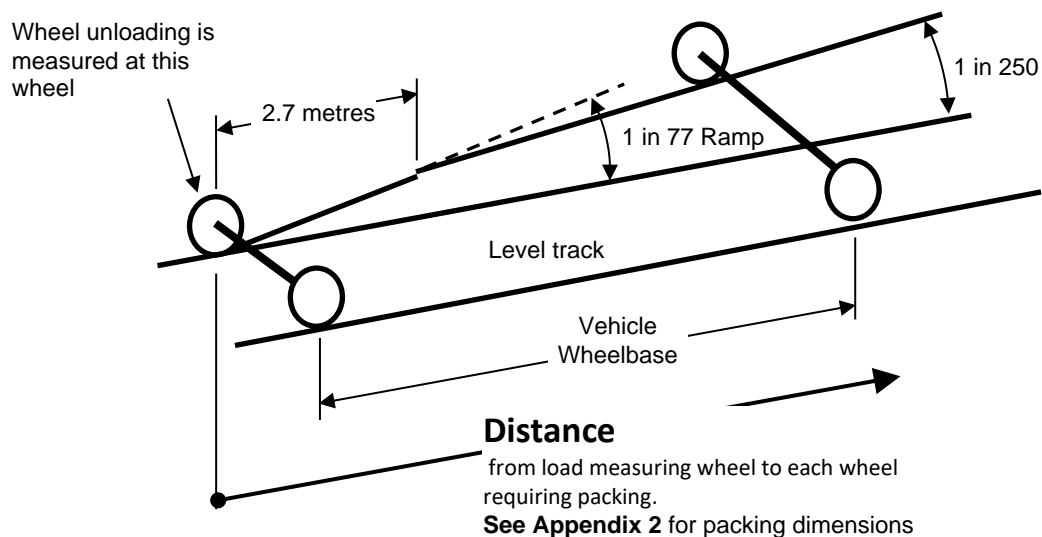


Figure 1 – Four wheeled vehicle twist

#### 4.5.2 Conventional bogie vehicle

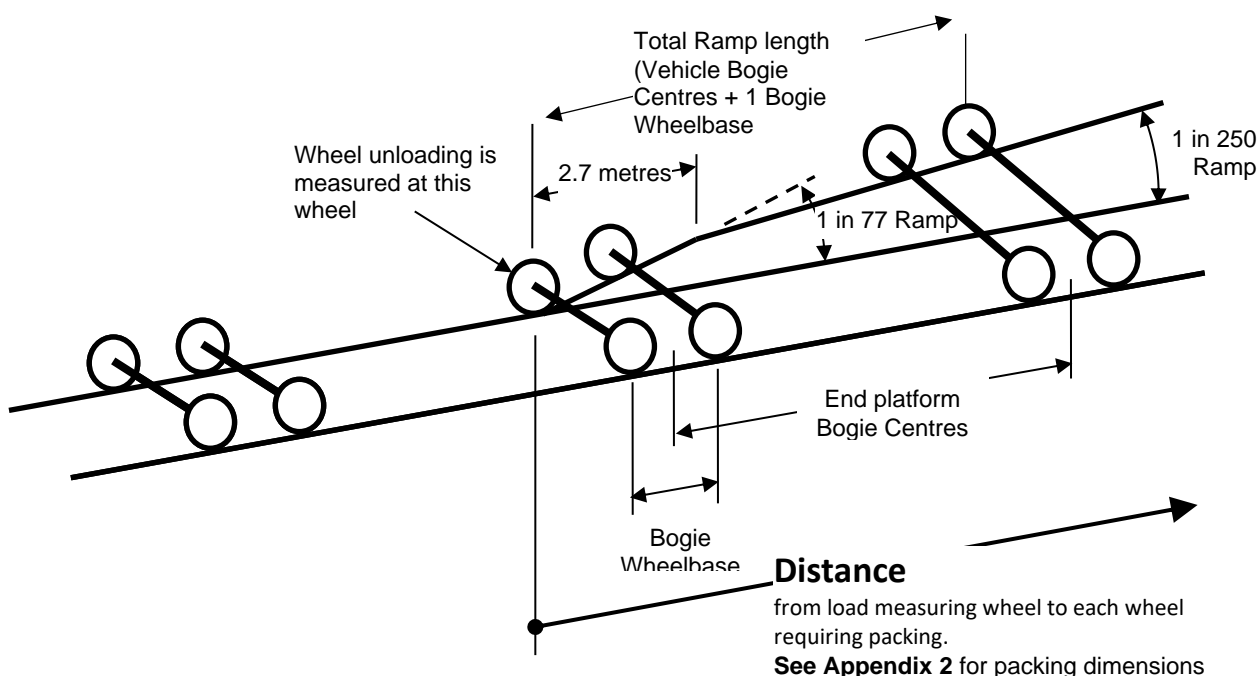
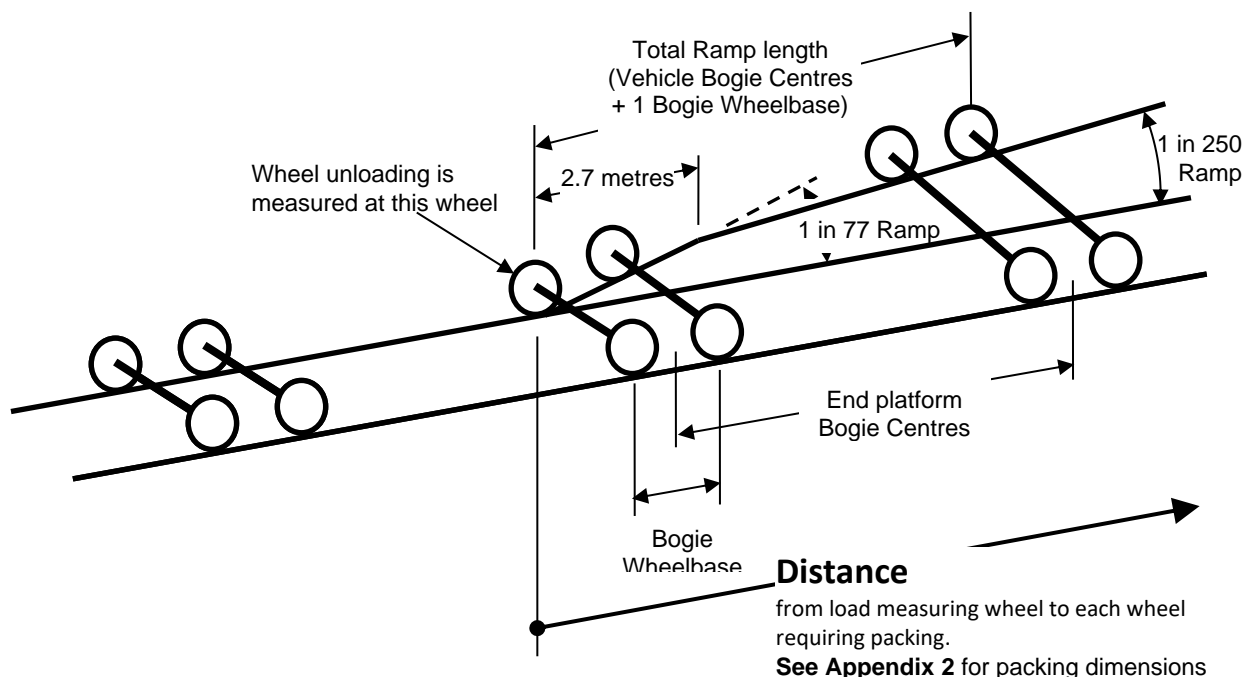
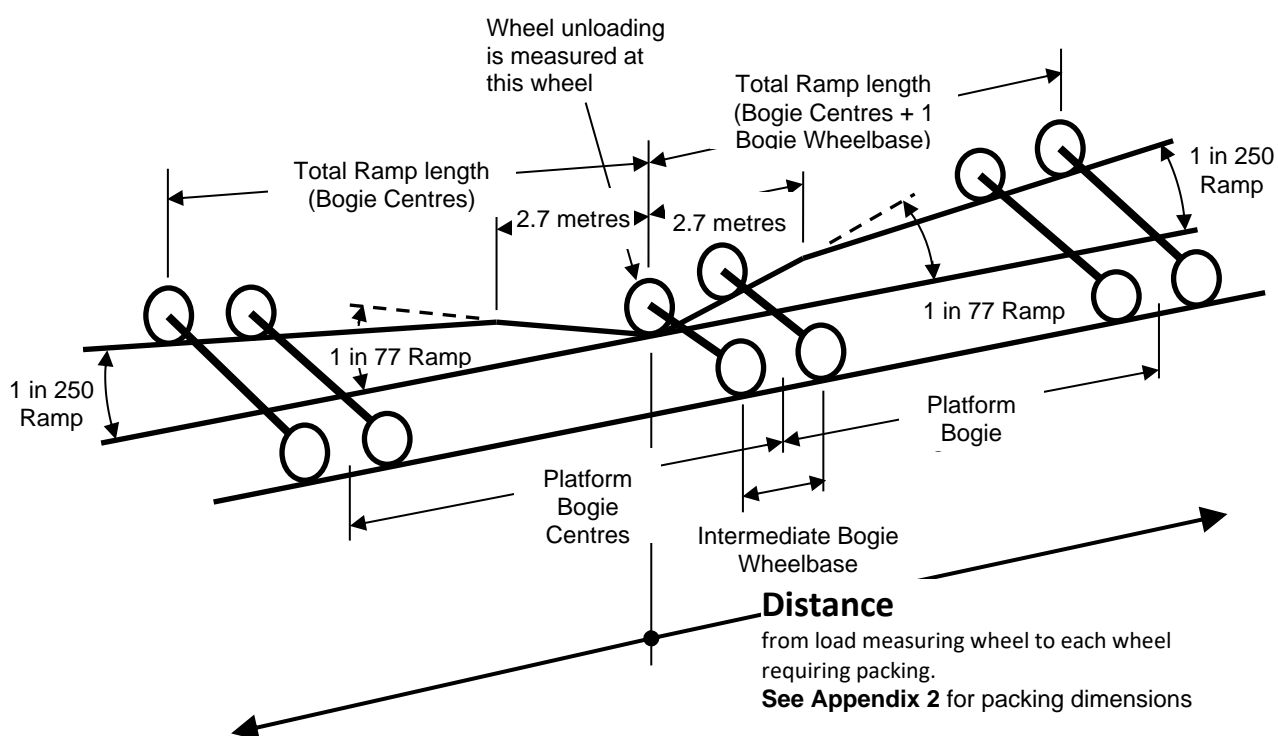


Figure 2 – Conventional bogie vehicle twist

### 4.5.3 Articulated bogie vehicle



**Figure 3 – Articulated bogie, end platform twist**



**Figure 4 – Articulated intermediate bogie twist**

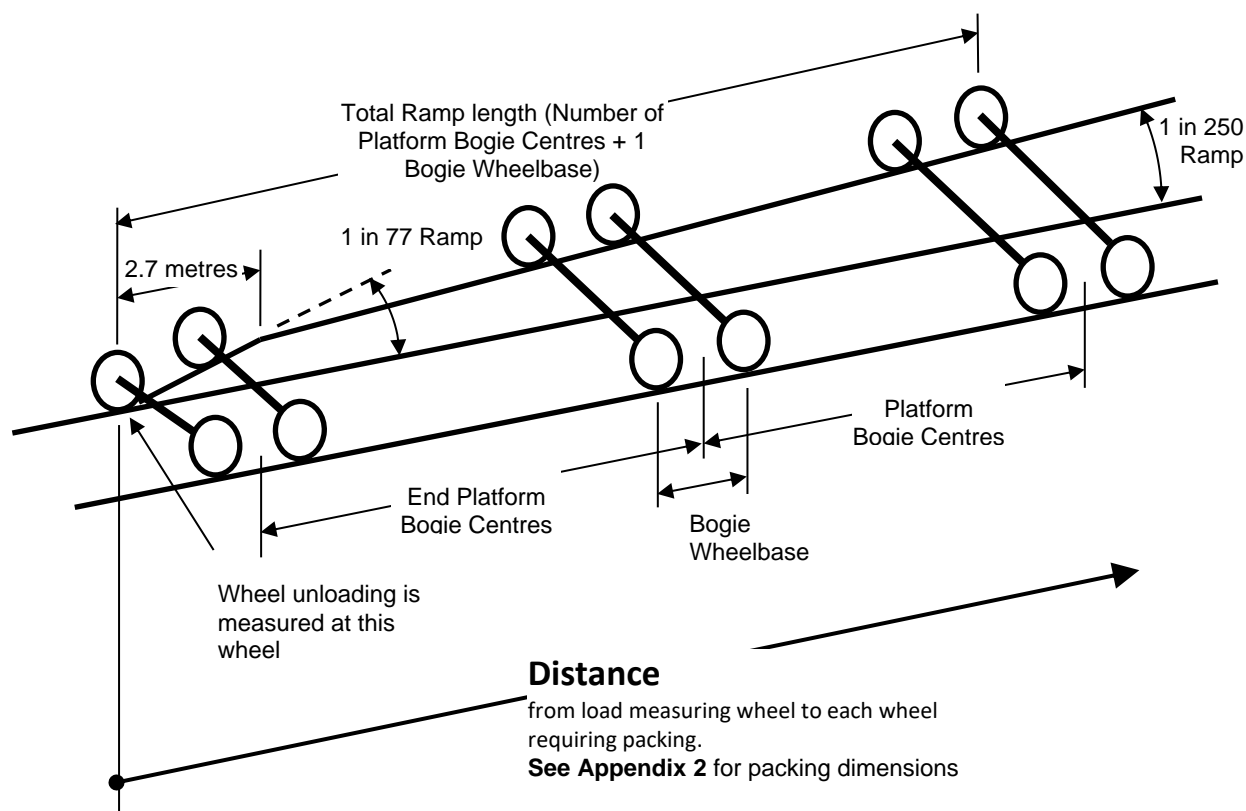


Figure 5 – Terminal bogie, maximum vehicle length twist

#### 4.5.4 Road/rail vehicle

Road/rail vehicles shall be tested in accordance with Figures 6 or 7 below. NOTE: If the front and/or rear road wheels are lifted clear of the track then no packing is required at those wheels

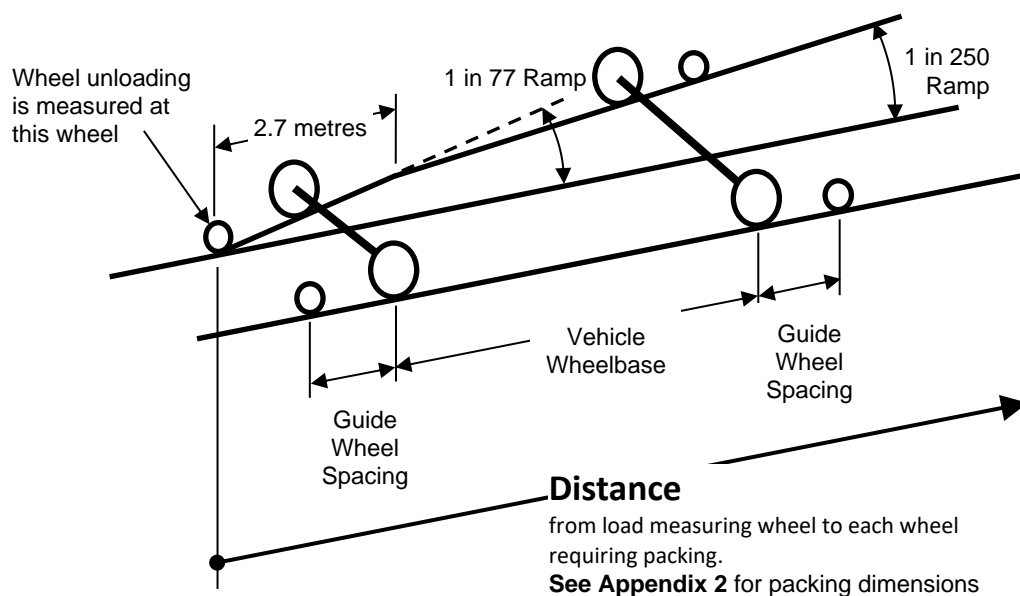
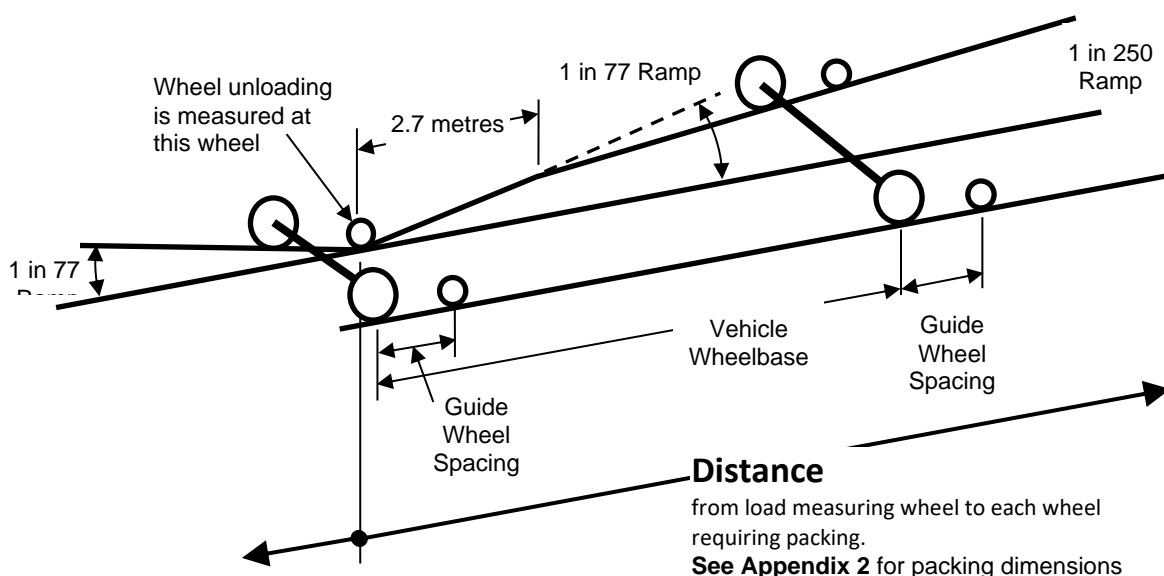


Figure 6 – Road/rail vehicle twist



**Figure 7 – Road/rail vehicle twist**

## 5 Static vehicle/bogie swing test

### 5.1 Introduction

A static vehicle / bogie swing test is designed to ensure adequate bogie to underframe / body clearance when negotiating the most extreme track curve radius. The swing test is required for bogie vehicles only.

The swing test consists of a simulation whereby a bogie of the vehicle is rotated relative to the body such that the angle of rotation is equivalent to the specified curve radius. This may be achieved by using a turntable or traverser, or by slewing the vehicle body using a crane.

This is a type test only.

The vehicle is not expected to negotiate the curve radius specified for this test while in service. Refer to CRN Standard CRN CS 210 for actual track geometry limits.

### 5.2 Vehicle configuration

Before conducting the swing test, check that the coupler height is within the allowable range. Refer to Standard CRN-RS-008, Section 6.10.

When a vehicle is subjected to a swing test its suspension system shall be in the solid condition. This may be achieved by replacing the springs with suitable packers, equivalent to the spring's solid height.

Vehicles equipped with air springs shall be tested with these in the deflated condition as well as the inflated condition.

The vehicles shall be tested complete with all equipment such as brake rigging, hoses, etc and new wheel condition (full diameter wheels).

CAD simulation may be used provided the owner/operator is confident that the vehicle construction complies with CAD design drawings.

### 5.3 Minimum horizontal curve radius

The minimum horizontal curve radius for conducting a swing test shall be a 70 metre simple curve.

## 5.4 Minimum clearance

There shall be minimal or no interference between any bogie component and any vehicle underframe/body/structure component when subjected to the minimum curve test, after allowances for all possible modes of vehicle bogie/body relative movement. These allowances will depend on the vehicle design.

The travel of brake rigging shall be taken into account when estimating clearances.

## 5.5 Calculation of swing deflection

The vehicle/bogie swing test can be performed by moving one end of the vehicle laterally to rotate the vehicle body relative to the bogie at the opposite end to simulate the vehicle/bogie relationship on a 70 metre curve. The lateral movement can be calculated using the diagrams in CRN Standard CRN RS 008 Section 5.

# 6 Static vehicle/vehicle swing test

## 6.1 Introduction

A static vehicle/vehicle swing test is designed to ensure adequate inter-vehicle clearances and inter-vehicle coupling compatibility when negotiating the most extreme track curve radii.

The vehicle/vehicle swing test consists of a simulation whereby one vehicle is rotated or translated relative to the other such that their relationship is equivalent to that of the vehicles negotiating the specified curve radii. This may be achieved by using a turntable or traverser, or by slewing one vehicle body using a crane.

This test is a type test only.

The test may be conducted as a practical test or by CAD simulation. The CAD simulation must take into account coupler length, draft gear displacement, body lateral displacements, air brake coupling hose lengths, jumper coupling length, diaphragms, etc.

## 6.2 Vehicle configuration

When a vehicle is subjected to a vehicle/vehicle swing test, allowance shall be made for the extremes in different vehicle heights, vehicle overhangs and coupler lengths on adjacent vehicles

All inter-vehicle connections including hoses, control cables, power cables, etc shall be correctly fitted and coupled during this test.

The vehicles shall be tested complete with all equipment such as brake rigging, hoses, etc.

## 6.3 Minimum horizontal curve radii

All vehicles shall be capable of successfully negotiating a 90 metre simple curve and a 120 metre reverse curve without any fouling or binding of inter-vehicle connections:

## 6.4 Minimum vertical curve radius

All vehicles shall be capable of successfully negotiating a vertical curve (both convex and concave) of 300 m radius, while coupled to a base vehicle (see definition in Section 6.5 below). Allowance shall be made for a difference in coupler height between the two vehicles of 75mm, on level track, plus a vertical displacement at the coupling line of +/- 35mm due to deflection of the vehicle suspensions.

## 6.5 Base vehicle dimensions

The base freight vehicle for the purpose of assessing vehicle to vehicle compatibility and determining the optimum couple length is defined by the following dimensions:

- Length over headstocks: 12 600mm

- Length over coupling lines: 13 490mm
- Bogie centres: 9 500mm
- Coupler length: 680mm (centre of pin to the coupling line)

The base vehicle for passenger vehicles and locomotives is the shortest vehicle that the test vehicle is likely to couple to during its service life. In the case of multiple unit trains the vehicles will normally work with like vehicles.

## 6.6 Minimum clearance

There shall be no interference or contact between any vehicle/vehicle component during the vehicle/vehicle swing test. Allowance shall be made for all possible modes of vehicle/vehicle relative movement. These allowances will depend on the vehicle design.

Hoses and other flexible couplings shall also be checked for adequate length and to avoid abrasion and kinking.

Clearance around inter-car connectors, diaphragms, gangways, etc shall also be checked.

## 7 Static brake tests

### 7.1 Introduction

A static brake test shall be conducted in accordance with CRN Standard CRN RS 008 Section 7.

Static brake tests include the following, where applicable, for each type of vehicle and in some cases, each individual vehicle.

- Measurement of brake block force and calculation of net brake ratio
- Single car air test
- Parking/hand brake holding test on a grade
- Static brake valve operation test
- Operation of Driver Safety Systems

### 7.2 Brake block force and net brake ratio

The net brake ratio shall be determined by dividing the sum of the actual measured brake block forces by the total vehicle weight at rail, for both tare and gross mass conditions.

The brake block forces are measured using a load cell placed between the brake block and the wheel or alternatively it is possible to obtain a brake block load cell insert that replaces the brake block.

Net brake ratios are specified for locomotives and locomotive hauled vehicles in the appropriate Standard for that type of vehicle.

- Locomotives CRN RS 001
- Freight vehicles CRN RS 002
- Locomotive hauled passenger vehicles CRN RS 003

### 7.3 Single car air test

All locomotive hauled freight and passenger vehicle brake systems shall have a single car test conducted on the automatic brake system to confirm the correct brake operation, in accordance with operator's procedures and CRN Standard CRN RS 008, Section 7.

During a single car test, the following items would normally be checked for correct operation:

- Brake pipe leakage
- Main reservoir leakage
- Sensitivity on brake application
- Sensitivity on brake release
- Accelerated release operation (where fitted)
- Grade control valve operation (where fitted)
- Load compensation operation (where fitted)
- Slack adjuster operation
- Brake cylinder leakage
- Auxiliary reservoir leak back
- Main reservoir leak back
- Independent brake (where fitted)
- Double check valve leakage
- Independent brake over automatic brake
- Independent control pipe leakage

## 7.4 Parking/hand brake holding test on a grade

This test can be carried out with the parking/hand brake applied, using either of the following methods:

- With the vehicle parked on an available 1 in 30 grade
- Parked on a simulated 1 in 30 grade using wedges under each wheel, OR
- By performing a drag load test where a drag (tensile) load is applied to the vehicle along the centreline of the track. The drag load shall be at least equivalent to 5% of the vehicle weight. The drag force shall be recorded.

During the test there shall be no tendency for the vehicle to move or for the wheels to rotate. In any case the parking/hand brake shall be capable of holding the vehicle secured indefinitely under the imposed gravitational or mechanical loads.

## 7.5 Static brake valve operation test

The brake valve functionality can be tested by making service applications of varying brake pipe reductions. The brake system shall be tested by moving the brake valve handle to all positions and checking the following:

- the brakes apply and release (ie the brake blocks/brake disc pads are forced onto the wheels/discs and then force released)
- the brake pipe, brake cylinder and reservoir pressures meet the specification

# 8 Safety equipment functionality test

## 8.1 Introduction

A safety equipment function test is required to ensure that all critical items of safety equipment are functioning correctly.

## **8.2 Driver safety system**

Driver safety equipment shall comply with the requirements specified in CRN Standard CRN RS 013.

### **8.2.1 Vigilance control system**

- Test the operation of the vigilance control system. Time the interval from acknowledgement to visual warning, audible warning, penalty brake application and the minimum time before the vigilance control system can be reset.
- Check that each acknowledgment button/pedal resets the vigilance cycle.
- Check that when each button/pedal is depressed continuously that this does not reset the vigilance cycle.
- For task linked systems, check that each task linked function resets the vigilance cycle.

### **8.2.2 Driver enable system**

Test the operation of the operator enable system. Release the pedal/hand controller and ensure the brakes apply.

### **8.2.3 Trip gear system**

Test the operation of the trip gear lever. Apply sufficient force on the trip gear lever to active a trip action and ensure that the brakes apply.

### **8.2.4 ATP system**

Test the operation of the ATP system. Operators and/or owners shall have procedures to test the operation of the ATP system.

### **8.2.5 Alternate safety systems**

Where other types of Driver Safety Systems are fitted to rolling stock, the operation of these systems shall be tested. Operators and/or owners shall have procedures to test the operation of any Driver Safety Systems.

## **8.3 Driver's emergency clock**

Open each driver's emergency cock in turn to ensure that the brake pipe is exhausted and the brakes apply.

## **8.4 Lights**

Check that all required lights are fitted in accordance with CRN Standard CRN RS 008, Section 8.3, positioned correctly and operate as required.

## **8.5 Horns**

Horns shall be tested for functionality and noise levels checked for compliance with that specified in Table 5 in CRN Standard CRN RS 008.

The horn sound shall be measured with the vehicle stationary in an unobstructed location with no significant reflecting infrastructure within 50 metres of the line of sight between the horn and the sound level measuring device. Ambient wind speed shall not exceed 10 metres/second whilst measurements are being recorded.

The horn shall maintain the level specified in CRN Standard CRN RS 008, Section 8.4 for a 30 second continuous horn operation. Tonality requirements do not apply to horn sound evaluations.

## 9 Signal visibility test

### 9.1 Introduction

The signal visibility test is designed to ensure that drivers or operators of all self-propelled vehicles including locomotives, multiple unit trains and infrastructure maintenance vehicles can clearly see trackside signals from their driving positions.

### 9.2 Visibility test

The signal visibility test shall be conducted on all driven vehicle types in order to gain approval to operate on the CRN. Refer to CRN Standard CRN RS 008, Section 9, Figures 10, 11 and 12.

Type testing will apply to all rolling stock of the same vehicle type provided there have been no substantial modifications to any single vehicle.

The driver should be positioned on the left hand side of the vehicle and when seated, shall have direct line of sight to each of the signal types used on the NSW rail network.

Vehicles where the driver is positioned on or to the right of the vehicle centre line shall still be positioned to enable the driver to meet the above signal visibility requirements.

In the case of vehicles where the driver is not seated at the front of the vehicle, such as in locomotives running long end leading, steam locomotives, or some track maintenance vehicles the driver must be accompanied by a second person who is qualified in safeworking and has the appropriate road knowledge.

## 10 Personnel safety inspection

### 10.1 Introduction

Rail vehicles required to work under overhead electrical wiring do present a risk to personnel and must be provided with sufficient mitigation to prevent or minimise the risk of personnel or equipment coming into contact with or entering the electrical safe clearance zone. Refer to CRN Standard CRN RS 008, Section 10, for sample overhead wiring electrical safety signs.

Any rail vehicle, including a locomotive, which has the potential to permit equipment or personnel to come into contact or come within the safe clearance limit of electrical equipment and/or wiring shall have appropriate warning signs. Height limiting equipment shall be installed on any vehicles with elevating equipment, such as cranes, elevated work platforms, backhoes, etc.

An electrical safety inspection for overhead wiring safety is not required where vehicles only operate outside of electrified areas. Vehicles that fail the overhead wiring electrical safety inspection will be restricted to operation outside of electrified areas.

### 10.2 Electrical safety inspection

The inspection must ensure the following requirements are met:

- “Danger” warning signs are appropriately displayed and securely fixed to vehicles and clearly visible, in locations adjacent to any track-side controls, ladders or equipment which may allow personnel to elevate equipment to within 3 metres or climb to within 1 metre of the overhead wiring.
- Controls for elevating equipment are clearly labelled for their intended function and the appropriate “Danger” warning sign is located within the operator’s field of vision.
- The vehicle is fitted with height limiting equipment to prevent unintended elevation of such equipment whilst the vehicle is in work mode.
- The vehicle is fitted with a lock-out mechanism which prevents unintended elevation of equipment whilst the vehicle is in travel mode.

## **10.3 Hazardous working environment**

Rolling stock, depending on its type and functionality can expose personnel to a hazardous environment. For example, high pressure air, high pressure hydraulic fluids, mechanisms which have a crush zone, stored energy with compressed springs, etc.

Such hazardous zones/equipment shall be labelled with appropriate warning signs.

## **11 AEI tag installation inspection**

All rail-bound vehicles shall be fitted with automatic equipment identification (AEI) tags, one (1) on each diagonal right hand corner.

The AEI tags and their installation shall comply with CRN Standard CRN RS 014.

## **12 Reflective delineator inspection**

Reflective delineators and their application to all rail vehicles shall comply with the requirements of CRN Standard CRN RS 008 Section 12.

## **13 Vehicle recovery interface requirements**

### **13.1 General**

To ensure vehicles are recovered with minimal consequential damage and delay following an incident, such as a derailment, they should be equipped for, or have attachments suitable for use with the recovery equipment used by the Emergency Response Groups.

It is the owner/operator's responsibility to have incident recovery plans in place.

Vehicles shall have the following equipment fitted to assist in vehicle recovery:

- Lifting brackets
- Towing fixture

### **13.2 Lifting brackets and towing fixtures**

Refer to CRN Standard CRN RS 008 Section 13 for details on the lifting bracket and towing fixture.

### **13.3 Specialised recovery equipment**

Vehicle owner/operators shall familiarise themselves with vehicle recovery equipment such as jacks and other lifting appliances. This may entail actually trialling the equipment prior to vehicle commissioning and acceptance tests in order to ensure that the vehicle is recoverable in the event of an incident during on-track tests.

Vehicles with traction equipment shall be checked for compatibility with pony bogie recovery equipment to ensure the equipment can be installed and operate satisfactorily without fouling other vehicle components. Refer to CRN Standard CRN RS 008, Section 13.

## **14 Environmental tests**

### **14.1 Introduction**

Environmental testing is designed to ensure that vehicles and trains do not exceed acceptable noise, vibration and air quality limits.

### **14.2 Noise tests**

All rolling stock shall comply with the noise requirements as specified in CRN Standard CRN-RS-008, Section 14 and reporting shall comply with CRN Standard CRN RS 017.

Type testing will apply to all rolling stock of the same vehicle type provided there have been no substantial modifications to any one vehicle, in which case, that vehicle shall also be tested..

The results of noise tests should be recorded on the standard noise test reporting form. Refer to the following:

- Noise Test Data Recording Form
- Locomotive Noise Test Recording Spreadsheet.xls

### **14.3 Vibration tests**

All rolling stock shall comply with the vibration requirements as specified in CRN-RS-008, Section 14.

Type testing will apply to all rolling stock of the same vehicle type provided there have been no substantial modifications to any one vehicle, in which case, that vehicle shall also be tested.

### **14.4 Air quality emission tests**

All powered rolling stock shall comply with the emission requirements as specified in CRN-RS-008, Section 14.

Type testing will apply to all rolling stock of the same vehicle type provided there have been no substantial modifications to any vehicle, in which case, that vehicle shall also be tested.

Emission testing shall include:

- Visible smoke
- Nitrogen oxides (NOx)
- Particulates
- Carbon monoxide
- Hydrocarbons (VOC)
- Exhaust flow
- Sulphur Dioxide (SO<sub>2</sub>).

### **14.5 Waste management inspection**

Waste handling equipment fitted to vehicles shall be inspected to ensure all waste material is retained and not discharged to track.

Waste material includes brown water and grey water on passenger vehicles as well as fuel, oil, coolant water and sand leakage/overflow from locomotives and other engine powered vehicles.

## **15 Kinematic rolling stock outline tests**

### **15.1 Introduction**

These tests are designed to ensure that the vehicle operates safely within the confines of the relevant kinematic rolling stock outline specified for that vehicle type and on the corridor/s along which the vehicle is to operate.

No part of the vehicle shall infringe the kinematic rolling stock outline under all conditions of loading, wear and dynamic behaviour unless otherwise approved by the CRN Manager.

Refer to CRN-RS-008, Section 2.2 for details of the kinematic rolling stock outline.

### **15.2 Rolling stock outline static displacement test**

The static kinematic outline test is designed to determine the vehicle roll and lateral displacement coefficients.

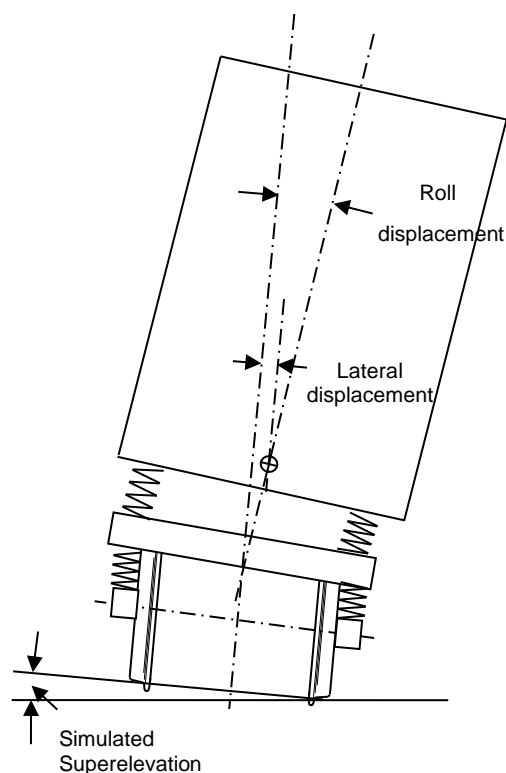
The purpose of this test is to plot the angular roll and lateral displacement of the vehicle body with respect to the track centre and rail plane.

For the static displacement test, the track should be level or if not level, then measured to determine the degree of incline.

This test is to be conducted on both sides of the vehicle by incrementally packing the wheels on one side of the vehicle until the vehicle is sitting on a simulated 160 mm of superelevation and then incrementally lowering the vehicle. The angular and lateral displacement can be measured with a plumb string line and rule or by a theodolite at a convenient datum point.

The progressive displacements are to be plotted against the track superelevation or lateral component of gravitational acceleration. The plots should show a hysteresis loop when completed.

The loading condition of the vehicle shall be such as to give the maximum expected centre of gravity height above rail.



**Figure 8 – Simulated cant deficiency**

### 15.3 Kinematic outline test requirements

The kinematic outline dynamic test can be conducted in conjunction with the ride performance test and as with the ride test the test speeds shall be incrementally increased whilst the performance parameters are monitored as required in Section 1.3.4.

The vehicle shall be instrumented to determine roll relative to the rail plane and the lateral displacement of the vehicle body relative to the wheels. Refer to CRN-RS-008, Section 2.2 for the displacement limits.

The loading of the vehicle for test purposes shall be such as to give the maximum expected centre of gravity height above rail.

The test shall be conducted with the vehicle negotiating an agreed test track site as specified in section 19.4 below with 'x' per cent of the vehicle design cant deficiency.

Where 'x' = 160 % for freight vehicles

'x' = 145 % for passenger vehicles and locomotives.

The worst condition of roll and the worst condition of lateral displacement determined above shall be used in assessing vehicle compliance with the kinematic rolling stock outline requirements.

## 15.4 Test track configuration

As with the ride quality test, the test track length shall be such as to provide 3 km of operation at the maximum test speed. The recording of kinematic outline test data shall be over at least a minimum track sample of 500 metres with a TCI less than or equal to 50 and with no significant defects, or as mutually agreed between the owner/operator and the CRN Manager. The test track section quality should represent at least 60 per cent of the routes on which the vehicle would be normally operating.

## 15.5 Simulation of kinematic outline test

As an alternative to conducting the kinematic rolling stock outline test, a computer-simulated test may be acceptable provided the simulation model is validated using data from actual on-track measured dynamic responses of a similar vehicle.

# 16 Signal compatibility test

## 16.1 Introduction

Signal compatibility testing is designed to ensure that vehicles operating on the NSW rail network operate the trackside signalling equipment.

Vehicles that do not satisfactorily operate the signalling system, such as road/rail vehicles and some track maintenance vehicles, shall only operate under special operating conditions.

Refer to CRN Standard CRN SD 026, Signal Design Principles - Rolling Stock Interface Requirements.

## 16.2 Signal compatibility tests

Signal compatibility tests shall be conducted in accordance with that specified in CRN Standard CRN SD 026, Signal Design Principles - Rolling Stock Interface Requirements.

# 17 Signal & communication system interference test

## 17.1 Introduction

Interference testing is designed to ensure that electrical equipment operating on a vehicle does not interfere with the operation of trackside signalling and communication equipment.

## 17.2 When a signal and communication system interference test is required

The signal and communication system interference tests shall be conducted on all vehicle types which have equipment that could potentially interfere with signal and communication systems, for approval to operate on the CRN.

A signal and communication system interference test shall be conducted on any vehicle that is suspected of interfering with signalling or communications equipment.

## 17.3 Interference tests

Interference tests shall be conducted in accordance with the requirements specified in CRN Standard CRN SD 026, Signal Design Principles - Rolling Stock Interface Requirements.

## 18 Brake performance tests

### 18.1 Introduction

Brake performance testing is designed to ensure that all self-propelled vehicles and multiple unit trains, operate safely within the current signalling limits.

The following brake performance tests shall be conducted on all self-propelled vehicles and multiple unit trains in order to gain approval to operate on the CRN.

Brake performance testing is also carried out on locomotive hauled trains of varying lengths.

Brake performance tests include the following tests where applicable for the type of vehicle.

- Stopping distance tests for individual vehicles or trains
- Deceleration tests for infrastructure maintenance vehicles
- Brake functionality test for infrastructure maintenance vehicles limited to operation within protected worksites.
- Infrastructure maintenance vehicles that are operated as locomotives must also be tested as specified in CRN Standard CRN RS 005

For specific brake performance tests applying to different vehicle types refer to the relevant standard for those vehicles:

- |  |            |
|--|------------|
| • Locomotives                                    | CRN-RS-001 |
| • Freight vehicles                               | CRN-RS-002 |
| • Locomotive hauled passenger vehicles           | CRN-RS-003 |
| • Multiple unit trains                           | CRN-RS-004 |
| • Rail bound infrastructure maintenance vehicles | CRN-RS-005 |
| • Road-rail vehicles                             | CRN-RS-006 |

### 18.2 Track configuration

The stopping distance test should be conducted on level tangent track or track with a slight falling grade. If tests have to be conducted on a grade, the grade should be constant for the length of the stopping distance test and the measured test results shall be corrected for level track.

The following formula should be used when correcting measured deceleration for track gradient:

- **For falling grades:**

Corrected deceleration = measured deceleration + 9.81 / G

- **For rising grades:**

Corrected deceleration = measured deceleration – 9.81 / G

Where the gradient is expressed as a 1 in G grade, that is for a 1 in 40 grade, G = 40.

**NOTE:** The measured deceleration is to be recorded as a negative value.

### 18.3 Stopping distance test procedure

The vehicle/train is accelerated up to test speed and allowed to coast (with power cut out) up to the brake test start point. The brakes are immediately applied to the agreed braking level and must remain applied until the vehicle/train comes to a stand.

The speed at which the brakes were applied is recorded.

The distance from the test start point to the location where the vehicle/train came to a stand is measured.

In the case of an emergency brake application, the emergency brake can be applied by:

- moving the driver's brake valve to the emergency position, or
- the on board trip gear trip arm contacting a trackside train stop, or
- the driver releasing the operator enable system foot pedal or hand control, or
- initiating a vigilance control penalty application.

Information to be recorded during the test includes:

- Speed at which brakes were applied
- Location of test starting point
- Type of brake application
- Direction of travel
- Distance from brake test start point to where vehicle/train came to a stand

**NOTE:** If it is possible to record and plot the speed verses time during the braking test, then the distance travelled is equal to the area under curve from the start time to the time the vehicle/train comes to a stand.

If the test area is not level, then the gradient of the track must be determined and included in the deceleration calculations.

It is customary to conduct three (3) stops at each speed and brake application type combination.

## 18.4 Brake functionality test

Instead of a deceleration test, a brake functionality test is carried out on infrastructure maintenance vehicles that are restricted to an operation wholly within protected worksites. The maximum speed permitted within a worksite is 15 km/h.

The brakes on the vehicle shall be tested to demonstrate that they operate and bring the vehicle to a stand within 20 metres from 15 km/h. If the maximum speed of the vehicle is less than 15 km/h, then the vehicle shall stop from its maximum speed within 20 metres.

## 19 Ride performance test

### 19.1 Introduction

A ride performance test is designed to ensure vehicle compatibility with the track and to establish the optimum vehicle operating conditions to provide minimum damage to the track and meet acceptable train pathing requirements.

This standard covers ride test requirements. For specific ride performance requirements refer to the following standards.

- |  |                        |
|--|------------------------|
| • Ride index algorithm and base ride performance | CRN-RS-008, Section 19 |
| • Locomotives                                    | CRN-RS-001, Section    |
| • Freight vehicles                               | CRN-RS-002, Section    |
| • Locomotive hauled passenger vehicles           | CRN-RS-003, Section    |
| • Multiple unit trains                           | CRN-RS-004, Section    |
| • Rail bound infrastructure maintenance vehicles | CRN-RS-005, Section    |
| • Road/rail infrastructure maintenance vehicles  | CRN-RS-006, Section    |

## 19.2 Test vehicle configuration

Tests are to be conducted with the vehicle in the tare or minimum mass condition.

For vehicles, such as locomotives, equipped with vibration isolated cabs, the base ride performance specified shall be measured using accelerometers positioned outside the cab, but as near as possible to the trailing bogie centre.

For vehicles, such as locomotives and track maintenance vehicles, with vibration isolated cabs, it is recommended that the comfort ride index be measured using accelerometers positioned inside the cab, as close as possible to the bogie centre.

Self-powered vehicles such as locomotives or track maintenance vehicles shall be tested alone. In the case of locomotive hauled vehicles, where possible, the test vehicle is to be the trailing vehicle in the test train consist. It is desirable to have an intermediate vehicle marshalled between the test vehicle and the locomotive to isolate the test vehicle from any dynamic effects from the locomotive.

For bogies equipped with air springs, the above ride performance also applies for vehicles with deflated air springs. A reduction in design speed may be required to achieve this.

The CRN Manager reserves the right to request and have the vehicle tested by the owner/operator in the fully loaded condition.

## 19.3 Wheel profile for vehicles undergoing ride tests

All wheels on the test vehicle shall have a worn wheel test profile, which has been agreed to by the CRN Manager, to ensure that the vehicle is tested for lateral stability under the most adverse wheel wear conditions likely to be experienced in service.

Alternatively, the agreed wheel test profile may initially be the “as new” profile, provided that the owner/operator is prepared to conduct ride tests at a later date with an agreed field worn wheel profile.

In the case where tests are initially conducted with an “as new” wheel profile:

- Interim approval to operate will be granted following successful completion of these tests but final approval to operate will not be granted until all required tests with the agreed field worn wheel profiles have been successfully completed.
- UGLRL reserves the right to request and have the owner/operator conduct further tests prior to the wheels reaching the agreed field worn wheel profile.
- These later tests on the vehicle when equipped with the agreed field worn wheel profile shall be conducted prior to any vehicles of that type reaching a state of wheel wear equivalent to, or exceeding that of the agreed field worn wheel profile.

## 19.4 Test track configuration

Ride performance testing shall be tested on a minimum length of track such that the maximum test speed can be maintained for at least 3 km. The track quality shall have a TCI less than or equal to 45 and with no significant defects, or as mutually agreed between the owner/operator and UGLRL. The test track should represent at least 60 per cent of the routes on which the vehicle would be normally operating.

Hunting shall be assessed on tangent track over a minimum distance of 3 km.

# 20 Pitch & bounce performance test

## 20.1 Introduction

A pitch and bounce test is designed to determine the vehicle critical speeds for pitch and bounce and ensure that the vehicle suspension is adequately damped to control vehicle oscillations created when negotiating cyclic vertical track perturbations at the critical speed.

## 20.2 Test vehicle configuration

Pitch and bounce performance shall be measured using vertical accelerometers positioned on the vehicle body as near as possible to the leading and trailing bogie centres.

All measured accelerations shall be filtered at 10 Hz low pass.

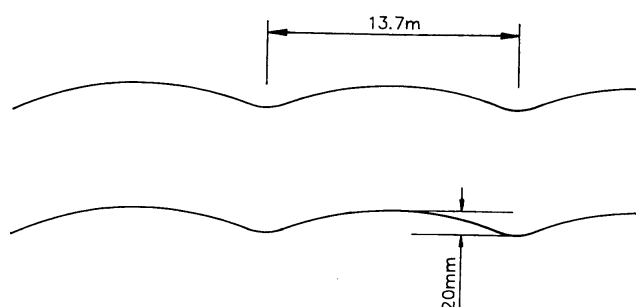
Average acceleration shall be taken as the mean peak acceleration measured about the zero axis. The mean peak acceleration shall be calculated from the 10 Hz low pass filtered acceleration.

The fully loaded vehicle shall first approach and negotiate the test site at a constant speed well below any calculated resonant speed, and thereafter increasing in 10 km/h increments for each subsequent test run until the critical values of the table above are reached, the resonance level is passed, or 110% of the design speed is reached.

If the critical acceleration levels specified CRN Standard CRN RS 008 Table 6 are exceeded, the vehicle is regarded as unsuitable for the proposed operation, but may be relegated to a lower maximum speed of at least 10 percent less than the critical speed.

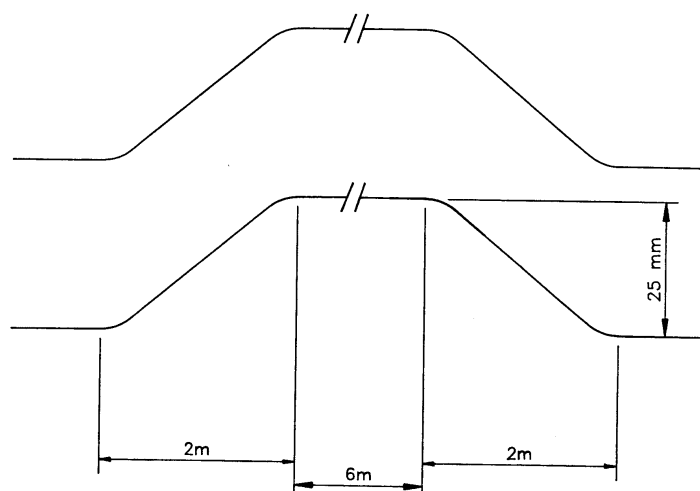
## 20.3 Pitch and bounce test track configuration

The test track configuration for the pitch and bounce test shall consist of three (3) cycles, with phase, wavelength and amplitude as defined in figure 9.



**Figure 9 - Pitch and bounce test track configuration**

In addition, the test track shall include a single bump as defined in figure 10



**Figure 10 - Single bump test track configuration**

Where an instrumented wheelset is not available to measure vertical wheel forces, the vertical acceleration in CRN Standard CRN RS 008, Section 19, table 6 shall be taken as the test limit.

## 20.4 Simulation of pitch and bounce test

As an alternative to conducting the pitch and bounce test, a computer-simulated test may be acceptable provided the simulation is validated by comparing the ride results with that of an actual on-track ride test.

## 21 Traction performance test

### 21.1 Introduction

To determine through practical testing, under varying track conditions, a safe maximum train load that can be hauled by a given locomotive up a known grade under all weather conditions.

References: Locomotive manufacturer's tractive effort speed curve.

Once determined from practical tests, the tractive effort, delivered at the locomotive wheels can then be expressed as a percentage of the total weight of the locomotive, usually given as the all-weather adhesion level (AWAL). The AWAL can then be used to determine a suitable load for that class of locomotive on any grade on the network.

### 21.2 Test equipment required

1. A typical locomotive, representing the locomotive class to be tested.
2. A suitable trailing load, preferably pre-weighed to determine total train mass.
3. A strain gauged coupler (if available).
4. A suitable recording instrument such as a computer and/or chart recorder, unless the locomotive is fitted with data logger. The following parameters shall be recorded during the test:
  - Speed
  - Sectional running time
  - Wheel slip
  - Traction motor current.
  - Throttle notch
  - Sanding
5. Suitable water-spraying equipment. The water spraying equipment shall have the following characteristics:
  - The water tank capacity shall be sufficient to last for the duration of testing.
  - The water spraying equipment shall pump water at a flow rate of 3 L/min, using CROPLANDS QUICK TEEJET nozzle housings with fan spray jets. The pump used shall be a FLOJET, model 2135-568, or equivalent, capable of delivering 6.4 Litres / minute (Max), with a pressure of 520 kPa (75 psi) maximum.
  - Water spraying equipment is to be applied such that the water spray is directed to the head of both rails vertically from an approximate height of 250mm, and 1 metre in front of the leading wheels of the leading locomotive of the test train.

## 21.3 Test train preparation

As a starting point, determine from the manufacturer's tractive effort speed curve, the tractive effort level available at the manufacturer's recommended continuous adhesion level and from this determine an estimated train load.

1. Assemble a suitable train consist, incorporating a train consist as close as practicable to the estimated continuous load.
2. Include in the train consist a suitable locomotive that can be utilised to clear the track if the locomotive under test fails to perform adequately. The assist locomotive must be shutdown (unless required to assist in the event of test failure), and should preferably be marshalled directly behind the locomotive under test.

**Note:** When testing AC traction locomotives, the assist locomotive **MUST** also be an AC traction locomotive, unless it is independently crewed.

3. The test site shall be nominated by the Network Manager and should contain a section of track with a continuous nominal grade of at least 900 metres long.
4. Conduct an inspection of the proposed site, paying particular attention any rail greasers in the area and to the railhead condition on the grade. Note any evidence of rail burns, grease contamination and general rail profile condition.
5. Indicate to the appropriate train operations area that an adhesion test is to be performed in their area. The test plan should include allowances for several passes of the test train over the test site.
6. Conduct a safety site inspection and safety briefing in accordance with the Network manager's Test Site Safety Evaluation.
7. Prepare the locomotive for test, check and record fuel level and sand, check wheel profiles, install water-spraying equipment to the leading wheel set of the test locomotive as described above.

## 21.4 Train test method

The train test is conducted in the following manner:

- Commence the grade ascent from the test start location at the base of the grade with sufficient distance before the grade such that the grade is approached at a normal speed for that location.
- The leading locomotive is the test vehicle and it must be powering during the test.
- Simulated wet weather conditions are to be applied using installed water spraying equipment, as described in Clause 5 of Section 21.2 above, with sufficient capacity for the duration of the testing. Note: Windscreen washer equipment is not acceptable for supplying the test water spray.
- The water spraying equipment shall be operating continuously on the grade under test. For example, if testing on Cowan Bank, this means between Hawkesbury River and Cowan.
- The water spraying equipment shall be deployed regardless of the ambient weather conditions.
- Air blowers shall not be used.
- The train speed shall not exceed the posted speed boards.
- The data specified in Clause 4 of Section 21.2 above is to be recorded for the duration of the test.

## 22 Vehicle structural tests

### 22.1 Introduction

Vehicle structural tests are carried out on vehicles to investigate and confirm that they have the structural capacity to perform their intended use in rail operations.

These tests are optional for an owner/operator, however the CRN Manager reserves the right to request and have a vehicle tested by the owner/operator, where, in the CRN Manager's opinion, there is doubt or adverse evidence questioning the structural integrity of the vehicle.

### 22.2 Jacking point vertical load test

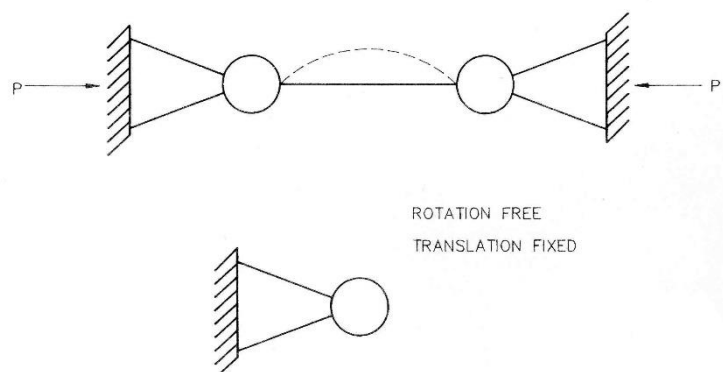
A vertically upward force to prove the structural integrity of the vehicle frame shall be applied to the coupler head immediately adjacent to the striker face of the draft gear body, or jacking point, at one end of the vehicle, sufficient in magnitude to lift the fully loaded vehicle free of the bogie nearest the applied load, and held for sixty seconds.

Platforms of articulated vehicles, that are not the end units of an articulated vehicle, do not need to be tested, as they do not have any bogie overhang.

### 22.3 Static end compression test

The single vehicle impact may be performed as an alternative to this test.

A longitudinal compressive end load of 4500 kN shall be applied to the couplers and held for sixty seconds minimum. The load shall be applied over an area equal to the contact area between the draft lugs and draft gear. The vehicle as tested shall simulate an axially loaded beam having ball end restraints ie the loading fixture shall be constrained from lateral and vertical motion. See Figure 11.



**Figure 11 - Loading fixtures for static end compression**

The vehicle shall be tested under the adverse stress conditions (empty and/or loaded) and shall withstand the applied loads without permanent deformation of any component.

### 22.4 Single vehicle impact test

The test vehicle shall be loaded to its maximum gross mass on rail and impacted by a rake of vehicles, consisting of three 50 tonne nominal capacity open or hopper cars. These cars shall be loaded to their allowable maximum gross mass on rail with sand or other granular material, and should be equipped with AAR M 901E rubber-friction draft gear or equivalent at the striking end. A metal plate may be placed on top of the granular material to stop load shift.

The test vehicle shall be stationary at the start of each test with the handbrake and air-brake released. It shall be located between, but not in contact with, the striking consist described above and a similar consist used as a buffer. The hand-brake on the buffer vehicle furthest from the

vehicle under test shall be firmly applied. No restraint other than the handbrake on the last vehicle shall be used. The track shall, therefore, be level.

A series of impacts shall be made on tangent track by the striking consist starting at 10 km/h. The speed should be increased in small increments of approximately 3 km/h. For freight vehicles the impacts shall continue until either a coupler force of 5500 kN or a speed of 22 km/h has been reached, whichever occurs first. For other vehicles, the vehicle owner or operator shall specify the maximum coupler force and maximum impact speed.

A vehicle consisting of two or more permanently coupled units shall also undergo impact testing as outlined above with the struck unit of the test vehicle being empty for a two-unit vehicle, or with the first two units being empty for a three (or more) unit vehicle.

## **23 P2 force wheel impact test**

This section is not complete. Refer to CRN Standard CRN RS 008 for a calculation method of P2 force.

## **24 Curve stability test**

The CRN Manager reserves the right to request and have a vehicle tested by the owner/operator, where in the CRN Manager's opinion, there is doubt regarding the stability of the vehicle during curve negotiation under draft and/or buff forces.

Where required, curve stability shall be tested as follows:

The test consist shall be subjected to a squeeze and draft load of 750 kN without vehicle body-suspension separation or wheel lift. The load application, firstly static and then at a nominal speed of 5 km/h, shall be sustained for a minimum of 20 seconds duration. The static case evaluates the rail stability, the dynamic case evaluates the vehicle's tendency to derail. Articulated vehicles consisting of more than two (2) platforms shall be tested with a minimum of three (3) platforms in the test consist. The number of platforms used shall generate maximum load in the critical L/V location of the vehicle.

For the purpose of this test the test vehicle shall be fitted with new full flange wheel profiles.

The empty vehicle shall be subjected to squeeze and draft load on a curve of not greater than 175 metre radius. The curve shall have 12 mm maximum superelevation. The test vehicle shall be coupled to a 'base vehicle' as defined in Section 6.5 and a 'long vehicle' having a length over strikers of 25 metres, long shank couplers and conventional draftgear.

## **25 Elevating work platform (EWP) stability test**

Rail vehicles forming part of or carrying an attached EWP shall be tested for stability on rail. The vehicle EWP shall be fully loaded to its maximum design capacity and be tested in accordance with Australian Standard AS1418, Parts 1 & 10.

## Appendix 1 CRN Rolling Stock Glossary

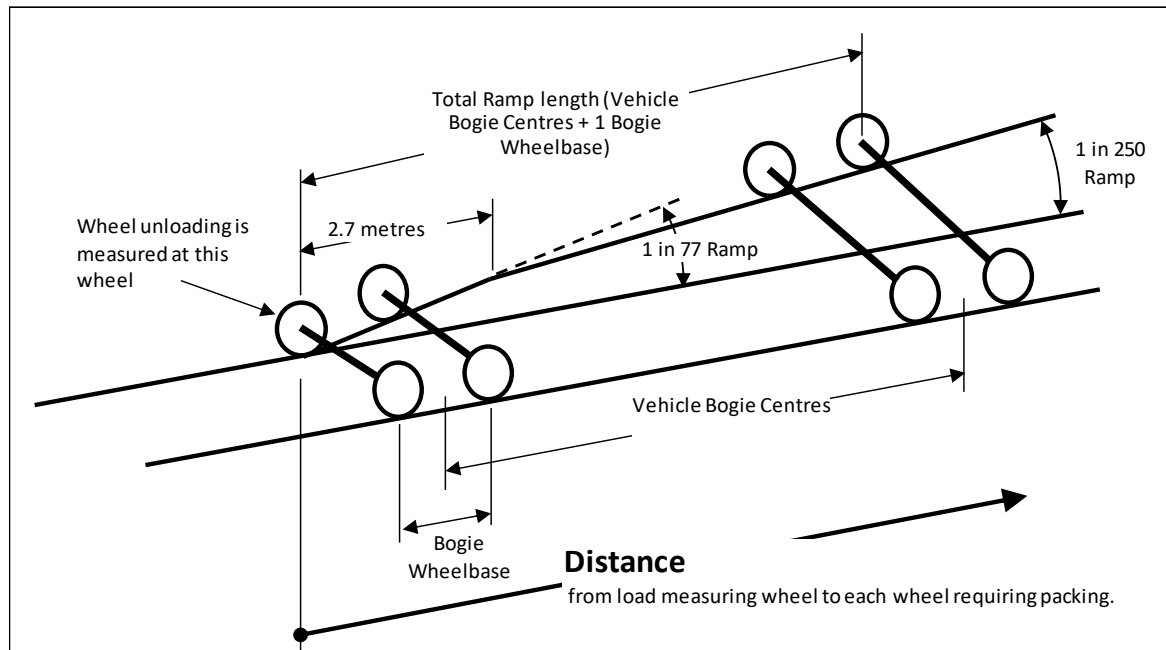
This appendix defines words that are used in the CRN Rolling Stock Standards

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	<p>The difference in superelevation between:</p> <p>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</p> <p>the actual superelevation existing in the curve.</p> <p>Cant deficiency is a function of superelevation, curve radius and vehicle speed.</p>
Continuous tractive effort	The tangential force that can be applied at the wheel/rail interface by a self powered vehicle for an indefinite period without causing wheel spin or overheating of the traction equipment.
Curved wheel web	Wheel web or plate which is domed such that its cross section is curved.
Design speed	The maximum speed at which a vehicle is expected to operate on the CRN.
Flat top trolley or trailer	A small non-powered infrastructure maintenance vehicle which is used for conveying tools and equipment along the track and which can be easily removed from the track.
Freight Train	A train predominantly consisting of freight vehicles.
Full supplies, Fully provisioned	Locomotive with all equipment and full of fuel, oil, water, coolant and sand.
Handbrake	<p>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.</p> <p>Note: Where the term “handbrake” is used, it will also mean “parking brake”.</p>
Heritage vehicle	Locomotive, passenger vehicle, freight vehicle or trolley that has historical significance and/or is not used in regular revenue service but used in special interest operations, such as steam tours.
Infrastructure maintenance vehicle	A rail bound self propelled vehicle which is used to carry out inspection and/or maintenance on railway infrastructure. Some of these vehicles may be removed from the railway track by the use of special take-offs or portable turnouts.
Light locomotive	One or more locomotives coupled together without hauled vehicles attached.
Locomotive	A self propelled vehicle, powered by any form of energy, which does not convey passengers or freight but which is used to move one or more other vehicles thus forming a train.
Multiple unit train	A distributed power train made up of similar electric or diesel powered vehicles and non-powered vehicles operating as a unit.
Net brake ratio	The ratio of the sum of the actual measured brake block forces divided by the total vehicle weight.



On-track infrastructure maintenance vehicle	Any infrastructure maintenance vehicle which operates exclusively on railway track.
Overhead wiring vehicle	An infrastructure maintenance vehicle with an elevating platform or equipped for maintenance of the overhead traction wiring system.
Power car	A self propelled vehicle, which may or may not convey passengers and/or freight, and operates in conjunction with similar vehicles in a multiple unit consist.
Quadricycle	A small self propelled rail-bound track vehicle which can be easily removed from the track.
Qualified worker	A worker certified as competent to carry out the relevant task.
Rail-bound infrastructure maintenance vehicle	An on-track infrastructure maintenance vehicle that cannot be removed from track without the use of a heavy crane. These vehicles are transferred around the network by rail.
Road/rail vehicle	Any type of track vehicle which can travel on either road or rail and can readily transfer from one mode of operation to the other.
Rolling Stock Exemption Certificate	A Certificate issued to a vehicle owner/operator covering vehicle non-conformances which are technically acceptable. These certificates remain in place for the life of the vehicle.
Rolling Stock Standards Waiver	A Waiver issued for a vehicle covering non-conformances that are deemed acceptable for a limited time period, until corrected.
Starting tractive effort	The tangential force applied at the wheel/rail interface that can be applied by self powered vehicle, to move itself and its trailing load from a stationary state without causing excessive wheel slip.
Straight wheel web	Wheel web consisting of a flat plate with no curvature such that its cross section is straight. Used primarily with wheel cheek mounted disc brakes
S-plate wheel	Wheel with a web such that its cross section forms an S shape, designed to provide low wheel rim stresses
Substantially modified vehicle	Vehicle modified to accommodate its use for a different purpose. Vehicle undergoing major refurbishment with updated equipment which can alter the braking, traction or suspension system performance.  Vehicle being moved with equipment removed resulting in a reduction of vehicle mass that could alter the vehicle performance.  Vehicle modified such that it may be incompatible with the infrastructure.
TOC Waiver	An authority issued for the movement of a vehicle for which there are no published operating conditions, or for which the operating conditions are different from those published in the CRN Train operating Conditions Manual.
Track maintenance vehicle	Infrastructure maintenance vehicle used for the maintenance, construction or inspection of track.
Train	One or more rail vehicles operating singularly or coupled together, hauled or self powered and capable of operating track signal circuits

## Appendix 2 Twist test packing selection



**NOTE:** Where the distance falls between the dimensions shown, round the packing up to the next available size

Distance	Packing	Distance	Packing	Distance	Packing	Distance	Packing	Distance	Packing	Distance	Packing
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
300	4	1700	22	3100	36.5	<b>4500</b>	42	5900	48	7300	53.5
350	4.5	1750	22.5	3150	37	4550	42.5	5950	48	7350	53.5
400	5	1800	23.5	3200	37	4600	42.5	<b>6000</b>	48	7400	54
450	6	1850	24	3250	37	4650	43	6050	48.5	7450	54
<b>500</b>	6.5	1900	24.5	3300	37.5	4700	43	6100	48.5	<b>7500</b>	54
550	7	1950	25.5	3350	37.5	4750	43	6150	49	7550	54.5
600	8	<b>2000</b>	26	3400	38	4800	43.5	6200	49	7600	54.5
650	8.5	2050	26.5	3450	38	4850	43.5	6250	49	7650	55
700	9	2100	27.5	<b>3500</b>	38	4900	44	6300	49.5	7700	55
750	9.5	2150	28	3550	38.5	4950	44	6350	49.5	7750	55
800	10.5	2200	28.5	3600	38.5	<b>5000</b>	44	6400	50	7800	55.5
850	11	2250	29	3650	39	5050	44.5	6450	50	7850	55.5
900	11.5	2300	30	3700	39	5100	44.5	<b>6500</b>	50	7900	56
950	12.5	2350	30.5	3750	39	5150	45	6550	50.5	7950	56
<b>1000</b>	13	2400	31	3800	39.5	5200	45	6600	50.5	<b>8000</b>	56
1050	13.5	2450	32	3850	39.5	5250	45	6650	51	8050	56.5
1100	14.5	<b>2500</b>	32.5	3900	40	5300	45.5	6700	51	8100	56.5
1150	15	2550	33	3950	40	5350	45.5	6750	51	8150	57
1200	15.5	2600	34	<b>4000</b>	40	5400	46	6800	51.5	8200	57
1250	16	2650	34.5	4050	40.5	5450	46	6850	51.5	8250	57
1300	17	2700	35	4100	40.5	<b>5500</b>	46	6900	52	8300	57.5
1350	17.5	2750	35	4150	41	5550	46.5	6950	52	8350	57.5
1400	18	2800	35.5	4200	41	5600	46.5	<b>7000</b>	52	8400	58
1450	19	2850	35.5	4250	41	5650	47	7050	52.5	8450	58
<b>1500</b>	19.5	2900	36	4300	41.5	5700	47	7100	52.5	<b>8500</b>	58
1550	20	2950	36	4350	41.5	5750	47	7150	53	8550	58.5
1600	21	<b>3000</b>	36	4400	42	5800	47.5	7200	53	8600	58.5
1650	21.5	3050	36.5	4450	42	5850	47.5	7250	53	8650	59

## PACKING TABLE (Continued)

Distance	Packing	Distance	Packing	Distance	Packing	Distance	Packing	Distance	Packing	Distance	Packing
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
8700	59	11050	68.5	<b>13400</b>	78	15750	87	18100	96.5	20450	106
8750	59	11100	68.5	13450	78	15800	87.5	18150	97	<b>20500</b>	106
8800	59.5	11150	69	<b>13500</b>	78	15850	87.5	18200	97	20550	106.5
8850	59.5	11200	69	13550	78.5	15900	88	18250	97	20600	106.5
8900	60	11250	69	13600	78.5	15950	88	18300	97.5	20650	107
8950	60	11300	69.5	13650	79	<b>16000</b>	88	18350	97.5	20700	107
<b>9000</b>	60	11350	69.5	13700	79	16050	88.5	18400	98	20750	107
9050	60.5	11400	70	13750	79	16100	88.5	18450	98	20800	107.5
9100	60.5	11450	70	13800	79.5	16150	89	<b>18500</b>	98	20850	107.5
9150	61	<b>11500</b>	70	13850	79.5	16200	89	18550	98.5	20900	108
9200	61	11550	70.5	13900	80	16250	89	18600	98.5	20950	108
9250	61	11600	70.5	13950	80	16300	89.5	18650	99	<b>21000</b>	108
9300	61.5	11650	71	<b>14000</b>	80	16350	89.5	18700	99	21050	108.5
9350	61.5	11700	71	14050	80.5	16400	90	18750	99	21100	108.5
9400	62	11750	71	14100	80.5	16450	90	18800	99.5	21150	109
9450	62	11800	71.5	14150	81	<b>16500</b>	90	18850	99.5	21200	109
<b>9500</b>	62	11850	71.5	14200	81	16550	90.5	18900	100	21250	109
9550	62.5	11900	72	14250	81	16600	90.5	18950	100	21300	109.5
9600	62.5	11950	72	14300	81.5	16650	91	<b>19000</b>	100	21350	109.5
9650	63	<b>12000</b>	72	14350	81.5	16700	91	19050	100.5	21400	110
9700	63	12050	72.5	14400	82	16750	91	19100	100.5	21450	110
9750	63	12100	72.5	14450	82	16800	91.5	19150	101	<b>21500</b>	110
9800	63.5	12150	73	<b>14500</b>	82	16850	91.5	19200	101	21550	110.5
9850	63.5	12200	73	14550	82.5	16900	92	19250	101	21600	110.5
9900	64	12250	73	14600	82.5	16950	92	19300	101.5	21650	111
9950	64	12300	73.5	14650	83	<b>17000</b>	92	19350	101.5	21700	111
<b>10000</b>	64	12350	73.5	14700	83	17050	92.5	19400	102	21750	111
10050	64.5	12400	74	14750	83	17100	92.5	19450	102	21800	111.5
10100	64.5	12450	74	14800	83.5	17150	93	<b>19500</b>	102	21850	111.5
10150	65	<b>12500</b>	74	14850	83.5	17200	93	19550	102.5	21900	112
10200	65	12550	74.5	14900	84	17250	93	19600	102.5	21950	112
10250	65	12600	74.5	14950	84	17300	93.5	19650	103	<b>22000</b>	112
10300	65.5	12650	75	<b>15000</b>	84	17350	93.5	19700	103	22050	112.5
10350	65.5	12700	75	15050	84.5	17400	94	19750	103	22100	112.5
10400	66	12750	75	15100	84.5	17450	94	19800	103.5	22150	113
10450	66	12800	75.5	15150	85	<b>17500</b>	94	19850	103.5	22200	113
<b>10500</b>	66	12850	75.5	15200	85	17550	94.5	19900	104	22250	113
10550	66.5	12900	76	15250	85	17600	94.5	19950	104	22300	113.5
10600	66.5	12950	76	15300	85.5	17650	95	<b>20000</b>	104	22350	113.5
10650	67	<b>13000</b>	76	15350	85.5	17700	95	20050	104.5	22400	114
10700	67	13050	76.5	15400	86	17750	95	20100	104.5	22450	114
10750	67	13100	76.5	15450	86	17800	95.5	20150	105	<b>22500</b>	114
10800	67.5	13150	77	<b>15500</b>	86	17850	95.5	20200	105	22550	114.5
10850	67.5	13200	77	15550	86.5	17900	96	20250	105	22600	114.5
10900	68	13250	77	15600	86.5	17950	96	20300	105.5	22650	115
10950	68	13300	77.5	15650	87	<b>18000</b>	96	20350	105.5	22700	115
<b>11000</b>	68	13350	77.5	15700	87	18050	96.5	20400	106	22750	115

PACKING TABLE (Continued)

Distance	Packing	Distance	Packing	Distance	Packing	Distance	Packing	Distance	Packing	Distance	Packing
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
22800	115.5	25150	125	<b>27500</b>	134	29850	143.5	32200	153	34550	162.5
22850	115.5	25200	125	27550	134.5	29900	144	32250	153	34600	162.5
22900	116	25250	125	27600	134.5	29950	144	32300	153.5	34650	163
22950	116	25300	125.5	27650	135	<b>30000</b>	144	32350	153.5	34700	163
<b>23000</b>	116	25350	125.5	27700	135	30050	144.5	32400	154	34750	163
23050	116.5	25400	126	27750	135	30100	144.5	32450	154	34800	163.5
23100	116.5	25450	126	27800	135.5	30150	145	<b>32500</b>	154	34850	163.5
23150	117	<b>25500</b>	126	27850	135.5	30200	145	32550	154.5	34900	164
23200	117	25550	126.5	27900	136	30250	145	32600	154.5	34950	164
23250	117	25600	126.5	27950	136	30300	145.5	32650	155	<b>35000</b>	164
23300	117.5	25650	127	<b>28000</b>	136	30350	145.5	32700	155	35050	164.5
23350	117.5	25700	127	28050	136.5	30400	146	32750	155	35100	164.5
23400	118	25750	127	28100	136.5	30450	146	32800	155.5	35150	165
23450	118	25800	127.5	28150	137	<b>30500</b>	146	32850	155.5	35200	165
<b>23500</b>	118	25850	127.5	28200	137	30550	146.5	32900	156	35250	165
23550	118.5	25900	128	28250	137	30600	146.5	32950	156	35300	165.5
23600	118.5	25950	128	28300	137.5	30650	147	<b>33000</b>	156	35350	165.5
23650	119	<b>26000</b>	128	28350	137.5	30700	147	33050	156.5	35400	166
23700	119	26050	128.5	28400	138	30750	147	33100	156.5	35450	166
23750	119	26100	128.5	28450	138	30800	147.5	33150	157	<b>35500</b>	166
23800	119.5	26150	129	<b>28500</b>	138	30850	147.5	33200	157	35550	166.5
23850	119.5	26200	129	28550	138.5	30900	148	33250	157	35600	166.5
23900	120	26250	129	28600	138.5	30950	148	33300	157.5	35650	167
23950	120	26300	129.5	28650	139	<b>31000</b>	148	33350	157.5	35700	167
<b>24000</b>	120	26350	129.5	28700	139	31050	148.5	33400	158	35750	167
24050	120.5	26400	130	28750	139	31100	148.5	33450	158	35800	167.5
24100	120.5	26450	130	28800	139.5	31150	149	<b>33500</b>	158	35850	167.5
24150	121	<b>26500</b>	130	28850	139.5	31200	149	33550	158.5	35900	168
24200	121	26550	130.5	28900	140	31250	149	33600	158.5	35950	168
24250	121	26600	130.5	28950	140	31300	149.5	33650	159	<b>36000</b>	168
24300	121.5	26650	131	<b>29000</b>	140	31350	149.5	33700	159	36050	168.5
24350	121.5	26700	131	29050	140.5	31400	150	33750	159	36100	168.5
24400	122	26750	131	29100	140.5	31450	150	33800	159.5	36150	169
24450	122	26800	131.5	29150	141	<b>31500</b>	150	33850	159.5	36200	169
<b>24500</b>	122	26850	131.5	29200	141	31550	150.5	33900	160	36250	169
24550	122.5	26900	132	29250	141	31600	150.5	33950	160	36300	169.5
24600	122.5	26950	132	29300	141.5	31650	151	<b>34000</b>	160	36350	169.5
24650	123	<b>27000</b>	132	29350	141.5	31700	151	34050	160.5	36400	170
24700	123	27050	132.5	29400	142	31750	151	34100	160.5	36450	170
24750	123	27100	132.5	29450	142	31800	151.5	34150	161	<b>36500</b>	170
24800	123.5	27150	133	<b>29500</b>	142	31850	151.5	34200	161	36550	170.5
24850	123.5	27200	133	29550	142.5	31900	152	34250	161	36600	170.5
24900	124	27250	133	29600	142.5	31950	152	34300	161.5	36650	171
24950	124	27300	133.5	29650	143	<b>32000</b>	152	34350	161.5	36700	171
<b>25000</b>	124	27350	133.5	29700	143	32050	152.5	34400	162	36750	171
25050	124.5	27400	134	29750	143	32100	152.5	34450	162	36800	171.5
25100	124.5	27450	134	29800	143.5	32150	153	<b>34500</b>	162	36850	171.5

## PACKING TABLE (Continued)

Distance	Packing	Distance	Packing	Distance	Packing	Distance	Packing	Distance	Packing	Distance	Packing
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
36900	172	39250	181	41600	190.5	43950	200	46300	209.5	48650	219
36950	172	39300	181.5	41650	191	<b>44000</b>	200	46350	209.5	48700	219
<b>37000</b>	172	39350	181.5	41700	191	44050	200.5	46400	210	48750	219
37050	172.5	39400	182	41750	191	44100	200.5	46450	210	48800	219.5
37100	172.5	39450	182	41800	191.5	44150	201	<b>46500</b>	210	48850	219.5
37150	173	<b>39500</b>	182	41850	191.5	44200	201	46550	210.5	48900	220
37200	173	39550	182.5	41900	192	44250	201	46600	210.5	48950	220
37250	173	39600	182.5	41950	192	44300	201.5	46650	211	<b>49000</b>	220
37300	173.5	39650	183	<b>42000</b>	192	44350	201.5	46700	211	49050	220.5
37350	173.5	39700	183	42050	192.5	44400	202	46750	211	49100	220.5
37400	174	39750	183	42100	192.5	44450	202	46800	211.5	49150	221
37450	174	39800	183.5	42150	193	<b>44500</b>	202	46850	211.5	49200	221
<b>37500</b>	174	39850	183.5	42200	193	44550	202.5	46900	212	49250	221
37550	174.5	39900	184	42250	193	44600	202.5	46950	212	49300	221.5
37600	174.5	39950	184	42300	193.5	44650	203	<b>47000</b>	212	49350	221.5
37650	175	<b>40000</b>	184	42350	193.5	44700	203	47050	212.5	49400	222
37700	175	40050	184.5	42400	194	44750	203	47100	212.5	49450	222
37750	175	40100	184.5	42450	194	44800	203.5	47150	213	<b>49500</b>	222
37800	175.5	40150	185	<b>42500</b>	194	44850	203.5	47200	213	49550	222.5
37850	175.5	40200	185	42550	194.5	44900	204	47250	213	49600	222.5
37900	176	40250	185	42600	194.5	44950	204	47300	213.5	49650	223
37950	176	40300	185.5	42650	195	<b>45000</b>	204	47350	213.5	49700	223
<b>38000</b>	176	40350	185.5	42700	195	45050	204.5	47400	214	49750	223
38050	176.5	40400	186	42750	195	45100	204.5	47450	214	49800	223.5
38100	176.5	40450	186	42800	195.5	45150	205	<b>47500</b>	214	49850	223.5
38150	177	<b>40500</b>	186	42850	195.5	45200	205	47550	214.5	49900	224
38200	177	40550	186.5	42900	196	45250	205	47600	214.5	49950	224
38250	177	40600	186.5	42950	196	45300	205.5	47650	215	<b>50000</b>	224
38300	177.5	40650	187	<b>43000</b>	196	45350	205.5	47700	215	50050	224.5
38350	177.5	40700	187	43050	196.5	45400	206	47750	215	50100	224.5
38400	178	40750	187	43100	196.5	45450	206	47800	215.5	50150	225
38450	178	40800	187.5	43150	197	<b>45500</b>	206	47850	215.5	50200	225
<b>38500</b>	178	40850	187.5	43200	197	45550	206.5	47900	216	50250	225
38550	178.5	40900	188	43250	197	45600	206.5	47950	216	50300	225.5
38600	178.5	40950	188	43300	197.5	45650	207	<b>48000</b>	216	50350	225.5
38650	179	<b>41000</b>	188	43350	197.5	45700	207	48050	216.5	50400	226
38700	179	41050	188.5	43400	198	45750	207	48100	216.5	50450	226
38750	179	41100	188.5	43450	198	45800	207.5	48150	217	<b>50500</b>	226
38800	179.5	41150	189	<b>43500</b>	198	45850	207.5	48200	217	50550	226.5
38850	179.5	41200	189	43550	198.5	45900	208	48250	217	50600	226.5
38900	180	41250	189	43600	198.5	45950	208	48300	217.5	50650	227
38950	180	41300	189.5	43650	199	<b>46000</b>	208	48350	217.5	50700	227
<b>39000</b>	180	41350	189.5	43700	199	46050	208.5	48400	218	50750	227
39050	180.5	41400	190	43750	199	46100	208.5	48450	218	50800	227.5
39100	180.5	41450	190	43800	199.5	46150	209	<b>48500</b>	218	50850	227.5
39150	181	<b>41500</b>	190	43850	199.5	46200	209	48550	218.5	50900	228
39200	181	41550	190.5	43900	200	46250	209	48600	218.5	50950	228