Standard

RSU 400 Series – Minimum Operating Standards for Rolling Stock – Freight Vehicle Specific Interface Requirements

Version 2.0
Issued date: 24 August 2017
Important message

This document is one of a set of standards developed solely and specifically for use on Transport Assets (as defined in the Asset Standards Authority Charter). It is not suitable for any other purpose.

The copyright and any other intellectual property in this document will at all times remain the property of the State of New South Wales (Transport for NSW).

You must not use or adapt this document or rely upon it in any way unless you are providing products or services to a NSW Government agency and that agency has expressly authorised you in writing to do so. If this document forms part of a contract with, or is a condition of approval by a NSW Government agency, use of the document is subject to the terms of the contract or approval. To be clear, the content of this document is not licensed under any Creative Commons Licence.

This document may contain third party material. The inclusion of third party material is for illustrative purposes only and does not represent an endorsement by NSW Government of any third party product or service.

If you use this document or rely upon it without authorisation under these terms, the State of New South Wales (including Transport for NSW) and its personnel does not accept any liability to you or any other person for any loss, damage, costs and expenses that you or anyone else may suffer or incur from your use and reliance on the content contained in this document. Users should exercise their own skill and care in the use of the document.

This document may not be current and is uncontrolled when printed or downloaded. Standards may be accessed from the Asset Standards Authority website at www.asa.transport.nsw.gov.au

© State of NSW through Transport for NSW 2017
Standard governance

**Owner:** Lead Rolling Stock Engineer, Asset Standards Authority

**Authoriser:** Chief Engineer, Asset Standards Authority

**Approver:** Executive Director, Asset Standards Authority on behalf of the ASA Configuration Control Board

Document history

<table>
<thead>
<tr>
<th>Version</th>
<th>Summary of changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4</td>
<td>First issued in December 2014 with the ASA standard numbering. ESR 0001 – 400 <em>Minimum Operating Standards for Rolling Stock – Freight Vehicle Specific Interface Requirements</em> was renumbered as T HR RS 004000 ST RSU 400 Series – Minimum Operating Standards for Rolling Stock – Freight Vehicle Specific Interface Requirements without any changes to the content.</td>
</tr>
<tr>
<td>2.0</td>
<td>Second issue. Revised contents of RailCorp document ESR 0001-400 as per summary of changes in Table 1.</td>
</tr>
</tbody>
</table>

For queries regarding this document, please email the ASA at standards@transport.nsw.gov.au or visit www.asa.transport.nsw.gov.au

© State of NSW through Transport for NSW 2017
Preface

The Asset Standards Authority (ASA) is a key strategic branch of Transport for NSW (TfNSW). As the network design and standards authority for NSW Transport Assets, as specified in the ASA Charter, the ASA identifies, selects, develops, publishes, maintains and controls a suite of requirements documents on behalf of TfNSW, the asset owner.

The ASA deploys TfNSW requirements for asset and safety assurance by creating and managing TfNSW's governance models, documents and processes. To achieve this, the ASA focuses on four primary tasks:

- publishing and managing TfNSW's process and requirements documents including TfNSW plans, standards, manuals and guides
- deploying TfNSW's Authorised Engineering Organisation (AEO) framework
- continuously improving TfNSW’s Asset Management Framework
- collaborating with the Transport cluster and industry through open engagement

The AEO framework authorises engineering organisations to supply and provide asset related products and services to TfNSW. It works to assure the safety, quality and fitness for purpose of those products and services over the asset's whole-of-life. AEOs are expected to demonstrate how they have applied the requirements of ASA documents, including TfNSW plans, standards and guides, when delivering assets and related services for TfNSW.

Compliance with ASA requirements by itself is not sufficient to ensure satisfactory outcomes for NSW Transport Assets. The ASA expects that professional judgement be used by competent personnel when using ASA requirements to produce those outcomes.

About this document


The changes to previous content include the following:

- replacement of RailCorp organisation roles and processes with those applicable to the current ASA organisational context
- amendments and clarification to content; refer to Table 1 for the summary of changes
• conversion of the standard to ASA format and style

Table 1 provides a summary of changes to the content of this standard since its previous publication. Changes to front matter, formatting, branding, and governance are not included.

**Table 1 – Summary of changes from T HR RS 00400 ST, version 1.4**

<table>
<thead>
<tr>
<th>Page</th>
<th>Section</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1.6</td>
<td>Authorisation of vehicles Added reference to test requirements in RSU 440</td>
</tr>
<tr>
<td>12</td>
<td>2.7.1</td>
<td>Wagon (bogie) steering performance requirements New sub section added detailing mandatory requirements for bogie angle of attach / steering performance</td>
</tr>
<tr>
<td>13</td>
<td>2.8</td>
<td>Vehicle suspension Added CCSB reference and limitations on rubber primary suspension</td>
</tr>
<tr>
<td>16</td>
<td>3.3</td>
<td>Location of end equipment Removed reference to non-standard couplers.</td>
</tr>
<tr>
<td>16</td>
<td>3.4</td>
<td>Standard pressures and timings Replaced 100 m with curvatures as per RSU 285</td>
</tr>
<tr>
<td>17</td>
<td>3.5</td>
<td>Performance requirements Added further clarification on control valve and vent valve requirements</td>
</tr>
<tr>
<td>18</td>
<td>3.7</td>
<td>Main reservoir pipe Added further details and clarification on 2 pipe wagons</td>
</tr>
<tr>
<td>19</td>
<td>3.8</td>
<td>Main reservoir branch tee requirements Added requirements for MR branch lengths and distances</td>
</tr>
<tr>
<td>19</td>
<td>3.11</td>
<td>ECP Brakes Clarified requirements for ECP brake systems</td>
</tr>
<tr>
<td>21</td>
<td>4.1</td>
<td>Design loads and stresses Added detail regarding welds in wagon body</td>
</tr>
<tr>
<td>23</td>
<td>4.4</td>
<td>Doors Clarified requirements of door clearances</td>
</tr>
<tr>
<td>31</td>
<td>5.5</td>
<td>P2 force determination and P/D ratio Added P/D reference</td>
</tr>
<tr>
<td>31</td>
<td>5.6</td>
<td>Bridges and structures loading requirements Added new section on bridge loading requirements</td>
</tr>
<tr>
<td>32</td>
<td>6.1</td>
<td>Net brake ratio Amended new torque figure in accordance with AS 7510 for new wagons</td>
</tr>
<tr>
<td>32</td>
<td>6.2</td>
<td>Air brake Added higher brake ratio for bulk type wagons and dynamic test requirement</td>
</tr>
<tr>
<td>33</td>
<td>6.3</td>
<td>Spring parking brake or handbrake Added higher brake ratio for bulk type wagons and friction coefficient requirement</td>
</tr>
<tr>
<td>34</td>
<td>7</td>
<td>Freight vehicle ride performance – RSU 442 Clarified wheel profiles</td>
</tr>
<tr>
<td>37</td>
<td>10.3</td>
<td>Brake retention Added note on functionality tests and inspections</td>
</tr>
</tbody>
</table>
# Table of contents

1. **General requirements – RSU 400**.......................................................................................................................... 8
   1.1. Introduction ......................................................................................................................................................... 8
   1.2. Purpose ................................................................................................................................................................. 8
   1.3. Application .......................................................................................................................................................... 8
   1.4. Referenced documents ........................................................................................................................................ 9
   1.5. Australian standards for railway rolling stock ................................................................................................. 9
   1.6. Authorisation of vehicles ................................................................................................................................. 10
2. **Bogie components – RSU 410**.............................................................................................................................. 11
   2.1. Introduction ......................................................................................................................................................... 11
   2.2. Wheels ................................................................................................................................................................. 11
   2.3. Wheel profiles ...................................................................................................................................................... 11
   2.4. Axles ................................................................................................................................................................. 11
   2.5. Wheel and axle assembly ................................................................................................................................. 11
   2.6. Axle bearing assemblies .................................................................................................................................... 11
   2.7. Bogie frames and associated componentry ..................................................................................................... 11
   2.8. Vehicle suspension ............................................................................................................................................ 13
3. **Brakes and pneumatic equipment – RSU 420**........................................................................................................ 15
   3.1. Introduction ......................................................................................................................................................... 15
   3.2. General requirements ........................................................................................................................................ 15
   3.3. Location of end equipment ................................................................................................................................ 16
   3.4. Standard pressures and timings ........................................................................................................................ 16
   3.5. Performance requirements ................................................................................................................................ 17
   3.6. Brake equipment ................................................................................................................................................ 18
   3.7. Main reservoir pipe ............................................................................................................................................ 18
   3.8. Main reservoir branch tee requirements ........................................................................................................ 19
   3.9. Identification of cocks and brake equipment ................................................................................................. 19
   3.10. Dummy couplers ............................................................................................................................................... 19
   3.11. ECP Brakes ....................................................................................................................................................... 19
4. **Body and underframe – RSU 430**........................................................................................................................... 21
   4.1. Design loads and stresses .................................................................................................................................... 21
   4.2. Couplers and draft gear ..................................................................................................................................... 22
   4.3. Towing fixtures, jacking, and lifting points ....................................................................................................... 23
   4.4. Doors ................................................................................................................................................................. 23
   4.5. Container fixings ................................................................................................................................................ 24
   4.6. Marking and identification ............................................................................................................................... 25
5. **Vehicle performance – RSU 440**........................................................................................................................... 30
   5.1. Test requirement summary ................................................................................................................................ 30
   5.2. Jacking point vertical load test ........................................................................................................................... 31
   5.3. Static end compression test ............................................................................................................................... 31
   5.4. Single vehicle impact ......................................................................................................................................... 31
5.5. P2 force determination and P/D ratio ................................................................. 31
5.6. Bridges and structures loading requirements .................................................. 31

6. Braking performance – RSU 441 ............................................................................ 32
6.1. Net brake ratio ..................................................................................................... 32
6.2. Air brake .............................................................................................................. 32
6.3. Spring parking brake or handbrake ...................................................................... 33
6.4. Single car air test .................................................................................................. 33

7. Freight vehicle ride performance – RSU 442 ........................................................ 34

8. Non-conventional freight vehicles – RSU 450 ..................................................... 35

9. Articulated or permanently coupled vehicles – RSU 451 ...................................... 35
9.1. Vehicle types ........................................................................................................ 35
9.2. Air brake equipment ............................................................................................ 35
9.3. Parking brake or handbrake .................................................................................. 35

10. Rail compatible trailers – RSU 452 ................................................................. 36
10.1. Description ......................................................................................................... 36
10.2. Design .................................................................................................................. 36
10.3. Brake retention .................................................................................................... 37

11. Vehicle specific requirements – RSU 460 ........................................................... 39

12. Tank wagons – RSU 461 ...................................................................................... 39
12.1. Design .................................................................................................................. 39
12.2. Tank inspections .................................................................................................. 39
1. **General requirements – RSU 400**

This section provides general requirements for freight vehicle specific interfaces.

### 1.1. Introduction

The Asset Standards Authority (ASA) has established the interface requirements pertaining to vehicles operating on the RailCorp network.

The T HR RS 00400 ST (RSU 400 series) standards contain specific interface requirements for freight vehicles operating on the RailCorp network.

The RSU 400 series of standards are part of the *Minimum Operating Standards for Rolling Stock*, which is made up of the following parts:

- T HR RS 00000 ST (RSU 000 series) *General requirements*
- T HR RS 00100 ST (RSU 100 series) *General interface requirements*
- T HR RS 00200 ST (RSU 200 series) *Common interface requirements*
- T HR RS 00811 ST to T HR RS 00890 ST (RSU App A1 to RSU App I) *Appendices*

### 1.2. Purpose

The purpose of this standard is to ensure that all rolling stock operating on the RailCorp network meet the minimum standards to ensure compatibility with the network and its infrastructure as required by the Transport for NSW (TfNSW) accreditation with the Office of the National Rail Safety Regulator (ONRSR).

### 1.3. Application

The requirements of these standards apply to all new, substantially modified vehicles and vehicles that have not operated on the RailCorp network.

Older rolling stock that were operating on the RailCorp network as at August, 1997 may not fully comply with the requirements of these standards; however will be assessed considering the design and proposed use of the vehicle(s).

In these standards, the terms ‘owner’ and ‘operator’ are used. They refer to the owner of the rolling stock and the operator using that rolling stock. These may or may not be the same organisation.

When the word ‘shall’ is used in this document, the requirements shall be read as mandatory for vehicles operating on the RailCorp network.

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.

1.4. **Referenced documents**

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies.

**Australian standards**

- AS 4100 Steel structures
- AS/NZS 1554.1 Structural steel welding Part 1: Welding of steel structures
- AS/NZS 1664 Aluminium structures
- AS/NZS 1665 Welding of aluminium structures
- AS/NZS 3788 Pressure equipment – In-service inspection
- Australian Standards for Railway Rolling Stock (RISSB AS 7500 Series Standards)

**TfNSW standards**

- EPR 0029 ECP Functionality Acceptance Test
- T HR RS 00000 ST (RSU 000 series) General requirements
- T HR RS 00100 ST (RSU 100 series) General interface requirements
- T HR RS 00200 ST (RSU 200 series) Common interface requirements
- T HR RS 00811 ST to T HR RS 00890 ST (RSU App A1 to RSU App I) Appendices
- Train Operating Conditions (TOC) Manual TS TOC 1, TS TOC 2, and TS TOC 3

**Other references**

- Association of American Railroads (AAR) Rule 47
- Network Rules

1.5. **Australian standards for railway rolling stock**

The Rail Industry Safety and Standards Board (RISSB), is currently writing the Australian standards for railway rolling stock which will eventually supersede the *Railways of Australia Manual of Engineering Standards and Practices*.

The requirements of the ASA minimum operating standards for rolling stock generally align with the Australian standards for railway rolling stock; however they can contain additional requirements.
Where applicable throughout this standard, the Australian standards for railway rolling stock are referenced for use.

The content in the applicable section of this standard is aligned with the Australian standards for railway rolling stock.

Where additional requirements to the Australian standards have been identified, these are indicated with separator lines and blue bold text.

For example:

**AS 7500: Additional requirements to the Australian standards for rolling stock will be indicated in bold text such as this.**

These additional requirements are mandatory.

For any rolling stock to operate on the RailCorp network, the requirements of the ASA minimum operating standards for rolling stock standards take precedence to the Australian standards where conflicts exist in requirements.

*Note: The gap analysis of the ASA minimum operating standards for rolling stock and the Australian standards for railway rolling stock is ongoing. As new Australian standards for railway rolling stock are published and as the gap analysis progresses, additional indications of variance will be added to these standards.*

The current listing of Australian standards for railway rolling stock can be found on the RISSB website. The list categorises standards as being ‘published’, ‘in progress’ or ‘future’.

To obtain access to the published Australian standards for railway rolling stock, visit the RISSB website.

1.6. **Authorisation of vehicles**

For assessment of freight vehicles to operate on the RailCorp network, the vehicle information pack in T HR RS 00812 ST (RSU Appendix A2) *Freight vehicle information pack*, shall be completed and submitted to ASA.

Vehicle testing requirements for freight vehicles are summarised in Section 5 (RSU 440) of this standard.
2. Bogie components – RSU 410

Requirements for bogie and suspension components involve wheels, axles, assembly of wheels and axles, and axle bearing assemblies.

2.1. Introduction

This section contains bogie related requirements that are specific to freight vehicles. All requirements in T HR RS 00200 ST (RSU 200 series), which are common rolling stock requirements also apply to freight vehicles.

2.2. Wheels

Refer to T HR RS 00200 ST, Section 2 (RSU 210) for common wheel requirements. In addition, the following requirements are applicable:

- T HR RS 00200 ST, Section 3 (RSU 211) Wheels, design & manufacture
- T HR RS 00200 ST, Section 4 (RSU 212) Wheels, minimum operational requirements

2.3. Wheel profiles

Wheel tread profiles shall be in accordance with T HR RS 00200 ST, Section 3.3.4 (RSU 211) Wheel profiles.

2.4. Axles

For axle requirements, refer to T HR RS 00200 ST, Section 5 (RSU 220) Axles.

2.5. Wheel and axle assembly

For wheel and axle assembly requirements, refer to T HR RS 00200 ST, Section 6 (RSU 230) Wheel and axle assembly.

2.6. Axle bearing assemblies

For axle bearing assemblies requirements, refer to T HR RS 00200 ST, Section 7 (RSU 240) Axle bearing assemblies.

2.7. Bogie frames and associated componentry

For bogie frames and associated componentry requirements, refer to T HR RS 00200 ST, Section 8 (RSU 250) Bogie frames and associated componentry.
2.7.1. Wagon (bogie) steering performance requirements

Wagon steering performance is assessed in terms of the angle of attack (AoA) of the wheelset when the bogie traverses curves. The AoA presented by the wheelsets of any freight bogie, measured at any wayside system on the RailCorp network, shall remain within acceptable limits throughout the service life of the bogie. This includes when the bogie is new and overhauled and when the bogie is at its wear limits.

Acceptable AoA is defined as being less than a value given by the following equation:

\[ \text{AoA} = 2.5 \times \frac{Bwb}{R} \]

Where,

- AoA - angle of attack (Rad)
- Bwb - bogie wheel base (m)
- R - radius of track curvature (m)

Note: At the Beecroft AoA detector on the Up Main North at 26.675 km (310 m radius curve), for a typical freight bogie, this corresponds to an acceptable AoA of <15 mrad.

This limit will be applied from 01 January 2018. Any wagon that exceeds the AoA limit at any wayside detection system on the RailCorp network from this date shall be held in breach and TfNSW will issue a notification of breach to the operator.

The operator shall, within 12 months from the day TfNSW has notified the breach to the operator, either:

- Rectify the performance of the wagon; or,
- Submit a plan to rectify the performance of the wagon to the satisfaction of the Lead Rolling Stock Engineer, ASA. The timeline for rectification shall be no longer than the next scheduled overhaul of the bogies on the wagon.

If the operator fails to satisfy these requirements, then the affected wagon shall not be operated on the RailCorp Network until its steering performance has been rectified to the satisfaction of the Lead Rolling Stock Engineer, ASA.

ASA reserve the right to restrict wagons from entering, or returning to service, onto the RailCorp Network, where the performance of the wagon’s steering is clearly noncompliant, or any corrective actions and assurance is ambiguous.

TfNSW shall provide AoA performance data from wayside systems on the RailCorp Network to freight operators in a timely manner sufficient to allow these operators to monitor the performance of their fleets and to ensure compliance with the AoA performance requirements.
2.8. **Vehicle suspension**

Refer to Section 9 (RSU 260) *Vehicle suspension* of T HR RS 00200 ST for common vehicle suspension requirements. This consists of the following subsections:

- T HR RS 00200 ST, Section 10 (RSU 261) Suspension springs
- T HR RS 00200 ST, Section 11 (RSU 262) Suspension damping
- T HR RS 00200 ST, Section 12 (RSU 263) Resilient suspension components
- T HR RS 00200 ST, Section 13 (RSU 264) Constant contact sidebearers (CCSB)

Bogies fitted with resilient rubber elements between the side frame and the bearing adaptor for the purposes of primary suspension shall not be considered to be primary sprung by ASA unless the following applies:

- the rubber element shall be clearly shown to have equivalent or better performance in deflection characteristics under all expected operating frequencies (frequency response) when compared to steel helical primary suspension for the bogie / wagon type
- the P2 force shall be clearly shown by measurement to be equivalent or less than an equivalent bogie with steel helical primary suspension for the bogie / wagon type in back to back comparative tests

### 2.8.1. Suspension damping defects

The condition of friction wedges shall comply with the requirements of Association of American Railroads (AAR) *Rule 47* or the bogie manufacturer’s instructions where applicable, or both.

A bogie shall not continue in service when any friction wedge wear indicating notch is obliterated for ride control bogies, or is 1 mm or less in depth for National C-1 bogies. They shall not be returned to service following bogie attention if the depth of the notch is 3 mm or less; such wedges shall be replaced.

Friction wedge pockets shall be maintained such that the level of damping provided remains within the design limits.

### 2.8.2. Reclamation of friction wedge assemblies

Friction wedges shall not be reclaimed by welding under any circumstances.

Where friction wedge pockets are reclaimed by welding, all welding shall be ground to form a flat surface with no pronounced ridges. Undressed weld beads shall not be permitted in wedge pockets.
2.8.3. Operation of vehicles with defective suspension damping

If it is desired to continue moving vehicles with the defects stated in Section 11.2 (RSU 262) of T HR RS 00200 ST, then the load shall be transhipped and the empty vehicle may proceed to the nearest repair location at the prevailing track speed limit not exceeding 50 km/h.
3. Brakes and pneumatic equipment – RSU 420

The requirements for brakes and pneumatic equipment involve end equipment, standard pressures and timings, brake equipment, main reservoir pipe, main reservoir branch tee, dummy couplers, and ECP brakes.

3.1. Introduction

The braking systems fitted to freight vehicles shall be compatible with the brake systems on locomotives to ensure that the brakes apply and release as required. Otherwise skidded or scaled wheels can occur. Refer to Section 3 (RSU 320) of T HR RS 00300 ST for locomotive brake system.

3.2. General requirements

Freight vehicles shall comply with the following requirements:

The control equipment shall be of the diaphragm type, and suitable to operate on trains of up to 150 bogie vehicles or 3000 m in length. The control equipment shall be compatible in operation with existing equipment.

The brake system shall have the following features:

- initial inshot feature to ensure a fast initial rate of application of the brakes to provide a rapid take up of the brake rigging on the vehicle
- regulated recharge feature to slow the recharging of the vehicle brake system towards the front of the train after a brake application to give more uniform recharging and resultant brake release along the train
- brake cylinder pressure maintaining feature to help ensure retention of brake cylinder pressure despite minor air leaks at the brake cylinder and associated pipework
- auxiliary reservoir pressure maintaining feature to permit some stability in the service lap position
- charging interlock feature to ensure that on trains of 80 or more bogie vehicles, the control valve cannot, due to slow flow rates, oscillate between the application and release positions during initial charging of the braking system
- reduction ensuring feature to provide an additional feature to assist with the propagation of the brake application down the train
- quick service feature to produce a substantially uniform time of quick service transmission regardless of the variations in frictional resistance in the brake rigging
• accelerated application feature to provide a controlled localised reduction of brake pipe pressure at each vehicle so that a positive application is made on every vehicle

• accelerated release feature to provide for a rapid rise in brake pipe pressure on each vehicle to assist with positive release of the brakes

[Reference: Section 7.3.2 of ROA Manual of Engineering Standards and Practices]

Some older vehicles may not fully comply with these requirements; however they will be assessed considering the brake equipment fitted and the proposed use of the vehicle.

Alternate brake systems, such as electronically controlled pneumatic (ECP) may be permitted. Refer to Section 3.11 of this standard for further information on ECP brake requirements.

3.3. Location of end equipment

Freight vehicles shall have coupling cocks located on the terminal ends as follows:

• brake pipe

  The brake pipe coupling cocks shall be located as shown in Figure G7 and Figure G8 in RSU Appendix G of T HR RS 00870 ST.

• main reservoir pipe and independent brake control pipe (optional)

  The main reservoir and independent brake control hoses and cocks shall be located such that they can couple to a locomotive or adjacent vehicle without causing damage or kinking hoses.

Freight vehicles with long overhang beyond the bogie centre may require bifurcation of the brake pipe and the hose connections.

3.4. Standard pressures and timings

Standard timings and pressures shall comply with the following requirements:

The standard control valve unit assembly for a vehicle shall be suitable for operating with a nominal train length of 3000 m as a basis for timing, with control valve unit assemblies up to 50 m apart. The following data apply for a single vehicle:

• brake pipe: 32 mm NB throughout the vehicle inclusive of end coupling cocks, hoses, coupling connections and bifurcations

• brake pipe pressure: 500 kPa nominal

• brake cylinder diameter: 254 mm, 305 mm, or according to bogie design

• brake cylinder pressure: nominal 350 kPa (loaded condition), design 380 kPa maximum

• braking ratio: as specified in Section 6 (RSU 441) of this standard
• brake cylinder piston travel requirements are as follows for underframe mounted brake cylinders:
  o nominal operating: 100 mm
  o design for reservoir volumes: 200 mm
• brake cylinder filling time from 0 kPa – 275 kPa: 10 seconds to 13 seconds
• time for release of brakes on a freight vehicle (exhaust rate from 350 kPa to 70 kPa)
  For vehicles with grade control valves:
  o EX - 6 seconds to 10 seconds
  o IP - 55 seconds (minimum)
  o HP - 105 seconds (minimum), retaining 50 kPa to 70 kPa for a minimum of five minutes
  For vehicles with fixed exhaust chokes – 40 + / - 10 seconds
• charging time of auxiliary reservoir:
  o initial fill: 0 kPa to 400 kPa in 60 seconds
  o recharge: 250 kPa to 450 kPa in 20 seconds to 25 seconds
• accelerated release reservoir charging time – 0 kPa to 420 kPa in 180 seconds nominal
• supplementary reservoir charging time (initial fill) – 100 seconds to 110 seconds
• propagation rate in a train:
  o brake application: 250 m/s - minimum
  o brake release: 80 m/s - minimum
• inshot capability – 70 kPa to 84 kPa brake cylinder pressure shall be obtained in 1.5 seconds to 2 seconds after control valve operation

[Reference: Section 7.4.1 of ROA Manual of Engineering Standards and Practices]

Flexible brake pipe connections should be provided between the individual platforms of articulated wagons. They should be positioned and orientated so that there is no kinking in normal operations and when traversing the minimum horizontal and vertical track curvatures in accordance with Section 23 (RSU 285) Vehicle to vehicle swing test of T HR RS 00200 ST.

3.5. Performance requirements

Control valve performance shall comply with the requirements specified in Section E of the latest revision of the AAR Manual of Standards and Recommended Practices, wherever applicable, except as specified in Section 3.4 of this standard.
For compliance with this requirement, vehicles shall be required to be fitted with an appropriate type and number of control valves and vent valves based on the length of brake pipe within the wagon.

It should be noted that more than one control or vent valve device may be required based on the length of brake pipe within the wagon, refer to the AAR requirements for details.

3.6. Brake equipment

Refer to Section 15 (RSU 271) Brake equipment of T HR RS 00200 ST, for common requirements.

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

Regulations regarding the use of grade control valves are contained in TS TOC 1 Train Operating Conditions Manual (TOC) - General Instructions, Section 3 Train Operations. Vehicles with fixed exhaust chokes are regarded as having operable grade control valves.

If a train has 80% or more of vehicles/load with fixed exhaust chokes, then a HP grade examination is not required.

Vehicles with ECP brake equipment do not require grade control valves. If the vehicle is to operate on grades steeper than 1 in 40, then the vehicles shall be fitted with fixed exhaust chokes.

3.7. Main reservoir pipe

The main reservoir (MR) pipe, where fitted, should be 25 mm NB heavy black steel pipe, or of other appropriate material with an equivalent flow rate and pressure rating, supported on the vehicle structure and installed such that there are no water traps.

Freight vehicles that are fitted with a MR pipe that does not assist the brake system is identified by ‘●□’ in TS TOC 1 Train Operating Conditions (TOC) Manual, in the Brake Type column in Section 10 and Section 10.1.1. Vehicles in this category may use the MR pipe to operate air operated equipment such as hopper doors.

Freight vehicles that are fitted with a MR pipe, where the MR air recharges the air brake system (referred to as ‘two pipe’ wagons), are identified by ‘●●’ in TS TOC 1 Train Operating Conditions (TOC) Manual, in the Brake Type column in Section 10 and Section 10.1.1.

When operating air operated equipment (such as hopper doors) on ‘two pipe’ wagons, the air capacity of the system shall be taken into account to ensure sufficient capacity is retained to operate the braking system.
When mixing ‘two pipe’ wagons with single pipe wagons, refer to restrictions detailed in Section 4.3 of TS TOC 1 *Train Operating Conditions (TOC) Manual*.

### 3.8. Main reservoir branch tee requirements

The following requirements apply to wagons where main reservoir air supply is fed into the air brake system to assist in recharging the brake system (referred to as ‘two pipe’ wagons).

Where a main reservoir through pipe is fitted to a vehicle, any branch pipe from the main reservoir pipe shall be not less than 15 mm NB steel or 12 mm OD for nylon tube. The length of the branch pipe shall be minimised with the length not exceeding 2500 mm.

The main reservoir supply to the supplementary reservoir of the brake system shall be through the following:

- 3 mm choke
- check valve
- air strainer

The 3 mm choke, check valve, and air strainer shall be placed prior to the supplementary reservoir at a distance not exceeding 1000 mm away from the reservoir.

The auxiliary reservoir shall have a volume of 15 l or less.

### 3.9. Identification of cocks and brake equipment

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

*[Reference: Section 7.5.10 of ROA Manual of Engineering Standards and Practices]*

### 3.10. Dummy couplers

All new vehicles shall be fitted with dummy couplings or coupling hose receptacles for all coupling hoses. The dummy couplings shall be used for all non-coupled hoses.

It is recommended that all existing vehicles be fitted with dummy couplings or coupling hose receptacles.

### 3.11. ECP Brakes

The functional properties of electronically controlled pneumatic (ECP) brake equipment shall comply with the latest requirements in *AAR Manual of Standards and Recommended Practices*, Section E-II, S 4200 series.
ECP fitted vehicles shall comply with the functional requirements of pneumatic venting devices as detailed in AAR Section E-II.

In addition, the ECP brake system shall include the following functionality:

- When entering and exiting ECP mode, an emergency brake application is applied automatically. This ensures no unintended train movements during the change in brake operating modes.

- The ECP system shall be designed so as to minimise the effects of ‘cross talk’ from other trains. Cross talk is attributed to grounding faults in trains that result in a train picking up the ECP network information from another train resulting in a failsafe emergency brake application. All ECP systems shall either be updated or already be configured to minimise the effects of ‘cross talk’. In addition, the electrical aspects of the ECP system shall be designed and maintained appropriately to minimise grounding faults.

The ECP brake system on the wagon shall be compatible with the ECP brake system fitted to the hauling locomotive.

ECP functionality shall be tested for correct operation on all train configurations for which it is intended to operate. Refer to EPR 0029 *ECP Functionality Acceptance Test*, for further details.
4. **Body and underframe – RSU 430**

The requirements for body and underframe involve design loads and stresses, couplers and draft gear, towing fixtures, jacking, lift points, doors, container fixings, and markings and identification.

4.1. **Design loads and stresses**

The structural design criteria shall be as set out in specification M-1001 of the latest revision of the AAR Manual of Standards, Section C, Part II, for freight vehicles other than tank cars.

The design procedures for fatigue analysis shall comply with Section C, Part II of the latest revision of the AAR Manual of Standards. This does not preclude the use of procedures specified in AS 4100 Steel structures, for steel, AS/NZS 1664 Aluminium structures for aluminium or other internationally recognised design standards.

Structural welding shall be in accordance with AS/NZS 1554.1 Structural steel welding Part 1: Welding of steel structures, for steel and AS/NZS 1665 Welding of aluminium structures for aluminium.

Transverse welds should be avoided in the central sections of the lower flanges of the wagon underframes.

The distance from the centre line of the bogie to the face of the headstock shall be the practical minimum.

All freight vehicles shall be designed and constructed to negotiate the horizontal and vertical curves specified hereunder, without interference between body, underframe, bogies, brake rigging and any other fittings or attachments:

- each vehicle shall be capable of successfully negotiating the following:
  - A horizontal curve of 100 m radius while coupled to a base vehicle with a total lateral coupler offset (from the vehicle centre line) of 90 mm at the coupler line; the vehicle path shall be through the curve from tangent track.
  - A reverse horizontal curve of 120 m radius, without transition between the two curves, while coupled to an identical vehicle.
  - A vertical curve (both convex and concave) of 300 m radius, while coupled to a base vehicle fitted with an interlocking shelf coupler (426 mm shank length) shown in Figure 15 in Section 5 (RSU 140) of T HR RS 00100 ST, with no vertical displacement of the couplers in either vehicle. Allowance shall be made for a difference in coupler height between the two vehicles, on level track, of 75 mm, plus a vertical displacement at the coupling line of + / - 35 mm due to deflection of the vehicle suspensions.
The base vehicle dimensions shall be as follows:

- length over end sills: 12,600 mm
- length over coupling points: 13,190 mm
- bogie centres: 9,500 mm
- coupler length: 680 mm (centre of pin to coupling line)

The combination of bogie centres, end overhang and coupler length shall be so determined that the ratio between the total lateral force per bogie and the total vertical load per bogie (L/V) shall not exceed 0.82 under the specified conditions.

The L/V ratio for the vehicle shall be determined under the following conditions:

- draft force of 890 kN
- coupled to a base car at the front (leading) end and a like car at the rear (trailing) end
- on a horizontal curve of 165 m radius
- the subject vehicle shall be unloaded (that is, at tare)

The method for computing coupler angles and lateral forces shall be in accordance with Section 2.1.6.2 to Section 2.1.6.5 inclusive of Section C-ll of the AAR Manual of Standards and Recommended Practices, Specification M-1001.

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

[Reference: Section 8.2 of ROA Manual of Engineering Standards and Practices]

4.2. Couplers and draft gear

Automatic couplers and draftgear shall comply with the requirements specified in Section 5 (RSU 140), Vehicle to vehicle interface of T HR RS 00100 ST.

Rigid drawbars are permitted to permanently connect two or more vehicles where the facility for uncoupling in service is not required. Refer to Section 5 (RSU 140) of T HR RS 00100 ST.

Slackless drawbars are permitted to permanently connect two or more vehicles where the facility for uncoupling in service is not required and where there is a need to minimise train slack. A suitable means shall be provided to prevent the system binding when negotiating curves. Refer to Section 5 (RSU 140) of T HR RS 00100 ST.

Articulated connectors are used to permanently couple adjacent units sharing a common bogie and forming part of an articulated vehicle.
The connectors shall consist of interconnecting male and female components, each permanently attached to the end structure of the vehicle units. The two components shall be permanently coupled at assembly by means of a vertical pin with positive retention. Refer to Section 5 (RSU 140) of T HR RS 00100 ST.


**Coupler heights**

Coupler heights shall be within the following limits:

- new condition – 870 mm to 880 mm
- in service condition – 780 mm to 915 mm

**4.3. Towing fixtures, jacking, and lifting points**

Vehicles shall be fitted with facilities for towing in emergencies. Two (2) emergency towing fixtures as shown in Figure 20 in Section 8.2 (RSU 170) of T HR RS 00100 ST shall be attached to each headstock.

[Reference: Section 10.2.9 of ROA Manual of Engineering Standards and Practices]

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

[Reference: Section 8.2.13 of ROA Manual of Engineering Standards and Practices]

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

The lifting brackets shall consist of pairs of vertical plates preferably mounted at the ends of the body bolsters and located to align with bolster web plates. Features to be incorporated in each lifting bracket are shown in Figure 19 in Section 8.2 (RSU 170) of T HR RS 00100 ST.


**4.4. Doors**

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

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

All bottom discharge doors (and any other associated loading and unloading equipment), when open, shall remain within the rolling stock outline when in tare condition, having fully worn wheels, and having maximum dynamic deflection of the suspension. All roof hatches (and any other associated loading and unloading equipment), when open, shall remain within the rolling
stock outline when in tare condition with new worn wheels. Refer to Section 2.3.2 (RSU 110) of T HR RS 00100 ST.

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

4.5. Container fixings

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

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

Longitudinal and lateral restraint shall be provided by engagement with the aperture in the base of each bottom corner fitting, while vertical restraint is provided by a rotating spigot engaging the inner surface of the corner fitting base. This type is referred to hereafter as internal locking devices.

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

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

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

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

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

[Reference: Section 11.2. of ROA Manual of Engineering Standards and Practices]

Alternate container fixings shall be approved by ASA prior to use on the RailCorp network.
4.6. **Marking and identification**

Requirements for marking and identification involve codes and numbers, markings, reflective delineators, and automatic equipment identification (AEI) tags. All freight vehicles shall have the marking and identification detailed within this Section.

4.6.1. **Code and number**

Each vehicle shall have a unique identification code or number conforming to standard Railways of Australia (ROA) / Australasian Railway Association (ARA) practices.

4.6.2. **Markings**

Information on the vehicles and bogies shall identify the vehicle owner or operator.

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

*Data panels shall contain the following information:*

- vehicle code
- vehicle number
- vehicle length
- symbols indicating if the vehicle is fitted with load compensation, grade control valve or fixed exhaust choke, or both

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

A sample data plate is shown in Figure 1 and details of the symbols on the data plate is shown in Figure 2.

*[Reference: Section 22 of the ROA Manual of Engineering Standards and Practices]*

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

- vehicle capacity or gross mass
- vehicle tare mass

4.6.3. **Reflective delineators**

Australian standard for Railway Rolling Stock AS 7531 *Lighting and Visibility* is acceptable for use for this section except where the indications of variance (separator lines and blue bold text) are shown. The remainder of the content of this section is in alignment with AS 7531.
To enhance visibility of freight vehicles from the side at level crossings, all freight vehicles shall be fitted with reflective delineators (reflectors) in accordance with T HR RS 00890 ST, (RSU Appendix I) Reflective delineators.

AS 7531 – AS 7531 specifies taillights on the end of freight trains. These are not specified in this standard (T HR RS 00400 ST) as end of train markers and taillights are not part of the vehicle but attached to the rear vehicle on a train. End of train markers and lights are specified in Sydney Trains Network Rules NTR 406.
Figure 1 – Sample freight vehicle data plate

Figure 2 – Details of symbols on data plate

Note for Figure 2:

For vehicles fitted with a fixed exhaust choke, the circle is replaced with a triangle.

For vehicles fitted with manual load compensation equipment, the handle shall be placed in the ‘EMPTY’ position when the load in the vehicle (net tonnage) is less than the figure shown, and placed in the ‘LOADED’ position when the load in the vehicle is more than or equal to the figure shown.

If a square but no figure is shown, then the changeover load shall be deemed to be 20 tonnes.

The letters ‘ALC’ indicates that the vehicle is fitted with automatic load compensation equipment.


No other information, other than the changeover load or ‘ALC’, should be displayed inside the square and circle or triangle.
4.6.4. **AEI Tags**

All freight vehicles shall be fitted with standard automatic equipment identification (AEI) tags as specified in T HR RS 00880 ST, (RSU Appendix H), *Automatic equipment identification*.

**Warning:** Reuse of used AEI tags is not permitted.

4.6.5. **Carrying containers in open wagons**

Containers shall not be carried in open wagons unless the wagon is fitted with fixed internal locating brackets to position the container along the longitudinal centreline of the wagon.

Tyres and dunnage shall not be used to position containers laterally in an open wagon.
5. **Vehicle performance – RSU 440**

The performance specified in this section relates to the operation of the freight vehicle on the RailCorp network. This section covers compatibility tests and structural strength.

5.1. **Test requirement summary**

Table 2 summarises the test requirements for freight vehicles.

### Table 2 – Freight vehicles test requirements

<table>
<thead>
<tr>
<th>Compatibility test</th>
<th>References in other standards</th>
<th>References in this standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static rolling stock outline test</td>
<td>T HR RS 00200 ST, Section 19 (RSU 281)</td>
<td>-</td>
</tr>
<tr>
<td>Static vehicle weigh test</td>
<td>T HR RS 00200 ST, Section 20 (RSU 282)</td>
<td>-</td>
</tr>
<tr>
<td>Static vehicle twist test</td>
<td>T HR RS 00200 ST, Section 21 (RSU 283)</td>
<td>Refer to Note 2 below</td>
</tr>
<tr>
<td>Vehicle / bogie swing test</td>
<td>T HR RS 00200 ST, Section 22 (RSU 284)</td>
<td>-</td>
</tr>
<tr>
<td>Vehicle / vehicle swing test</td>
<td>T HR RS 00200 ST, Section 23 (RSU 285)</td>
<td>-</td>
</tr>
<tr>
<td>Static brake test</td>
<td>T HR RS 00200 ST, Section 24 (RSU 286)</td>
<td>Section 6 (RSU 441)</td>
</tr>
<tr>
<td>Ride performance test</td>
<td>T HR RS 00200 ST, Section 26 (RSU 288)</td>
<td>Section 7 (RSU 442) Refer to Note 1 below</td>
</tr>
<tr>
<td>Kinematic rolling stock outline test</td>
<td>T HR RS 00200 ST, Section 27 (RSU 289)</td>
<td>Refer to Note 1 below</td>
</tr>
<tr>
<td>Pitch and bounce performance test</td>
<td>T HR RS 00100 ST Section 28 (RSU 290)</td>
<td>-</td>
</tr>
<tr>
<td>Curve stability test</td>
<td>T HR RS 00200 ST, Section 35 (RSU 298)</td>
<td>-</td>
</tr>
<tr>
<td>Electrical safety inspection</td>
<td>T HR RS 00200 ST, Section 31 (RSU 294)</td>
<td>-</td>
</tr>
<tr>
<td>Signal compatibility test</td>
<td>T HR RS 00200 ST, Section 32 (RSU 295)</td>
<td>-</td>
</tr>
<tr>
<td>Signal interference test</td>
<td>T HR RS 00200 ST, Section 33 (RSU 296)</td>
<td>-</td>
</tr>
<tr>
<td>Environmental test</td>
<td>T HR RS 00100 ST Section 29 (RSU 292)</td>
<td>-</td>
</tr>
<tr>
<td>Fitment of AEI tags</td>
<td>T HR RS 00880 ST, (RSU App H)</td>
<td>Section 4.6.4 (RSU 430)</td>
</tr>
<tr>
<td>Fitment of reflective delineators</td>
<td>T HR RS 00890 ST, (RSU App I)</td>
<td>Section 4.6.3 (RSU 430)</td>
</tr>
</tbody>
</table>
Notes associated with Table 2:

1. Refer to Section 18 (RSU 280) of T HR RS 00200 ST for sequencing of tests, and the requirements for movement of vehicles and for conducting dynamic tests.

2. Vehicles equipped with standard three piece bogies, and gapped sidebearers having 10 mm to 14 mm clearance, may be exempt from certain tests, subject to written approval from ASA, for operation up to 80 km/h. Torsionally stiff vehicles such as tank vehicles, and high centre of gravity vehicles may not necessarily be exempt and may require testing.

5.2. Jacking point vertical load test

The owner or operator should conduct jacking point vertical load tests to ensure that the vehicle is capable of withstanding loads imposed during vehicle recovery.

Refer to Section 34 (RSU 297) Vehicle structural tests of T HR RS 00200 ST for more information.

5.3. Static end compression test

The owner or operator should conduct a static end compression test to ensure that the vehicle is capable of withstanding the loads imposed during operation. Loads shall be commensurate with the proposed maximum duty of the vehicle.

Refer to Section 34 (RSU 297) of T HR RS 00200 ST for more information.

5.4. Single vehicle impact

The owner or operator should conduct single vehicle impact tests to ensure that the vehicle is capable of withstanding the loads imposed during operation.

Refer to Section 34 (RSU 297) of T HR RS 00200 ST, for more information.

5.5. P2 force determination and P/D ratio

The P2 force and P/D ratio shall not exceed the limits specified in Section 3 (RSU 120) of T HR RS 00100 ST.

5.6. Bridges and structures loading requirements

The wagon mass, axle spacing, and coupling length shall be designed such that it meets the limits and requirements specified in Section 3.8 (RSU 120) of T HR RS 00100 ST.
6. Braking performance – RSU 441

Braking performance is specified to ensure that freight trains are able to brake within the current signalling requirements. Refer to Section 7 (RSU 160) Signalling interface of T HR RS 00100 ST for more information.

6.1. Net brake ratio

The net brake ratio is the ratio of the sum of the measured actual brake block forces in kilograms divided by the total vehicle mass, in kilograms, at rail. Refer to Section 24.3 (RSU 286) of T HR RS 00200 ST.

Brake block forces are measured with the air brake in both empty and loaded conditions for a brake pipe reduction of 150 kPa. When measuring the brake block forces for the air brake, the rigging pins shall be tapped with a hammer to overcome static friction of the brake rigging.

Handbrake forces are measured at the brake block with a 560 N tangential force applied to the rim of the handbrake wheel, or the handbrake arm (this figure shall be 420 N for new wagons introduced from 1 January 2018 onwards). When measuring the brake block forces for the handbrake or spring parking brake, the rigging pins shall not be tapped.

6.2. Air brake

The following net brake ratios as detailed in Table 3 are mandatory to provide effective braking without skidding wheels.

<table>
<thead>
<tr>
<th>Brake block type</th>
<th>Vehicle condition</th>
<th>Net brake ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low friction composite</td>
<td>Tare or empty</td>
<td>55% maximum</td>
</tr>
<tr>
<td>Low friction composite</td>
<td>Fully loaded</td>
<td>28% minimum</td>
</tr>
<tr>
<td>Medium friction composite</td>
<td>Tare or empty</td>
<td>55% maximum</td>
</tr>
<tr>
<td>Medium friction composite</td>
<td>Fully loaded</td>
<td>20% minimum</td>
</tr>
<tr>
<td>High friction composite</td>
<td>Tare or empty</td>
<td>35% maximum</td>
</tr>
<tr>
<td>High friction composite</td>
<td>Fully loaded</td>
<td>13% minimum 16% minimum (for bulk*)</td>
</tr>
<tr>
<td>Cast iron</td>
<td>Tare or empty</td>
<td>55% maximum</td>
</tr>
<tr>
<td>Cast iron</td>
<td>Fully loaded</td>
<td>28% minimum</td>
</tr>
</tbody>
</table>

* Note:

From 1 January 2018 for all new bulk commodity type wagons, such as grain hopper, coal hopper, ore hopper, and wagons that are commonly marshalled in unit train
6.3. **Spring parking brake or handbrake**

The spring parking or handbrakes shall be able to hold the loaded vehicle on a 1 in 30 grade indefinitely.

The spring parking or handbrakes shall operate on at least 40% of axles on the vehicle.

The net brake ratios in Table 4 are recommended in order to provide an effective parking brake.

**Table 4 – Freight vehicle parking brake ratios**

<table>
<thead>
<tr>
<th>Brake block type</th>
<th>Vehicle condition</th>
<th>Net brake ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low friction composite</td>
<td>Fully loaded</td>
<td>28% minimum</td>
</tr>
<tr>
<td>Medium friction composite</td>
<td>Fully loaded</td>
<td>20% minimum</td>
</tr>
<tr>
<td>High friction composite</td>
<td>Fully loaded</td>
<td>16% minimum *</td>
</tr>
<tr>
<td>Cast iron</td>
<td>Fully loaded</td>
<td>28% minimum</td>
</tr>
</tbody>
</table>

*Note:

From 1 January 2018, for all new wagons, figures less than 16% net brake ratio, down to 13% net brake ratio as a minimum, may be accepted; however the brake block static coefficient of friction shall be confirmed to be greater than 0.30, based on the brake block manufacturer’s data.

6.4. **Single car air test**

Each freight vehicle shall have a single car air test carried out prior to entering service, and as part of the owners or operators routine maintenance. Refer to T HR RS 00200 ST, Section 24.4 (RSU 286).
7. **Freight vehicle ride performance – RSU 442**

Refer to Section 26 (RSU 288) of T HR RS 00200 ST for the requirements regarding freight vehicle ride performance.

Freight vehicles shall have field worn wheel profiles when carrying out a ride test. Refer to Section 3.3.4 (RSU 211) of T HR RS 00200 ST, for a typical field worn test wheel profile. It should be noted, however, that this profile may not reflect the final field worn profile of the vehicle under test.

If it is possible for a freight vehicle to be unevenly loaded, then the vehicle shall be tested under the worst condition of loading. This is in addition to the requirements stated in Section 26.4 (RSU 288) of T HR RS 00200 ST.

For articulated vehicles, accelerometers shall be placed as near as practicable to the articulated bogie centre, toward the trailing end of the vehicle.
8. **Non-conventional freight vehicles – RSU 450**

This section specifies the minimum design and performance requirements for non-conventional rolling stock, the operation of which require that some sections of these RSU are not applicable.

9. **Articulated or permanently coupled vehicles – RSU 451**

Refer to Section 26 (RSU 288) of T HR RS 00200 ST for the requirements regarding freight vehicle ride performance.

9.1. **Vehicle types**

These vehicles include the following:

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

- permanently coupled conventional vehicles with shared air brake equipment and handbrakes

- permanently coupled articulated vehicles with shared air brake equipment and handbrakes

9.2. **Air brake equipment**

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

9.3. **Parking brake or handbrake**

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

The force applied by the parking brake or handbrake shall be reasonably evenly distributed over each of the handbraked axles.
10. **Rail compatible trailers – RSU 452**

This section details the requirements specific to rail compatible trailers for use on road and on rail.

10.1. **Description**

These vehicles use the road trailer as the vehicle underframe or body on both road and rail.

For use on rail, the trailer is raised to allow a rail bogie to be fitted under a special rear subframe, and the front of the trailer is supported on the rear of the trailer in front. The road wheels slide forward when in rail mode.

A transition vehicle may be used to couple units to conventional rolling stock.

10.2. **Design**

*Each unit is essentially a conventional road trailer designed in accordance with AAR Specification RP-257-90 and capable of absorbing draw and buff loads up to 650 kN.*

Additional equipment on each unit for rail operations shall include a separate train brake pipe, inter-trailer connectors at front and rear, valves and piping necessary for road/rail transfer and coupling operations, and facilities to raise road wheels clear of the rail.

*In rail mode, the road wheels shall clear the rail by at least 100 mm with fully worn rail wheels, solid bogie springs and with new road tyres fitted. No part of the vehicle is permitted to extend beyond the outlines shown in Section 18* for the proposed rail corridor in which it will operate.*

*Each unit shall also comply with all applicable State and federal Road Transport Authority Regulations (ADR 38 and so on).*

The units in rail mode will be coupled to the locomotive or normal train consist by means of a suitable adaptor to haul 40 units, loaded to 42 tonnes gross on rail each, up a 1 in 30 grade. This adaptor shall be designed in accordance with the relevant Sections of this manual* for draw and buff loadings and so on.

*The rail bogie shall be designed in accordance with Section 6* of this manual with brakes designed in accordance with Section 7* and AAR Specification RP-257-90. All braking equipment shall be bogie mounted.

*The rail compatible road trailers, when operating in the rail mode, shall comply with the Roadworthiness Acceptance Standards as contained in Section 5 (RSU 440) of this standard **, excluding impact testing.*

Refer to Figure 3 which details the above design criteria.

10.3. **Brake retention**

These vehicles have spring applied parking brakes on the rail bogies. When the brake pipe pressure is dropped to zero, the internal spring applies the parking brake. During train inspection or examination, a brake retention test is not required; however functional tests and inspections of these parking brakes shall be included in the technical maintenance plan for these vehicles.
Figure 3 – Rail compatible road trailer leading dimensions

11. **Vehicle specific requirements – RSU 460**

This section covers requirements for specific types of freight rolling stock.

12. **Tank wagons – RSU 461**

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

12.1. **Design**

Tank wagons shall be designed in accordance with the requirements specified in Section 15 of *ROA Manual of Engineering Standards and Practices*.

12.2. **Tank inspections**

Tank wagons shall be inspected in accordance with the requirements specified in Australian Standard AS/NZS 3788 *Pressure equipment – In-service inspection*. 