Technical Note – TN 024 : 2018

Issue date: 21 September 2018
Effective date: 21 September 2018

Subject: Update to T HR RS 00100 ST – RSU 110 and T HR RS 00200 ST - RSU 289 with Sub-Medium rolling stock outline

This technical note is issued by the Asset Standards Authority (ASA) to provide an update to the rolling stock outline and kinematic rolling stock outline test detailed in the following:

- Section 2 (RSU 110) of T HR RS 00100 ST RSU 100 Series - Minimum Operating Standards for Rolling Stock – General Interface Standards
- Section 27 (RSU 289) of T HR RS 00200 ST RSU 200 Series - Minimum Operating Standards for Rolling Stock - Common Interface Requirements

The update details the addition of the Sub-Medium rolling stock outline and includes the static outline, kinematic outline, and testing requirements.

This technical note adds content to T HR RS 00100 ST, Section 2.3.1, Section 2.3.2, new Section 2.3.4, Section 2.6.2, Section 2.6.4, and Section 2.6.5 (RSU 110). In addition this technical note replaces content in T HR RS 00200 ST, Section 27 (RSU 289).

T HR RS 00100 ST RSU 100 Series – Minimum Operating Standards for Rolling Stock – General Interface Standards

2. Rolling stock outline interface – RSU 110

2.3. Standard rolling stock outlines

2.3.1 General
The following table replaces Table 1 in Section 2.3.1.

Table 1 – Rolling stock outlines

<table>
<thead>
<tr>
<th>Outline description</th>
<th>Base width</th>
<th>Figure</th>
<th>RISSB reference vehicle number *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrow Non-Electric</td>
<td>Narrow based</td>
<td>Figure 1</td>
<td>21</td>
</tr>
<tr>
<td>Narrow Electric</td>
<td>Narrow based</td>
<td>Figure 2</td>
<td>22</td>
</tr>
<tr>
<td>Narrow Container</td>
<td>Narrow based</td>
<td>Figure 3</td>
<td>23</td>
</tr>
<tr>
<td>Narrow Square</td>
<td>Narrow based</td>
<td>Figure 4</td>
<td>24</td>
</tr>
<tr>
<td>Intersystem</td>
<td>Narrow based</td>
<td>Figure 5</td>
<td>25</td>
</tr>
<tr>
<td>Narrow Hopper</td>
<td>Narrow based</td>
<td>Figure 6</td>
<td>26</td>
</tr>
<tr>
<td>Medium Electric</td>
<td>Medium based</td>
<td>Figure 7</td>
<td>27</td>
</tr>
<tr>
<td>Extended Medium Electric (see note)</td>
<td>Medium based</td>
<td>Figure 8</td>
<td>28</td>
</tr>
<tr>
<td>Wide Electric (see note)</td>
<td>Wide based</td>
<td>Figure 9</td>
<td>29</td>
</tr>
<tr>
<td>Sub-Medium</td>
<td>Medium based</td>
<td>Figure 10</td>
<td>N/A</td>
</tr>
</tbody>
</table>

* For rolling stock outline diagrams for RISSB reference vehicles refer to AS 7507.

Note: Only existing and heritage Extended Medium and Wide Electric rolling stock are permitted to operate on the TfNSW Metropolitan Heavy Rail Network.

AS 7507 includes a number of rolling stock outline diagrams, but only those outlines listed in Table 1 of this standard are permitted on the TfNSW Metropolitan Heavy Rail Network.

AS 7507: This RISSB standard is not applicable for use with the Sub-Medium rolling stock outline.

2.3.2 Description

The following Figure 10 is added to Section 2.3.2.
Figure 10 – 'Sub-Medium' rolling stock outline dimensions
2.3.4 Kinematic rolling stock outline – additional requirements for Sub-Medium rolling stock outline

Section 2.3.4 is a new subsection in Section 2.3 and shall be inserted after Section 2.3.3.

Rolling stock designed to the Sub-Medium rolling stock outline shall comply with the requirements of Section 2.3.3, and additionally, shall comply with the requirements of this section.

The Sub-Medium kinematic rolling stock outline is the cross-sectional envelope produced by the Sub-Medium static rolling stock outline displaced through the following motions:

- maximum body roll ± 1.3 degrees
- lateral movements ± 50 mm
- vertical bounce 40 mm upwards

The above parameters are applicable when the vehicle negotiates track conforming to track geometry and transit space requirements defined by ESC 210, ESC 215, and track defect limits defined by TMC 203 for response category P1, considering single discrete defects only (not combined defects), for Sub-Medium rolling stock, and whilst operating at a maximum design cant deficiency of 0 mm (equilibrium conditions).

The above motions are defined as follows:

- maximum body roll
  Roll of the vehicle body with respect to the rail plane, about the vehicle roll centre. This includes roll about both primary and secondary suspensions.

- lateral movement
  Lateral displacement of the vehicle body with respect to the centre of the wheelset. This lateral displacement is made up of all possible movements, including, but not limited to:
  - bogie centre pin clearance
  - secondary suspension lateral clearance or movement
  - primary suspension lateral clearance or movement

- vertical bounce
  The vertical bounce allowance results from the primary and secondary suspension.

- centre throw and end throw
  Centre throw and end throw need to be considered in conjunction with the above factors for the negotiation of a 100 m radius horizontal curve and 300 m radius vertical curve.

- kinematic rolling stock outline test
  The vehicle shall be tested in accordance with T HR RS 00200 ST, Section 27 (RSU 289) Kinematic rolling stock outline test.
2.6.2 Expendable items

The following paragraph shall be added to the start of Section 2.6.2 and shall be the first paragraph in Section 2.6.2.

Rolling stock designed to the Sub-Medium rolling stock outline shall not contain any expendable items in areas with potential to impact on passing and infrastructure clearances, due to the tighter infrastructure and passing clearances associated with operation with this outline.

2.6.4 Foul load infringements

The following paragraph shall be added to the end of Section 2.6.4 and shall be the last paragraph in Section 2.6.4.

Rolling stock designed to the Sub-Medium rolling stock outline shall not contain any foul load infringements due to the tighter infrastructure and passing clearances associated with operation with this outline.

2.6.5 Passenger vehicle plug doors

The following paragraph shall be added to Section 2.6.5 and positioned after the first paragraph and shall be the second paragraph in Section 2.6.5.

Rolling stock designed to the Sub-Medium rolling stock outline shall not contain any foul load infringements due to the tighter infrastructure and passing clearances associated with operation with this outline.

T HR RS 00200 ST RSU 200 Series – Minimum Operating Standards for Rolling Stock – Common Interface Requirements

The following content replaces the published content detailed in Section 27 (RSU 289) of T HR RS 00200 ST.

27. Kinematic rolling stock outline test – RSU 289

27.1. Introduction

The kinematic rolling stock outline test is a type test.

This test is designed to ensure that the vehicle performs within the confines of the particular kinematic rolling stock outline specified for that vehicle type and the corridors 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 ASA.
Refer to T HR RS 00100 ST, Section 2.3.3 and Section 2.3.4 (both sections are in RSU 110) for details of the kinematic rolling stock outline.

27.2. When a kinematic test is required

A kinematic outline test shall be conducted on all vehicle types for approval to operate on the TfNSW Metropolitan Heavy Rail Network.

ASA reserves the right to request and have a kinematic outline test carried out on any vehicle for the following reasons:

- proposed modification to the suspension characteristics
- proposed increase in vehicle centre of gravity height
- proposed change in wheel profile
- proposed change in bogie type
- proposed change in vehicle operating conditions
- any proposed vehicle modification which may affect the vehicle lateral ride performance
- where, in ASA's opinion, there is suspected infringement of the kinematic rolling stock outline

27.3. Basic (static) kinematic outline test

The roll and lateral displacements shall be determined on a vehicle standing on a simulated 160 mm superelevation. The state of loading shall be such as to give the maximum centre of gravity.

The vehicle shall be lifted in increments up to 160 mm on one side, and then lowered gently in increments back to the level condition. The test shall be repeated by lifting the other side of the vehicle, unless the results from the initial test are measured well within the required limits (less than 50% of the limits detailed in Section 2.3.3 (RSU 110) of T HR RS 00100 ST).

At each increment the following shall be measured:

- body roll (may be measured as an offset from the vertical datum such as string line and plumb bob)
- lateral displacement of secondary suspension
- lateral displacement of primary suspension

The results of the basic (static) kinematic outline test shall comply with the limits specified in Section 2.3.3 (RSU 110) of T HR RS 00100 ST.

The basic (static) kinematic outline test shall be successfully carried out, and requirements met, prior to attempting the (dynamic) kinematic outline test.
27.4. **Basic (static) kinematic outline test – additional requirements for Sub-Medium rolling stock outline**

For rolling stock designed to meet the Sub-Medium rolling stock outline, the requirements of this section are additional to the requirements of Section 27.3.

The roll and lateral displacements shall be determined on a vehicle standing on a simulated superelevation equivalent to 126 mm, determined by calculating S x 1.143, where S is the maximum actual superelevation of 110 mm for track meeting the requirements for the Sub-Medium rolling stock outline.

The state of loading shall be such as to give the maximum centre of gravity.

The vehicle shall be lifted in increments up to the required test superelevation on one side, and then lowered gently in increments back to the level condition. The test shall be repeated by lifting the other side of the vehicle, unless the results from the initial test are measured well within the required limits (less than 50% of the limits detailed in Section 2.3.4 (RSU 110) of T HR RS 00100 ST).

At each increment the following shall be measured:

a. body roll (may be measured as an offset from the vertical datum such as string line and plumb bob)

b. lateral displacement of secondary suspension

c. lateral displacement of primary suspension

The results of the basic (static) kinematic outline test shall comply with the limits specified in Section 2.3.4 (RSU 110) of T HR RS 00100 ST.

The basic (static) kinematic outline test shall be successfully carried out, and requirements met, prior to attempting the (dynamic) kinematic outline test.

27.5. **Dynamic kinematic outline test**

The vehicle shall be instrumented to determine roll relative to the rail plane, taken as the average position of the wheelsets and lateral displacement of the vehicle body relative to the wheel. Refer to Section 2.3.3 (RSU 110) of T HR RS 00100 ST for allowable kinematic parameters.

The state of loading of the vehicle shall be such as to give the maximum centre of gravity.

The test shall be conducted with the vehicle negotiating an agreed test track site as specified in Section 27.7 with 145 per cent of the design cant deficiency.

27.6. **Dynamic kinematic outline test – additional requirements for Sub-Medium rolling stock outline**

For rolling stock designed to meet the Sub-Medium rolling stock outline, the requirements of this section are additional to the requirements of Section 27.5.
The vehicle shall be instrumented to determine roll relative to the rail plane, taken as the average position of the wheelsets and lateral displacement of the vehicle body relative to the wheel. Refer to Section 2.3.4 (RSU 110) of T HR RS 00100 ST for allowable kinematic parameters.

The state of loading of the vehicle shall be such as to give the maximum centre of gravity.

The test shall be conducted with the vehicle negotiating a test track site as specified in Section 27.8.

For the purpose of simulation, car body roll should be measured:

a. relative to the average position of all axles / wheelsets associated with the vehicle body
b. at the mid-point of the car length (that is, equal distances between bogie centres)

For the purpose of simulation, car body lateral translation should be measured at each bogie as follows:

a. relative to the average of the longitudinal centreline of the two axles associated with each bogie
b. at a height 610 mm from top of rail
c. with vehicle centre throw excluded from the results

For the purpose of on track testing, it is not feasible to measure relative to the design alignment. Therefore, for on track testing:

a. the rail plane should be calculated based on the average measured position of all four axles/wheelsets
b. the car body roll is the angle between the car body and the average measured position of all four axles/wheelsets
c. the car body lateral translation is determined at each bogie, relative to the average position of the longitudinal centrelines of the two axles/wheelsets associated with each bogie

27.7. Test track configuration

Kinematic outline testing shall be conducted on a minimum length of track of 500 m with a track condition index (TCI) less than or equal to 50 and with no significant defects, or as agreed by ASA. The test track quality should represent at least 60 per cent of the routes on which the vehicle would be operating.

27.8. Test track configuration for Sub-Medium rolling stock outline test

Due to the additional controls in place on designated Sub-Medium corridors, the following test track requirements apply when conducting kinematic rolling stock outline tests for vehicles designed to meet the Sub-Medium rolling stock outline.
These requirements apply only for the additional test requirements that apply for vehicles designed to meet the Sub-Medium rolling stock outline, as specified by the kinematic parameters in Section 2.3.4 (RSU 110) of T HR RS 00100 ST.

The test track configuration shall be as follows:

a. The vehicle shall be tested (by simulation) to a speed representing 145 mm cant deficiency, on the design track alignment representing the Sub-Medium corridor, with no track defects present, and with the vehicle configuration to give the maximum centre of gravity, and using nominal suspension parameters (not considering suspension tolerances).

b. Additionally, the vehicle shall be tested (by physical test) at a test speed of 65 km/h, representing 130% of the design operating speed at the Sub-Medium corridor. The test shall be carried out with track conforming to track geometry and transit space requirements defined by ESC 210, ESC 215, and track defect limits defined by TMC 203 for response category P1, considering single discrete defects only (combined defects shall not be considered), for Sub-Medium rolling stock, and with the vehicle configuration to give the maximum centre of gravity.

Note: Where kinematic performance of the vehicle exceeds the limits due to combined track defects, the performance associated with the combined defects should not be considered.

Kinematic outline testing and simulation shall be conducted on a minimum length of track representing the full extent of the Sub-Medium corridor.

27.9. Assessment of tests

The worst condition of roll and the worst condition of lateral displacement, whether from the static or dynamic testing or both, shall be assessed for compliance with the kinematic rolling stock outline requirements.

27.10. Simulation of kinematic outline test

Unless indicated otherwise in the above test requirements, a computer-simulated test may be accepted as an alternative to conducting the kinematic rolling stock outline test.

For rolling stock designed to meet the Sub-Medium rolling stock outline, simulations will not be accepted as the primary means of validation of kinematic performance, and a physical test will be required, except where indicated in Section 27.8.

The simulation shall be validated using data from measured dynamic responses of the vehicle.

AS 7507 does not require the validation of computer simulation. Validation is required for all vehicle computer simulations before operating on the TfNSW Metropolitan Heavy Rail Network.
**Authorisation:**

<table>
<thead>
<tr>
<th>Technical content prepared by</th>
<th>Technical content endorsed by</th>
<th>Checked and approved by</th>
<th>Interdisciplinary coordination checked by</th>
<th>Authorised for release</th>
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</tr>
<tr>
<td>Name</td>
<td>Signature</td>
<td>Date</td>
<td>Name</td>
<td>Position</td>
</tr>
<tr>
<td>Principal Engineer, Rolling Stock Access Integrity</td>
<td>Jakub Zawada</td>
<td>John Paff</td>
<td>Michael Uhlig</td>
<td>Peter McGregor</td>
</tr>
<tr>
<td>Lead Track Engineer</td>
<td></td>
<td></td>
<td>Lead Rolling Stock Engineer</td>
<td>A/Chief Engineer</td>
</tr>
<tr>
<td>Lead Rolling Stock Engineer</td>
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<td></td>
<td></td>
<td>Director Network Standards and Services</td>
</tr>
</tbody>
</table>
Technical Note – TN 017 : 2018

Issue date: 26 July 2018
Effective date: 26 July 2018

Subject: Update to digital train radio system (DTRS) on-board equipment requirements detailed in T HR RS 00100 ST - RSU 190

This technical note is issued by the Asset Standards Authority (ASA) to set out digital train radio system (DTRS) on-board equipment requirements for rolling stock accessing and operating on the TfNSW Metropolitan Heavy Rail Network.

This technical note is to ensure that all electric and diesel rolling stock are equipped with type approved DTRS on-board equipment (cab radio) in order to support DTRS communications for train operation.

This technical note provides a list of type approved DTRS on-board equipment.

This technical note replaces all content in T HR RS 00100 ST, Section 10 (RSU 190).

Note, existing Section 10.2 Metronet train radio system, Section 10.3 Metronet hand portable train radio system, and Section 10.5 CountryNet train radio system have been removed as they are no longer applicable.

10. Train radio interface – RSU 190

10.1. General

A type approved train radio is required on all trains to permit communication between train crews and signallers, train controllers, and mechanical controllers whilst on the TfNSW Metropolitan Heavy Rail Network.

Two train radio systems have been deployed to provide radio communication within the TfNSW Metropolitan Heavy Rail Network:

- digital train radio system (DTRS)
• national train radio communication system (NTCS)

10.2. Digital train radio system (DTRS)

Within the electrified portion of TfNSW Metropolitan Heavy Rail Network, primary communications between train crews and signallers, train controllers, and mechanical controllers is via DTRS.

The electrified portion of the TfNSW Metropolitan Heavy Rail Network is bounded by Kiama, Macarthur, Leppington, Bowenfels, Richmond, Carlingford, Woodville Junction, Newcastle Interchange, Bondi Junction, Cronulla, and Port Kembla.

Within the non-electrified portion of TfNSW Metropolitan Heavy Rail Network (Kiama to Bomaderry) communications between train crews and signallers, train controllers, and mechanical controllers is via NTCS. Refer to Section 10.3 of this standard for NTCS.

Type approved DTRS on-board equipment is mandatory for all new and existing electric passenger rolling stock.

Type approved DTRS on-board equipment is mandatory for all new and existing diesel passenger and freight rolling stock (including infrastructure maintenance vehicles) from 1 January 2019.

10.2.1 Type approval of DTRS on-board equipment

DTRS on-board equipment shall be type approved following a Sydney Trains type approval process for use on the electrified portion of TfNSW Metropolitan Heavy Rail Network.

Type approval is in accordance with T MU MD 00005 GU Type Approval of Products.

Refer to section 10.2.3 and 10.2.4 DTRS equipment which is type approved for the TfNSW Metropolitan Heavy Rail Network.

10.2.2 DTRS SIMs

SIMs are required to enable DTRS functionality. DTRS SIMs are owned, controlled, and managed by Sydney Trains.

10.2.3 Type approved DTRS on-board equipment for electric passenger rolling stock

Table 1 provides the approved DTRS on-board equipment for electric passenger rolling stock.
### Table 1 - Type approved DTRS on-board equipment for electric passenger rolling stock

<table>
<thead>
<tr>
<th>DTRS on-board equipment</th>
<th>Hardware version/Module number</th>
<th>Software version</th>
<th>Equipment vendor</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTRS Cab Radio</td>
<td>CR26P-1800</td>
<td>1.5.8</td>
<td>Funkwerk</td>
</tr>
<tr>
<td>Control Head (HMI)</td>
<td>P/N: 1551.095-00001</td>
<td>1.5.8</td>
<td>Funkwerk</td>
</tr>
<tr>
<td>Handset</td>
<td>Dac TUFF (MetroNet Handset)</td>
<td>N/A</td>
<td>Siemens</td>
</tr>
<tr>
<td>Loudspeaker</td>
<td>BG 17</td>
<td>N/A</td>
<td>Funkwerk</td>
</tr>
<tr>
<td>Loudspeaker Amplifier</td>
<td>C-AMP</td>
<td>N/A</td>
<td>Funkwerk</td>
</tr>
<tr>
<td>Roof-top Antenna</td>
<td>1399.99.0037</td>
<td>N/A</td>
<td>Huber+Suhner</td>
</tr>
<tr>
<td>Interrogator Reader Unit</td>
<td>N/A (Gemco IRU for Sydney Trains)</td>
<td>MOD 2 (except Oscar &amp; Waratah) MOD 3 (Oscar &amp; Waratah only)</td>
<td>MRX</td>
</tr>
<tr>
<td>Undertrain Antenna</td>
<td>N/A (Gemco Under Train Antenna for Sydney Trains)</td>
<td>N/A</td>
<td>MRX</td>
</tr>
<tr>
<td>Track Mounted Transponder</td>
<td>Yellow transponder 50 mm Base 25 mm spacer</td>
<td>N/A</td>
<td>MRX (contact Sydney Trains for provisioning)</td>
</tr>
<tr>
<td>SIM Card (Standard size)</td>
<td>N/A</td>
<td>N/A</td>
<td>Gemalto (contact Sydney Trains for SIM provisioning)</td>
</tr>
</tbody>
</table>

### 10.2.4 Type approved DTRS on-board equipment for diesel rolling stock

DTRS on-board equipment for diesel passenger (DMU and locomotive hauled), freight rolling stock and infrastructure maintenance vehicles shall be In-Cab Communications Equipment (ICE) used for NTCS with integrated DTRS functions.

Electric locomotives, used for the purposes of freight or maintenance/work trains only shall be included in this category (diesel rolling stock) for the purposes of train radio interface.

Table 2 provides the approved DTRS on-board equipment for diesel rolling stock.
Table 2 - Type approved DTRS on-board equipment for diesel rolling stock

<table>
<thead>
<tr>
<th>DTRS on-board equipment</th>
<th>Hardware version/ Module number</th>
<th>Software version</th>
<th>Equipment vendor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICE-DTRS Cab Radio (CCU Enclosure)</td>
<td>N/A</td>
<td>4.0C</td>
<td>Base 2</td>
</tr>
<tr>
<td>Control Head (HMI) (consist of LCD screen, keypad, speakers and microphones)</td>
<td>N/A</td>
<td>4.0C</td>
<td>Base 2</td>
</tr>
<tr>
<td>Roof-top Antenna for DTRS module</td>
<td>SWA 0859/360/4/0/V_1</td>
<td>N/A</td>
<td>Huber+Suhner</td>
</tr>
<tr>
<td>Fist Mic/Speakers</td>
<td>Subject to Rolling Stock</td>
<td>N/A</td>
<td>Base 2</td>
</tr>
<tr>
<td>SIM Card (Standard size)</td>
<td>N/A</td>
<td>N/A</td>
<td>Gemalto (contact Sydney Trains for SIM provisioning)</td>
</tr>
</tbody>
</table>

10.2.5 Supplier contact details for type approved DTRS on-board equipment

Table 3 provides supplier contact details for type approved DTRS on-board equipment.

Table 3 – Type approved DTRS on-board equipment supplier contact details

<table>
<thead>
<tr>
<th>Rolling stock type</th>
<th>DTRS on-board systems supplier</th>
<th>Contact details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric passenger rolling stock</td>
<td>UGL</td>
<td>Through Life Support Manager – DTRS</td>
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<td>Transport and Technology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UGL Pty Limited</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Level 4, 3 Bridge Street, Pymble NSW 2073</td>
</tr>
<tr>
<td>Diesel passenger and freight rolling stock (including infrastructure maintenance vehicles)</td>
<td>Base 2</td>
<td>General Manager</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Base 2 International Pty Limited (Sydney Branch)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suite 610, Level 6, Manning Building, 451 Pitt St, Haymarket NSW 2000</td>
</tr>
<tr>
<td>All rolling stock types (for SIM allocation and provisioning)</td>
<td>Sydney Trains</td>
<td>DTRS TLS Contract Manager</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Level 2, 36 George St, Burwood NSW 2134</td>
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</table>
10.3. National train communication system (NTCS)

NTCS with In-cab Communications Equipment (ICE) is a radio system implemented by Australian Rail Track Corporation (ARTC) and is designed primarily for use by interstate locomotives for communications with train controllers across the ARTC Defined Interstate Rail Network and the Metropolitan Freight Network in the Sydney area.

The NTCS supports voice and data communications between train drivers and train controllers. NTCS is deployed to provide radio communication within non-electrified portion of TfNSW Metropolitan Heavy Rail Network

Trains are required to be fitted with ICE to communicate on NTCS. ICE can be equipped with a GSM-R module to allow for communications with GSM-R systems, including the TfNSW Digital Train Radio System, (DTRS).

Further details regarding the NTCS should be sought from ARTC and refer to the NTCS Equipment Specification SPM 0179.
Technical Note - TN 089: 2015

Issued date: 17 December 2015
Effective date: 17 December 2015
Subject: Update to medium electric rolling stock outline diagram in T HR RS 00100 ST (RSU 110) and ESC 215

This technical note is issued by the Asset Standards Authority to notify the amendment to Figure 7 in T HR RS 00100 ST Minimum Operating Standards for Rolling Stock – General Interface Standards, version 1.0 and Figure 15 in ESC 215 Transit Space, version 4.9.

1. T HR RS 00100 ST

The medium electric rolling stock outline as shown in Figure 7 in Section 2.3 of T HR RS 00100 ST is amended to show that the roof line encompasses the extended medium electric rolling stock outline. The existing Figure 7 is now replaced with the figure shown on the following page.

2. ESC 215

The medium electric rolling stock outline as shown in Figure 15 in Appendix B of ESC 215 is amended to show that the roof line encompasses the extended medium electric rolling stock outline. The existing Figure 15 is now replaced with the figure shown on the following page with the addition of the following bullet points:

- all cross-section dimensions are symmetrical about the vehicle centreline
- the origin for all horizontal coordinates is the vehicle centreline
- the origin for all cross-section vertical coordinates is the rail level
- the origin for all pantograph vertical coordinates is the contact position with fully worn contact brushes
- all dimensions are in millimetres
T HR RS 00100 ST Figure 7 - Medium electric rolling stock outline dimensions

ESC 215 Figure 15 - Medium electric rolling stock outline dimensions
## Authorisation:

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<th>Checked and approved by</th>
<th>Interdisciplinary coordination checked by</th>
<th>Authorised for release</th>
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</tr>
<tr>
<td>Date</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Jakub Zawada</td>
<td>Michael Uhlig</td>
<td>John Paff</td>
</tr>
<tr>
<td>Position</td>
<td>Principal Engineer, Lead Rolling Stock Engineer</td>
<td>A/Chief Engineer Rail Network Standards and Services</td>
<td></td>
</tr>
</tbody>
</table>

© State of NSW through Transport for NSW
This technical note is issued by the Asset Standards Authority to notify the following updates to T HR RS 00100 ST RSU Series - Minimum Operating Standards for Rolling Stock – General Interface Standards, Version 1.0:

- modification of Section 7.6 Signal visibility requirements
- addition of Section 7.7, Section 7.8 and Section 7.9

This technical note supersedes TN 035:2015 and the updates stated in this technical note apply to the requirements for signal visibility, particularly the additional sighting requirements for any new EMU and DMU type rolling stock.

Some of the text in Section 7.6 has been modified and this section now reads as follows:

### 7.6 Signal visibility – All driven rolling stock

It has been conventional practice on existing TfNSW fleets to seat the driver on the left hand side of the vehicle.

The driver shall have a field of view as shown in Figure 16, Figure 17 and Figure 18, including a direct line of sight to the items described in this section.

The driver shall have a direct line of sight to dwarf post signals and ground mounted signals located at rail level height to a height of 2.5 m above rail level, at all distances greater than 13 m from the driver’s eye position while in the seated position. This field of view shall be seen to a width of 2.5 m from the adjacent rail running face on either side of the track. This is illustrated in Figure 16.
Figure 16 - Seated dwarf post signals and ground mounted signal visibility

The driver shall have a direct line of sight to standard or high post signals and gantry mounted signals located at a height of 2.5 m above rail level to a height of 6.7 m above rail level, at all distances greater than 13 m from the driver’s eye position while in the seated position. This field of view shall be seen to a width of 5 m from the adjacent rail running face on either side of the track. This is illustrated in Figure 17.

Figure 17 - Seated standard or high post and gantry mounted signal visibility
The driver shall have a direct line of sight to ground mounted signals, located at rail level to a height of 1 m above rail level at all distances greater than 4 m from the driver’s eye position while in the standing position. This field of view shall be seen to a width of 2.5 m from the adjacent rail running face on either side of the track. This is illustrated in Figure 18.

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 shall be accompanied by a second person who is qualified in safeworking.

The following sections are new and have been added after Section 7.6.

### 7.7 Signal visibility – Additional requirements for EMU and DMU rolling stock

For new or substantially modified EMU and DMU type rolling stock (effective from July 2015 onwards), the driver shall have a field of view as explained in Section 7.7.1, Section 7.7.2 and Section 7.7.3, including a direct line of sight to the items described in this section. These requirements are in addition to those specified in section 7.6.
7.7.1. **EMU (only) rolling stock sighting requirements for tunnel signals**

The driver shall have a direct line of sight to tunnel signals located 1.3 m above rail level to a height of 3.3 m above rail level, located at all distances greater than 4 m from the driver’s eye position while in the seated position. This field of view shall be seen to a width of 1.25 m from the adjacent rail running face on either side of the track. This is illustrated in Figure 19.

![Figure 19 - EMU (only) seated tunnel signal visibility](image)

7.7.2. **EMU and DMU rolling stock sighting requirements for ground mounted signals**

The driver shall have a direct line of sight to ground mounted signals located at rail level to a height of 1 m above rail level, at all distances greater than 2.5 m from the driver’s eye position while in the standing position. This field of view shall be seen to a width of 1 m from the adjacent rail running face on either side of the track. This is illustrated in Figure 20.
7.7.3. **EMU and DMU rolling stock sighting requirements for post mounted signals**

The driver shall have a direct line of sight to post mounted signals located 1.3 m above rail level to a height of 5.6 m above rail level, located at all distances greater than 4 m from the driver's eye position while in the seated position. This field of view shall be seen to a width of 2.5 m from the adjacent rail running face on either side of the track. This is illustrated in Figure 21.

![Figure 20 - EMU and DMU standing ground mounted signal visibility](image-url)
7.8 **Signal visibility – Additional requirements for EMU and DMU rolling stock (driving cab side windows)**

Driving cabs in existing TfNSW passenger trains are fitted with cab side windows adjacent to the drivers seated position on both sides of the vehicle. The main purpose of the cab side windows is to provide the train crew with visibility of platforms and car markers in order to align the train at the correct position when stopping at platforms, and for general peripheral vision.

Suitable means shall be provided to achieve this requirement.

7.9 **Signal visibility – Allowance for drivers head movement**

All sighting requirements should be met without any movement in the point of origin for the above defined sightlines. However, in order to provide some flexibility in defining the point of origin for the above defined sightlines, consistent with the degree of head movement expected of a driver, the point of origin of the sightlines shall be taken as anywhere within an oblate spheroid (with a horizontal radius of 200 mm and a vertical radius of 100 mm) centred at the point of origin as shown in Figure 18 through to Figure 21.
The requirement of this standard shall be deemed to be met if the sighting requirement can be met at any point (but not necessarily all points) within the oblate spheroid specified.

Figures 16 and Figure 17 are considered normal driving sighting requirements and are not permitted to be met with any allowance for head movement. Only Figures 18 through to Figure 21 are permitted to be met with allowance for head movement as these are considered focus driving actions normally associated with departure from platforms when stationary.

The updates in this technical note will be incorporated in the revised version of this standard.

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Superseded by T HR RS 00100 ST v2.0, 19/12/2018
Subject: Update to passenger train stop braking, braking, and traction performance requirements (RSU 160, RSU 620, and new section RSU 643)

This Technical Note is to advise the update to the requirements for passenger train stop, brake, and traction performance. The update is detailed in four sections of the Minimum Operating Standards for Rolling Stock as follows:

- T HR RS 00100 ST section 7.4 Train braking requirements (Signalling interface – RSU 160)
- T HR RS 00600 ST section 3.2 Brake systems - (Brakes and pneumatic equipment – RSU 620)
- T HR RS 00600 ST section 3.3 Emergency brake additional requirements - (Brakes and pneumatic equipment – RSU 620)
- T HR RS 00600 ST section 8 Traction requirements - (Traction requirements – RSU 643) (new section)

Updates to the relevant sections are shown below in bold. Please note the entire applicable section is shown for clarity.

T HR RS 00100 ST section 7.4 (RSU 160) – Signalling interface

The spacing of signals in the TfNSW network is determined by the braking characteristics of an average train for the terrain and track speeds relevant to the signal location.

For further information, refer to T HR SC 00006 ST Rolling Stock Signalling Interface Requirements.

The service and emergency braking performance of all new multiple unit trains shall comply with T HR RS 00600 ST, Section 6 (RSU 641) in dry weather conditions.
The train stop braking distance, as a minimum, shall meet the ‘GE52A - 15%’ braking curve, that is brake distances 15% shorter than GE52A, in all weather conditions up to 130 km/h; for speeds above 130 km/h and up to 160 km/h the GX2M brake curve shall apply. New passenger rolling stock shall meet RSU 641 emergency brake performance for train stop braking distance. It should be noted that operating speeds associated with XPT or High speed boards will require rolling stock designed to operate at no less than 110 mm cant deficiency.

An effective wheel slide protection system shall be employed to maximise the use of the available adhesion. The performance in wet weather shall be demonstrated through on track testing. Brake performance curves can be found in T HR RS 00830 ST RSU Appendix C – Brake Performance Curves.

Vehicles shall be maintained in a condition such that the braking performance as tested is maintained for the life of the vehicle.

Trains with stopping distances exceeding these limits shall be driven at reduced speeds to provide the ability to stop within the signalling distances.

At some locations ‘advisory speed signs’ have been displayed for XPT trains, Xplorer trains, Endeavour trains, express trains, and freight trains exceeding 1150 m in length. This is to ensure that these trains have sufficient distance to enable them to stop within the required signal spacing.

All vehicles shall be maintained such that braking performance does not deteriorate over time.

**T HR RS 00600 ST section 3.2 (RSU 620) – Brake systems**

The train brake control system shall be designed so that no single failure in the brake system will prevent the system achieving its braking performance.

The train brake stopping distances specified in T HR RS 00600 ST, Section 6 Braking performance – RSU 641 shall be maintained for all brake demand inputs in different operating modes. This includes driver control, automatic train protection (ATP) control, driver safety system, and train response to failures. If a failure occurs that prevents the above demand inputs from achieving the stopping distance, a full service brake or emergency brake shall be applied automatically.

The brake system shall allow the full range of movement of the bogie and its components without loss of performance. Operational movement of the bogie shall not cause deterioration to the brake system.

A wheel slide protection (WSP) system shall be provided for all forms of wheel-based braking except the park brake.
The braking system reliability shall contribute to meeting on time running (OTR) requirements and fleet availability requirements set by TfNSW. The total operational impact of brake failure shall be evaluated and minimised.

The rheostatic or regenerative brake system shall account for continuous operation on all terrain and conditions found in the RailCorp network.

The rheostatic brake mode shall be fully rated such that the train can use full dynamic braking when in a non-receptive part of the Network.

**Use of adhesion modifying systems (such as sanding) may be used to improve the adhesion characteristics.**

Use of adhesion modifying systems (such as sanding) shall be minimised to limit the deposit of adhesion modifying substance on the track. The use shall be limited to instances where high deceleration is required, for example during emergency braking, and where rail adhesion conditions fall to a level below that required to achieve the deceleration.

Any use of adhesion modifying systems shall require an effective system to clear the adhesion modifying substance from the railhead behind the car or set applying the adhesion modifying substance.

The brake performance as detailed in this section shall be met without the application or use of adhesion modifying systems.

**T HR RS 00600 ST section 3.3 (RSU 620) - Emergency brake additional requirements**

The emergency brake shall be controlled by brake pipe pressure throughout all coupled sets.

The emergency brake shall be applied if the brake pipe pressure is vented and shall include wheel slip or wheel slide operation.

The emergency brake shall be applied if the set passes a raised train stop.

In the case of an unintentional train separation, all parts of the train shall be braked automatically with an emergency brake application.

The performance of the emergency brake shall be not less than that specified in T HR RS 00600 ST, Section 6 Braking performance – RSU 641.

It is preferred that the emergency brake performance is obtained by pneumatic braking only. **Pneumatic only braking excludes any electric control, dynamic or regenerative braking, and any adhesion modifying systems (such as sanding).**

Where non-pneumatic systems, such as dynamic brakes, are used to supplement pneumatic brakes during emergency braking, pneumatic only emergency braking performance shall meet 'GE52A – 15%' (the 'GE52A – 15%' brake performance are stopping distances that are 15%
shorter than GE52A) for speeds up to 130 km/h; for speeds above 130 km/h and up to 160 km/h the GX2M brake curve shall apply.

**T HR RS 00600 ST section 8 (RSU 643) – Traction requirements (new section)**

Multiple unit trains shall be fitted with a traction system that meets the following requirements:

- traverse the RailCorp network geometry (and any other networks as specified by Transport for NSW)
- meet the required timetable and sectional running times (on time running requirements)
- operate under all loading conditions
- start from standstill on a 1 in 30 grade
- operate under all expected environmental and track conditions
- for electric multiple unit trains, operation within the limits of the electrical interface requirements, refer to T HR RS 00850 ST, RSU Appendix E – *Rolling stock 1500V dc overhead power supply interface requirements*
- meet the specified reliability requirements
- the traction system shall allow for the recovery of a failed multiple unit train with a functional multiple unit train
- meet the above requirements under degraded conditions within the operator’s minimum engineering requirements to operate passenger trains

A suitable and effective wheel slip control system shall be fitted to minimise track damage and meet the acceleration requirements in poor adhesion conditions.

Use of adhesion modifying systems (such as sanding) may be used to improve the adhesion characteristics in poor adhesion conditions.

Use of adhesion modifying systems (such as sanding) shall be minimised to limit the deposit of adhesion modifying substance on the track. The use shall be limited to instances where the highest levels of acceleration is demanded and where rail adhesion conditions fall to a level below that required to achieve the acceleration.

Any use of adhesion modifying systems shall require an effective system to clear the adhesion modifying substance from the railhead behind the car or set applying the adhesion modifying substance.

The performance of the traction system shall be confirmed by all weather adhesion testing under maximum crush loading conditions. Refer to T HR RS 00300 ST, RSU 341, for further information.
This technical note is issued by the Asset Standards Authority (ASA) as a temporary update to:

Table 1 – Applicable ASA engineering standards

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Important Warning

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Standard governance

Owner: Lead Engineer Rolling Stock, Asset Standards Authority
Authoriser: Chief Engineer Rail, Asset Standards Authority
Approver: Director, Asset Standards Authority on behalf of ASA Configuration Control Board

Document history

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

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Preface

The Asset Standards Authority (ASA) is an independent unit within Transport for NSW (TfNSW) and is the network design and standards authority for defined NSW transport assets.

The ASA is responsible for developing engineering governance frameworks to support industry delivery in the assurance of design, safety, integrity, construction, and commissioning of transport assets for the whole asset life cycle. In order to achieve this, the ASA effectively discharges obligations as the authority for various technical, process, and planning matters across the asset life cycle.

The ASA collaborates with industry using stakeholder engagement activities to assist in achieving its mission. These activities help align the ASA to broader government expectations of making it clearer, simpler, and more attractive to do business within the NSW transport industry, allowing the supply chain to deliver safe, efficient, and competent transport services.

The ASA develops, maintains, controls, and publishes a suite of standards and other documentation for transport assets of TfNSW. Further, the ASA ensures that these standards are performance based to create opportunities for innovation and improve access to a broader competitive supply chain.

This document supersedes TfNSW standard ESR 0001-100 – RSU 100 Series – Minimum Operating Standards for Rolling Stock – General Interface Requirements, Version 1.5. The changes to previous content include the following:

- replacement of RailCorp organisation roles and processes with those applicable to the current ASA organisational context
- minor amendments and clarification to content
- conversion of the standard to ASA format and style
- addition of bridges and structures requirements (RSU 120)
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1. General interface requirements – RSU 100

1.1. Introduction

The Asset Standards Authority (ASA) has established interface requirements pertaining to rolling stock operating on the TfNSW network. The following are typical examples of where infrastructure and rolling stock interface:

- various interface requirements allow for rolling stock to operate on the track without fouling bridges, tunnels and structures, or passing rolling stock
- requirements for rolling stock dynamics are provided to ensure that rolling stock do not cause undue damage to the track
- some requirements allow for rolling stock belonging to different operators to be coupled and operate together if necessary to clear a section in the case of failure
- performance requirements allow for different rolling stock to operate together in the same system safely. In particular, train braking performance shall be compatible with the current signalling systems

The T HR RS 00100 ST (RSU 100 series) of standards are part of the Minimum Operating Standards for Rolling Stock. This series should be read in conjunction with the entire standard, 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 00300 ST (RSU 300 series) Locomotive Specific Interface Requirements
- T HR RS 00400 ST (RSU 400 series) Freight Rolling Stock Specific Interface Requirements
- T HR RS 00500 ST (RSU 500 series) Locomotive Hauled Passenger Rolling Stock Specific Interface Requirements
- T HR RS 00600 ST (RSU 600 series) Multiple Unit Train Specific Interface Requirements
- T HR RS 00700 ST (RSU 700 series) Infrastructure Maintenance Rolling Stock Specific 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 these standards is to ensure that all rolling stock operating on the TfNSW 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 National Rail Safety Regulator (ONRSR).

1.3. Application

The requirements of these standards will apply to all new or substantially modified rolling stock, and rolling stock that has not operated on the TfNSW network.

Older rolling stock that was operating on the TfNSW network as at August 1997 may not fully comply with these standards but will be assessed considering the design and proposed use of the rolling stock.

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 rolling stock operating on the TfNSW 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 allowable.

1.4. Referenced documents


Australian Standards for Railway Rolling Stock (RISSB AS 7500 Series Standards)

ASA Train Operating Conditions Manual TS TOC 1, TS TOC 2, and TS TOC 3

1.5. Australian standards for railway rolling stock

The Rail Industry Safety and Standards Board (RISSB), part of the Australasian Railway Association, 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 Asset Standards Authority (ASA) minimum operating standards for rolling stock will generally align with the Australian standards for railway rolling stock but may contain additional requirements.

Where applicable throughout this standard, the Australian standards for railway rolling stock are referenced for use. See below.

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 TfNSW network, the requirements of the ASA minimum operating standards for rolling stock standards will take precedence to the Australian standards where there are conflicts 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 categorised standards as being “published”, “in progress” or “future”.

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

---

1 www.rissb.com.au
2. Rolling stock outline interface – RSU 110

2.1. Introduction

Australian Standard for Railway Rolling Stock AS 7507 – Rolling Stock Outlines is acceptable for use for this section except where shown below by the indications of variance (separator lines and blue bold text). The remainder of the content of this section is in alignment with AS 7507.

This section describes and details the rolling stock outlines that are authorised to operate on the TfNSW network. Some corridors are constructed and maintained to a larger rolling stock outline than the rolling stock currently authorised for operation on that corridor, to provide potential for future business. Refer to the Train Operating Conditions Manual for approved areas of operation for rolling stock and load types.

This section aims to control the risk of infringement between rolling stock and infrastructure to acceptable levels. This is achieved by setting out the aspects of rolling stock design, construction, inspection, and maintenance, which in combination with infrastructure design, construction, inspection, and maintenance standards, together with rolling stock operations, affect the clearance between rolling stock and trackside features or other rolling stock.

These requirements are the minimum conditions for the passage of rolling stock operating on the TfNSW network and shall be followed by all owners or operators or both of rolling stock on the network. However, this does not preclude the owner or operator or both of such rolling stock imposing requirements that are more stringent in terms of design, construction, inspection, or maintenance.

2.2. Authority

A number of different authorised rolling stock outlines are in use on TfNSW network. Each track section is categorised for the operation of one or more authorised rolling stock outlines as detailed in the Train Operating Conditions (TOC) Manual. Only vehicles conforming to one of the authorised rolling stock outlines for a particular track section is permitted to operate unrestricted on that section.

A register of authorised vehicles (in the Train Operating Conditions (TOC) Manual) is maintained by the ASA. This register contains details of all vehicle types that are authorised to operate on the TfNSW network.

All vehicles listed in the Train Operating Conditions (TOC) Manual, either comply with the rolling stock outline requirements for unrestricted operation or are identified by exception note for restricted operation.
2.3. **Standard rolling stock outlines**

2.3.1. **General**

The standard rolling stock outlines are based on those outlines applicable to existing rolling stock that has been operating on particular sections of track. Historically, rolling stock has been constructed to one of the three basic New South Wales rolling stock outlines (that is, narrow, medium and wide), but with a number of allowable controlled infringements. New standard rolling stock outlines have been developed such that no infringements are permitted other than those cases detailed in Section 2.6.

Table 1 is a list of allowable rolling stock outlines that are authorised for operation on the TfNSW network, and the outlines on which each is based.

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</table>

* For rolling stock outline diagrams for RISSB Reference Vehicles refer to AS 7507 Appendix A

Note: Only existing and heritage extended medium and wide electric rolling stock will be permitted to operate on the TfNSW network.

---

AS 7507 includes a number of rolling stock outline diagrams but only those outlines listed in Table 1 are permitted on the TfNSW network.
2.3.2. Description

For rolling stock to conform to a particular standard rolling stock outline, the following conditions shall be met:

- The rolling stock shall not exceed the relevant standard rolling stock outline at any cross-section, under the following conditions:
  - new wheel diameter together with tare spring height and the rolling stock packed to compensate for future wheel turn (see Note below), where applicable
  - minimum wheel diameter, combined with a solid suspension (including fully deflated air springs, where applicable)
  - bottom discharge hopper doors in the open position and any other loading and unloading equipment, with rolling stock at tare condition with minimum wheel diameters and dynamic suspension movement

Note: Some rolling stock is packed, during overhaul, to provide maximum coupler and body height such that when the wheels are turned, the coupler and body heights above rail remain within limits and don't require further packing.

- The area shown for "wheels" also includes wheel related equipment such as wheel guards, derail catch bars, sanding equipment, and de-sanding equipment. This equipment shall remain above rail level under the following conditions:
  - new wheel diameter together with tare spring height and the rolling stock packed to compensate for future wheel turn (see Note above), where applicable
  - minimum wheel diameter, combined with solid suspension (including fully deflated air springs, where applicable)

---

AS 7507 permits open bottom discharge doors to exceed the rolling stock outline provided the doors remain above rail level.

This is not permitted on the TfNSW network.
Figure 1 – "Narrow non-electric" rolling stock outline dimensions
Figure 2 – "Narrow electric" rolling stock outline dimensions
Figure 3 – “Narrow container” rolling stock outline dimensions
Figure 4 – "Narrow square" rolling stock outline dimensions
Figure 5 – "Intersystem" rolling stock outline dimension
Figure 6 – "Narrow hopper" rolling stock outline dimensions
Figure 7 – "Medium electric" rolling stock outline dimensions
Figure 8 – "Extended medium electric" rolling stock outline dimensions
2.3.3. Kinematic rolling stock outline

The kinematic rolling stock outline is the cross-sectional envelope produced by the applicable static rolling stock outline displaced through the following motions:

- maximum body roll ± 2.0 degrees
- lateral movements ± 60 mm
- vertical bounce 50 mm upwards
The above motions are defined as follows:

**Maximum body roll**

Roll of the vehicle body with respect to the rail plane, about the vehicle roll centre. This includes roll about both primary and secondary suspensions.

**Lateral movement**

Lateral displacement of the vehicle body with respect to the centre of the wheelset. This lateral displacement is made up of all possible movements, including, but not limited to:

- bogie centre pin clearance
- secondary suspension lateral clearance or movement
- primary suspension lateral clearance or movement

**AS 7507:** On the TfNSW Network, the kinematic lateral displacement of 60 mm shall be used. This is different to the 40 mm specified in AS 7507 Appendix A. clause A1.2.

**Vertical bounce**

The vertical bounce allowance results from the primary and secondary suspension.

**Centre throw and end throw**

Centre throw and end throw need to be considered in conjunction with the above factors for the negotiation of a 100 m radius horizontal curve and 300 m radius vertical curve.

**Kinematic rolling stock outline test**

The vehicle shall be tested in accordance with T HR RS 00200 ST, Section 27 (RSU 289) *Kinematic rolling stock outline test.*

**AS 7507:** On the TfNSW Network, where computer simulations are used to determine kinematic outline, the simulation shall be validated using measured dynamic responses of the vehicle test results or sway test results or both. This differs with the requirement of AS 7507 Section 6.3.1.3.
2.4. Equivalent swept path rolling stock outlines

2.4.1. General

The equivalent swept path rolling stock outline is that envelope generated during curve negotiation, by the throw of a vehicle that is constructed to the proportions applicable to a standard rolling stock outline.

This means that a vehicle may be constructed or maintained to the following:

- larger tolerances
- a different roll centre height
- longer bogie centres
- a longer body overhang
- active tilting of body, than that of the standard rolling stock outline

To achieve this, the vehicle will require a smaller cross-section.

*Note: No part of a vehicle can have a larger cross-section than that of the applicable standard rolling stock outline, other than where detailed in Section 2.6.2 (expendable items).*

2.4.2. Description

For vehicles to conform to a particular equivalent swept path rolling stock outline, the swept path developed by the vehicle shall not be larger than the swept path developed by the standard rolling stock outline at any cross-section, under the conditions of the following:

- new wheel diameter together with tare spring height and the vehicle packed to compensate for future wheel wear, where applicable
- condemned wheel diameter, combined with a solid suspension (including fully deflated air springs, where applicable)
• horizontal curves down to 100 m radius
• vertical convex and concave curves down to 300 m radius
• maximum rolling stock displacements

2.5. Special load outline conditions

2.5.1. General

Vehicles that exceed the rolling stock outlines for a particular route may be permitted to travel under special conditions, such as, restrictions on passing other vehicles or warnings to public on platforms.

2.5.2. Authority

The conditions for the operation of out of gauge vehicles are issued by the ASA.

2.5.3. Special conditions

Special conditions for the operation of particular vehicle and loads may be published in the Train Operating Conditions Manual.

2.6. Rolling stock and loading infringements

2.6.1. General

The authorised rolling stock outline for any track section can be infringed in two ways. These are as follows:

• expendable items
• out of gauge loads

Some existing vehicles may be operating outside of the requirements of this standard. This is a legacy of the past, and shall be controlled to minimise risk. These vehicles shall have an approved concession prior to operating on the TfNSW network.

2.6.2. Expendable items

Expendable items shall be minimised by design and shall not be incorporated as a design feature of new rolling stock. New rolling stock designs shall incorporate alternative means of achieving the requirement without resorting to outline infringement resulting in expendable items.

Where no alternative is possible, some parts (generally items of equipment attached to the exterior) of vehicles may project beyond the rolling stock outline. These items can only be
permitted if they are considered, and treated as, expendable items. By their nature, they shall have low consequences if contact at speed occurs with infrastructure or other vehicles.

The following are some examples of potentially expendable items:

- mirrors
- blue lights
- speakers
- handrails (in the designated handrail area only)

  *Note: handrails for existing rolling stock only*

- periscopes
- antennae
- roof guttering

The responsibility of vehicle owner or operators is to ensure that expendable items are constructed and maintained such that, in the event of contact with the infrastructure or other vehicles, they will not cause damage to the infrastructure or other vehicles, injury to employees or public, or result in an unsafe operating condition.

Examples include the following:

- damage to infrastructure, for example, cable or signal troughing on a tunnel wall
- the item cannot become a dangerous projectile if broken off
- the item cannot become partially dislodged, resulting in flapping, and so forth
- the item cannot result in an unsafe operating condition due to loss of lights, communications, beacons, strobe lights, and so forth

**Management**

New expendable items cannot be introduced, or existing items modified, without the authorisation of the ASA (by the ASA concession process).

Figure 10 details some existing expendable items.

### 2.6.3. Out of gauge loads

Loads that do not conform to the rolling stock outlines for the proposed route or corridor are termed out of gauge loads.

Authority to move any out of gauge loads can only be granted by the ASA.

Out of gauge load movements are treated as specific movements and special operating conditions will apply. These special conditions are determined by the ASA.
Because of the unique dimensions of each out of gauge load, the suitability of a proposed route will have to be determined for each movement. Special and out of gauge loads are usually accompanied by a representative from a suitable authorised engineering organisation (AEO).

### 2.6.4. Foul load infringements

Loads identified as being foul shall not be moved, and shall immediately be brought to the attention of the local train control. Special authority will be arranged to deal with the situation, or special operating conditions will be placed on the vehicle.

Some standard responses to common foul load infringements already exist. Passenger vehicles with plug type doors that can fail in the open condition, resulting in the vehicle being foul of the authorised rolling stock outline (such as Tangara passenger vehicles) are included in this category. For vehicles having plug type doors, which when failed do not exceed the dimensions detailed in the following Figure 10, existing special operating conditions can be applied, as per Tangara passenger vehicles.

### 2.6.5. Passenger vehicle plug doors

Passenger vehicles fitted with plug type doors that can fail in the open condition, resulting in the vehicle being foul of the authorised rolling stock outline are categorised as a foul load infringement.

The position of plug type doors shall be in the designated door areas as shown Figure 11 and Figure 12. Alternative door positions might be accepted by TfNSW. However, the doors in the open condition shall not exceed the swept path of the applicable rolling stock outline when negotiating 100 m curve radii. All body side doors shall be positioned such that the gap between the doorway and the platform at curved platforms is minimised.
Figure 10 – "Expendable items – medium electric" rolling stock outline dimensions
Figure 11 – "Existing foul load infringement – narrow non electric" rolling stock outline dimensions
Figure 12 – "Existing foul load infringement – medium electric" rolling stock outline dimensions
2.7. Physical interface requirements

2.7.1. General

Portions of vehicles that are required to interface physically with Infrastructure are permitted to be outside the rolling stock outline. These items can only be approved by the ASA.

Items currently requiring physical interface include the following:

- trip valve arms (refer to Figure 1 to Figure 9 for details)
- wheels (refer to Figure 1 to Figure 9 for details)
- pantographs (refer to Section 2.7.2)

2.7.2. Pantographs

When in the lowered position, all parts of the pantograph shall fit within the rolling stock outline. The minimum free height when fully extended is 6100 mm above rail level.

The maximum allowable pantograph head dimensions are detailed in drawing CV0131343 – Standard Pantograph Profiles (refer to T HR RS 00870 ST – RSU Appendix G). All other pantograph equipment shall remain below, and narrower than the pantograph head. The designated pantograph head position area, along the vehicle, shall result in the pantograph pan being within 1000 mm longitudinally from the bogie pivot centre.

These maximum dimensions only apply when combined with the rolling stock tolerances, and when the pantograph head is constrained to permit no lateral movement relative to the vehicle. Vehicles having greater rolling stock tolerances, pantographs mounted along the vehicle such that a head is outside of the designated area, or pantograph heads capable of any lateral movement relative to the vehicle, are required to have pantograph heads of lesser dimensions.

These maximum dimensions only apply when combined with the maximum upward thrust detailed in Section 4 (RSU 130).

Vehicles with pantographs of lesser dimensions than the maximum, or pantographs mounted outside the designated area, may fail to maintain contain with the overhead wire. This is outside the scope of this standard.

For further information, refer to T HR RS 00850 ST (RSU Appendix E).
AS 7507: The pantograph interface outlines referenced above are to be used on the TfNSW network. They are different from the RISSB pantograph outlines specified in AS 7507 Appendix B, Section B2, which are not permitted.
3. **Track interface – RSU 120**

3.1. **Introduction**

Australian Standard for Railway Rolling Stock AS 7508 – *Track Forces and Stresses* is acceptable for use for this section except where shown below by the indications of variance (separator lines and blue bold text). The remaining content is in alignment with AS 7508.

3.2. **Track**

3.2.1. **General geometry**

The normal design and absolute limits for main line and siding track geometry are specified in the transport standard ESC 210 *Track Geometry and Stability*.

3.2.2. **Cant deficiency**

The TfNSW network is designed to allow rolling stock to operate at two different design cant deficiencies, 75 mm and 110 mm.

Rolling stock operating at the General, Normal, or Medium speed boards shall be able to cope with a cant deficiency of at least 75 mm.

Rolling stock operating at the XPT or High speed boards shall be able to cope with a cant deficiency of at least 110 mm.

Rate of change of cant deficiency shall be taken into account in the design of rolling stock. Rate of change of cant deficiency of up to 55 mm/s on plain track and up to 135 mm/s in turnouts may be experienced when operating at the General, Normal, or Medium speed boards.

Rate of change of cant deficiency of up to 65 mm/s on plain track and up to 135 mm/s in turnouts may be experienced when operating at the XPT or High speed boards.

3.3. **P₂ force**

The results of a P₂ force calculation shall be submitted to ASA, using the algorithm shown below and including the relevant track constants shown in Table 2 below, and at the maximum design speed for the vehicle:

<table>
<thead>
<tr>
<th>Track class</th>
<th>Max P₂ force locomotives (kN)</th>
<th>Max P₂ force other rolling stock (kN)</th>
<th>Equivalent track stiffness Kₜ (MN/m)</th>
<th>Equivalent track damping Cₜ (kNs/m)</th>
<th>Equivalent track mass Mₜ (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>295</td>
<td>230</td>
<td>110</td>
<td>52.5</td>
<td>135</td>
</tr>
<tr>
<td>2</td>
<td>230</td>
<td>230</td>
<td>100</td>
<td>48</td>
<td>117</td>
</tr>
</tbody>
</table>
Equation 1 – \( P_2 \) force calculation

\[
P_2 = P_0 + 2\alpha\sqrt{\frac{M_u}{M_u + M_t}}^{1/2} \times \left[ 1 - \frac{C_t \pi}{4(K_t(M_u + M_t))^{1/2}} \right] \times \left[ K_t M_u \right]^{1/2}
\]

Where:

- \( P_2 \) = Force (kN)
- \( P_0 \) = Vehicle static wheel load (kN) at nominal gross mass
- \( M_u \) = Vehicle unsprung mass per wheel (kg)
- \( 2\alpha \) = Total joint angle, 0.014 radians
- \( v \) = Maximum vehicle velocity (m/s)
- \( K_t \) = Equivalent track stiffness (MN/m)
- \( C_t \) = Equivalent track damping (kNs/m)
- \( M_t \) = Equivalent track mass (kg)

### 3.4. P/D Ratio

In determining operating conditions, the ASA will consider the maximum P/D ratio (the ratio of maximum static wheel load to minimum [worn] wheel diameter).

Maximum allowable P/D ratios for operation of worn wheels on the TfNSW network are as follows in Table 3.

<table>
<thead>
<tr>
<th>Area of operation</th>
<th>Maximum P/D ratio (t/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unlimited (class *1 and class *2 tracks)</td>
<td>12.66</td>
</tr>
<tr>
<td>(Class*1 track)</td>
<td>15.13</td>
</tr>
</tbody>
</table>

**Notes on Table 3:**

- Track Class *1 = track structure 53SI/TN/SL or better as defined in ESC 200. This is basically track with 53 kg/m rail with 250 mm of ballast
- Track Class *2 = track structure 47SI/TN/SL or better as defined in ESC 200. This is basically track with 47 kg/m rail with 250 mm of ballast

A maximum P/D ratio of 17.56 is permitted for coal trains under current authorisations only operating between Vales Point and Woodville Junction.

Where it is proposed to operate vehicles having P/D ratios outside these limits, approval shall be obtained from the ASA via a concession to the relevant standard.
Refer to Table 4 for currently approved bogie load and wheel diameter or wheel load and wheel diameter combinations for new wheels.

Track classes are shown in the *Train Operating Conditions Manual*, Section 1, Route Standards.
### Table 4 - Approved bogie type, wheel load, and wheel diameter combinations

<table>
<thead>
<tr>
<th>Wagon type</th>
<th>Sidebearer type</th>
<th>Bogie type</th>
<th>Axle load (tonnes)</th>
<th>New wheel diameter (mm)</th>
<th>Speed (km/h)</th>
<th>Track Class</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cartainer wagon</td>
<td>CCSB</td>
<td>3 piece</td>
<td>16</td>
<td>737</td>
<td>115</td>
<td>1 or better</td>
<td>19 tonne axle load approved for a limited number of services</td>
</tr>
<tr>
<td>All types</td>
<td>Gap</td>
<td>3 piece</td>
<td>20</td>
<td>840 - 920</td>
<td>80</td>
<td></td>
<td>Reduced speed over all lower track classes</td>
</tr>
<tr>
<td>Super freighter</td>
<td>CCSB</td>
<td>3 piece</td>
<td>19</td>
<td>840</td>
<td>115</td>
<td></td>
<td>Reduced speed over some lower track classes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 piece</td>
<td>21</td>
<td>840</td>
<td>100</td>
<td></td>
<td>Reduced speed over some class 2 track and 2mm wheel tread hollowing limit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 piece</td>
<td>23</td>
<td>80</td>
<td></td>
<td></td>
<td>Limited operation at reduced speed on some class 2 track and 2mm wheel</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>tread hollowing limit</td>
</tr>
<tr>
<td>Steel traffic</td>
<td>Gap</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coal traffic</td>
<td>CCSB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ex – BHP vehicles used in the Hunter Valley</td>
</tr>
<tr>
<td></td>
<td>Gap</td>
<td>3 piece</td>
<td>25</td>
<td>60 - 65</td>
<td>1</td>
<td>1 or better</td>
<td>BHP traffic in Port Kembla area – short sections of TfNSW track</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Coal working</td>
</tr>
<tr>
<td></td>
<td>Gap or CCSB</td>
<td>3 piece</td>
<td>30</td>
<td>40 - 60</td>
<td>1 or better</td>
<td>1 or better</td>
<td>Between Woodville Junction and Vales Point Junction</td>
</tr>
<tr>
<td>Super freighter</td>
<td>Gap + large</td>
<td>WN</td>
<td>19.25</td>
<td>840</td>
<td>115</td>
<td>1 or better</td>
<td>Reduced speed over all track classes</td>
</tr>
<tr>
<td></td>
<td>centre pivot</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CCSB YM</td>
<td>920</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>YM</td>
<td>3 piece</td>
<td>20</td>
<td>80</td>
<td></td>
<td></td>
<td>Reduced speed over some lower track classes</td>
</tr>
<tr>
<td>Grain</td>
<td>YM</td>
<td>20.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coal traffic</td>
<td>DEA</td>
<td>19.25</td>
<td>840</td>
<td>115</td>
<td></td>
<td></td>
<td>Reduced speed over all track classes</td>
</tr>
<tr>
<td></td>
<td>DEA</td>
<td>25</td>
<td>920</td>
<td>80</td>
<td></td>
<td></td>
<td>Coal working</td>
</tr>
<tr>
<td></td>
<td>EBA</td>
<td>30</td>
<td>40 - 60</td>
<td></td>
<td></td>
<td></td>
<td>Between Woodville Junction and Vales Point Junction</td>
</tr>
</tbody>
</table>
3.5. **Platform clearances**

All platforms are being constructed for level access. For clearances, refer to ASA standard, ESC 215 Transit Space.

3.6. **Maximum allowable axle loads**

The maximum allowable axle loads for operation on the TfNSW network for different vehicle types are indicated in Table 4 for freight and Table 5 for other rolling stock.

<table>
<thead>
<tr>
<th>Vehicle type</th>
<th>No. of axles</th>
<th>Maximum gross mass tonnes</th>
<th>Max axle load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locomotives</td>
<td>6</td>
<td>134</td>
<td>22.33</td>
</tr>
<tr>
<td>Locomotives</td>
<td>4</td>
<td>88</td>
<td>22</td>
</tr>
<tr>
<td>Electric multiple unit train – intercity</td>
<td>4</td>
<td>71</td>
<td>17.75</td>
</tr>
<tr>
<td>Electric multiple unit train - suburban</td>
<td>4</td>
<td>69</td>
<td>17</td>
</tr>
<tr>
<td>Diesel multiple unit train</td>
<td>4</td>
<td>67</td>
<td>14.75</td>
</tr>
<tr>
<td>Loco hauled passenger cars</td>
<td>4</td>
<td>57</td>
<td>14.25</td>
</tr>
<tr>
<td>Infrastructure maintenance vehicles</td>
<td>various</td>
<td>Dependent on configuration</td>
<td>23</td>
</tr>
</tbody>
</table>

3.7. **Wheel rail interface**

The matching of wheel and rail profiles ensure minimum wear on both the rail and the wheel as well as better contact band for wheel/rail contact stress and train detection on the signalling system.

Refer to T HR RS 00200 ST, Section 3 (RSU 211) for details of wheel profiles.

Refer to TfNSW transport standard ESR 0330 for permissible wheel defects.

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**AS 7508: Appendix A, Table A1** can be used as a guide for re-assessing track forces and stresses criteria when comparing against current rolling stock. However, the ASA will give final determination for vehicles operating on the TfNSW network.
3.8. **Bridges and structures loading requirements**

In addition to the track load and force considerations in the design of rolling stock, the bridges and structures loading aspect of rolling stock shall also be taken into account. The main details affecting the loading include gross vehicle mass (and subsequent axle loading), wheel spacing, and coupling spacing of the vehicle.

*Note, these bridge loading considerations apply to all rolling stock, including locomotives, wagons, passenger vehicles, and infrastructure maintenance vehicles.*

3.8.1. **Maximum design load**

All rolling stock shall be designed such that the vehicles’ load effects on bridges and structures do not exceed the equivalent design load as follows:

- 200 LA for spans from 10 m to 136 m
- 210 LA for spans up to 10 m

The load effects, in terms of bending and shear, shall be derived from the calculations proportioned on the 300 LA railway traffic load as described in AS 5100.2, *Bridge Design*, Part 2 Design Loads, Clause 8.

3.8.2. **Maximum design load**

Vehicles satisfying the above design load limit criteria will be permitted to operate on the TfNSW main lines only, this includes the following lines:

- main north
- main south
- main west
- Illawarra

Evidence of the vehicle satisfying the design load limit criteria shall be provided by way of report as per Section 3.8.3.

Owners with vehicles that wish to operate on the TfNSW Network at higher load effects or to operate on passenger only lines are to contact ASA for information regarding additional investigation requirements and design load limits.

3.8.3. **Submission requirements**

A detailed report shall be submitted to ASA that certifies that the load effects of the vehicle design in all operating conditions do not exceed the limit for bridge spans between 1 m and 136 m in 1 m increments.
The report shall include the following:

- vehicle description with all relevant dimensions and masses (including axle spacing)
- vehicle operating conditions (including multiple unit details)
- investigation methodology
- resultant LA load effects (including bending and shear versus span charts)
- conclusion
- certification by an appropriate authorised engineering organisation (AEO) or an ASA approved organisation (that is, civil – bridges and structures discipline)

The above report is not required if the vehicle can be clearly shown to have a gross vehicle mass and axle load the same (or lighter), and wheel spacing and coupler spacing the same as the rolling stock detailed in Section 3.8.4. However, a written statement from the vehicle designer and owner or operator is required to certify this detail.

### 3.8.4. Rolling stock with compliant dimensions

The following locomotives satisfy the design load requirements as per Section 3.8.1:

#### Figure 13 – Locomotive dimensions

#### Table 6 – Compliant locomotive dimensions (mm)

<table>
<thead>
<tr>
<th>Loco type</th>
<th>Axle load (t)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>22.33</td>
<td>2227</td>
<td>1702</td>
<td>1702</td>
<td>8957</td>
<td>1702</td>
<td>1702</td>
<td>2227</td>
<td>20218</td>
</tr>
<tr>
<td>2</td>
<td>22.33</td>
<td>2250</td>
<td>1900</td>
<td>1900</td>
<td>9900</td>
<td>1900</td>
<td>1900</td>
<td>2250</td>
<td>22000</td>
</tr>
<tr>
<td>3</td>
<td>22.33</td>
<td>2686</td>
<td>1850</td>
<td>1850</td>
<td>9590</td>
<td>1850</td>
<td>1850</td>
<td>2324</td>
<td>22000</td>
</tr>
<tr>
<td>4</td>
<td>22.00</td>
<td>2217</td>
<td>1905</td>
<td>1905</td>
<td>9946</td>
<td>1905</td>
<td>1905</td>
<td>2217</td>
<td>22000</td>
</tr>
</tbody>
</table>
The following wagons satisfy the design load requirements as per Section 3.8.1:

![Diagram of wagon dimensions]

**Figure 14 – Wagon dimensions**

**Table 7 – Compliant wagon dimensions (mm)**

<table>
<thead>
<tr>
<th>Wagon type</th>
<th>Axle load (t)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 #</td>
<td>25</td>
<td>1085</td>
<td>1800</td>
<td>11100</td>
<td>1800</td>
<td>1085</td>
<td>16774</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(989)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(16678)</td>
</tr>
<tr>
<td>2 @</td>
<td>23 %</td>
<td>1060</td>
<td>1830</td>
<td>11792</td>
<td>1830</td>
<td>1060</td>
<td>15597</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>(13429)</td>
<td></td>
<td></td>
<td>(15259)</td>
</tr>
<tr>
<td>3 @</td>
<td>23 %</td>
<td>1166.5</td>
<td>1727</td>
<td>11981</td>
<td>1727</td>
<td>1166.5</td>
<td>15738</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(13704)</td>
<td></td>
<td></td>
<td>(15431)</td>
</tr>
<tr>
<td>4</td>
<td>25</td>
<td>1070</td>
<td>1780</td>
<td>11170</td>
<td>1780</td>
<td>1070</td>
<td>16870</td>
</tr>
</tbody>
</table>

# Permanently coupled wagons, dimensions nominally for end wagons, dimensions in brackets for intermediate wagons (only for three or more permanently coupled wagons, two permanently coupled wagons are effectively only end wagons, however dimension E is assumed the permanently coupled end).

@ Articulated multi pack wagons. Dimension F is coupler to bogie centre distance for end wagons and bogie centre distance for intermediate wagons.

% Axle loads expressed as gross vehicle mass divided by number of axles (articulated multi pack wagons).
4. Overhead power interface – RSU 130

4.1. General

The requirements for the interface between the electric rolling stock and the overhead electric power supply is specified in T HR RS 00850 ST (RSU Appendix E) *Rolling Stock 1500 V dc overhead power supply interface requirements*.

For rolling stock to operate in electrified areas, they shall have an electrical safety inspection as specified in T HR RS 00200 ST, Section 31 (RSU 294). Where appropriate, rolling stock operating under the overhead wiring shall display suitable high voltage warning signage.
5. Vehicle to vehicle interface – RSU 140

5.1. General

5.1.1. Locomotives and locomotive-hauled rolling stock

For multiple unit locomotive coupling compatibility, the location of end equipment on locomotives shall be in accordance with Diagram G9 and Diagram G10 in T HR RS 00870 ST (RSU Appendix G).

The location of end equipment on locomotive hauled rolling stock shall be in accordance with Diagram G7 and Diagram G8 in T HR RS 00870 ST (RSU Appendix G), unless otherwise approved by the ASA. For vehicles fitted with main reservoir or independent brake or both, the type and location of hoses should be such that they couple with locomotives and other vehicles.

5.1.2. EMU and DMU trains when hauled by locomotives

If an EMU or DMU is hauled by locomotive during transfer, for recovery operations or as required, the following requirements will apply.

The location of end equipment shall be compatible with locomotives configured in accordance with Diagrams G9 in T HR RS 00870 ST (RSU Appendix G), unless otherwise approved by the ASA. Transition couplers or fittings or both and hoses may need to be provided to achieve this.

5.1.3. All rolling stock

When vehicles are fitted with drawbars, buffers, buffer beams, gangway beams, transition lugs, or anti-climbers these shall be compatible in height, loading, and under conditions of curving or dynamics, they shall not be capable of fouling or locking together. Refer to T HR RS 00200 ST, Section 23 (RSU 285) for static vehicle-vehicle swing test.

Diaphragms (gangways) fitted to the ends of vehicles shall be compatible with adjacent coupled vehicles to ensure there is no fouling or locking together.

5.2. Couplers

Automatic couplings for locomotives and locomotive hauled vehicles shall be in accordance with Figure 15 and shall have the No. 10A contour to Association of American Railroads, (AAR) Standard S-106 with bottom shelf.

Coupler material shall be cast steel to the following:

- AAR Specification M-201 Grade E – with the impact test at 0°C acceptable

or alternatively
• AS 2074 Grade L6B2 – with Charpy impact test at 0°C to AS 1544, Part 2, Part 3 tests required, average energy 27 J minimum, and no individual test less than 20 J

[Reference: Section 9 of the ROA Manual of Engineering Standards and Practices]

5.3. Non standard, combined or multi-function couplers

Vehicles with non-standard couplings, combined, or multi-function couplings shall be compatible with similar vehicles with which they must operate. On terminal end vehicles, emergency couplings shall be provided to interface mechanically with the standard AAR 10A contoured coupler, brake pipe, and main reservoir air brake coupling hoses.

Vehicle couplings and end equipment shall be designed to enable vehicles with the same coupling system to be readily coupled together on a minimum curve radius of 200 metres. Refer to T HR RS 00200 ST, Section 23 (RSU 285) for minimum curve radii for end equipment clearance requirements.

5.4. Shelf-type couplers for special purpose freight rolling stock

All vehicles fitted with AAR type couplers, except tank cars for the conveyance of dangerous goods in bulk, shall conform to the requirements of Figure 15 with a bottom shelf.

Tank cars for the conveyance of dangerous goods in bulk shall be fitted with couplers conforming to Figure 15 with top and bottom shelves (double shelf type).

Special purpose couplers for rotary-dump operations and so forth may be fitted where required.

Special purpose couplers shall comply with all relevant aspects of this section and AAR requirements, with the impact and Charpy tests as specified in Section 5.2.

[Reference: Section 9 of the ROA Manual of Engineering Standards and Practices]

5.5. Uncoupling operation (all vehicles)

The uncoupling mechanism shall be designed to prevent damage when loading, unloading, or coupling vehicles.

[Reference: Section 9 of the ROA Manual of Engineering Standards and Practices]

5.6. Rigid drawbars

Rigid drawbars are permitted to permanently connect two or more vehicles where the facility for uncoupling in service is not required.

The length of the drawbar shall be selected to comply with the following parameters:

L/V ratio shall be determined under the following conditions:
• maximum expected draft force for multiple unit trains (including appropriate safety factors)
• maximum expected draft force of 890 kN, whichever is greater, applied to locomotive-hauled rolling stock
• coupled to vehicles with which it is intended to operate at front and rear for multiple unit trains. For freight rolling stock, this means the vehicle should be coupled to a base vehicle front and rear as defined in T HR RS 00200 ST, Section 23.5 (RSU 285) on a horizontal curve of 165 m radius
• the vehicle shall be in the tare condition

Curve negotiability: 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-II of the AAR Manual of Standards and Recommended Practices, Specification M-1001.

The drawbar and components shall be designed to withstand longitudinal buff and draft forces equivalent to those of the couplers.

[Reference: Section 9 of the ROA Manual of Engineering Standards and Practices]

5.7. Slackless drawbars fitted to freight rolling stock

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.

The slackless drawbar shall connect to each vehicle with an assembly incorporating components for load transfer and self-adjustment of wear induced slack, without draft gear.

The drawbar shall be designed to permit movement in the vertical and lateral planes.

The length of the drawbar shall be selected to comply with the parameters specified in Section 5.6.

The slackless drawbar and components shall be designed to withstand longitudinal buff and draft forces equivalent to those of the couplers.

A suitable means shall be provided to prevent the system binding when negotiating curves.

[Reference: Section 9 of the ROA Manual of Engineering Standards and Practices]

5.8. Articulated connector

5.8.1. Freight rolling stock

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 inter-connecting 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 a vertical pin with positive retention.

The connector shall be designed to permit rotation in the longitudinal, vertical and lateral planes, with sufficient internal clearance to permit the vehicle to be lifted clear of the bogie.

Longitudinal buff forces shall be transmitted by direct contact between the mating components; draft forces shall be transmitted through the connecting pins.

The connector assembly shall incorporate components for load transfer and self-adjustment of wear-induced slack.

The female component shall incorporate a spigot, equivalent to a body centre plate, to mate with the bogie centre plate and include provision for a bogie centre pin.

The minimum capacity for angular rotation when installed shall be the following:

- vertical plane (concave and convex): ± 7°30’ (for undulations and lifting)
- horizontal plane: ± 18° (for curving)
- lateral roll: ± 5° (for twist)

The connector and components shall be designed to withstand longitudinal buff and draft forces equivalent to those of the couplers.

[Reference: Section 9 of the ROA Manual of Engineering Standards and Practices]

5.8.2. Passenger rolling stock

Articulated connectors are used to permanently couple adjacent units sharing a common bogie and forming part of an articulated vehicle.

The connector shall be designed to permit rotation in the longitudinal, vertical, and lateral planes, to cope with the expected vehicle to vehicle movements expected to be encountered under all of the track conditions of the TfNSW network and the requirements of T HR RS 00200 ST (RSU 283, RSU 284 and RSU 285).

The connector and components shall be designed to withstand the maximum longitudinal buff and draft forces (including appropriate safety factors) expected to be encountered in service including when the consist is locomotive-hauled in the maximum mass and length configuration envisaged.

5.9. Draft gear

All drawgear shall be equipped with draft gear of sufficient capacity to withstand longitudinal buff and draft forces equivalent to those of the couplers and shock loading due to train dynamic forces.
[Reference: Section 9 of the ROA Manual of Engineering Standards and Practices]

5.10. **Coupler swing**

Automatic coupler swing should be sufficient to allow for coupling to vehicles with short or long overhangs and to couple on curves.

5.11. **Coupler height**

Coupler heights shall be within the following limits:

**Locomotives:**
- new condition, full provisions 880 mm to 890 mm
- in service condition 840 mm to 900 mm

**Freight vehicles:**
- new condition 870 mm to 880 mm
- in service condition 780 mm to 915 mm

**Passenger vehicles:**
- electric fleet 853 mm to 890 mm
- XPT 875 mm to 915 mm
- Xplorer and Endeavour 904 mm to 906 mm

Any multifunction couplers shall be maintained level.
Figure 15 – Standard coupler (bottom shelf type)

[Reference: ROA Manual of Standards and Recommended Practices, Diagram 9-1]
6. **Environmental interface – RSU 150**

6.1. **General**

All vehicles shall comply with all relevant legislative environmental requirements, including those relating to exhaust emissions, noise, waste removal, and handling of fuel.

Vehicle owners and operators shall consult with the New South Wales Environment Protection Authority (EPA), the holder or holders of the applicable environmental protection licence (EPL) (for the Network and for the intended operations), and TfNSW on the environmental standards that do or will apply to a vehicle type. Vehicle owners and operators shall demonstrate compliance with the appropriate standards and regulations thereby nominated, prior to operation of the vehicle on the TfNSW network.

Owners and operators shall minimise all relevant environmental problems generated from vehicles with the best available techniques not entailing excessive costs (BATNEEC) principle.

Owners and operators shall comply with the relevant EPL for the network and intended operations with respect to maintenance of rolling stock. The relevant EPL can be determined and obtained by contacting the EPA.

6.2. **Noise - general**

All vehicles shall comply with the noise requirements of the *Protection of the Environment Operations Act 1997* as amended and the objectives of the applicable EPL for the Network and intended operations.

6.2.1. **Locomotives**

The owner and operator shall seek approval from the EPA prior to permitting operation on the licensed premise for the following:

- a class or type of locomotive, whether new or existing, that has not been operated on the TfNSW rail network
- a locomotive that has been “substantially modified” since it was last used on the TfNSW network

If the vehicle falls within either of the definitions of “locomotive” or “substantially modified” below, the vehicle needs to comply with conditions stipulated in the applicable EPL.

6.2.2. **Non-locomotives**

While only locomotives are required to have approval from the EPA to operate under the applicable EPL, the ASA requires that all vehicles comply with the noise requirements of the...
EPL, except for passenger electric multiple unit (EMU) trains which shall comply with the noise emission requirements defined in Section 6.3.2 of this standard.

Noise of empty freight wagons, such as drumming from empty hopper wagons, shall be tested and comply with emission requirements defined in Section 6.3.

6.2.3. Definitions:

a) the EPA defines a “locomotive” as:

“A powered vehicle primarily intended for hauling freight and/or passenger rolling stock or a rail vehicle comprising part of a diesel-multiple unit train, but does not include:

- a vehicle used for maintenance of track or other infrastructure
- a vehicle used or intended to be solely for heritage purposes"

Note: Both diesel hydraulic DMUs (for example, Hunter Railcars) and diesel locomotives are captured by EPA’s definition.

b) EPA defines “substantially modified” as:

"The major upgrading, replacement, restructuring or reconfiguration of one or more of the principal noise-emitting components of a locomotive, including where applicable:

- the combustion engine
- the engine exhaust system
- the traction system, including traction motors and gearboxes
- the electric supply system, including alternators, invertors and control equipment
- cooling systems, and
- the dynamic braking system

but does not include the routine maintenance of the locomotive."

c) A “non-locomotive” is defined as anything other than a “locomotive” and includes:

- a bogie/wheel set as part of either a freight or passenger train
- a rail vehicle comprising part of an electric-multiple unit
- a vehicle used for maintenance of track or other infrastructure
- a vehicle used or intended to be solely for heritage purposes

Examples of non-locomotives have included the Millennium Train and the OSCar.
6.3. **Noise emissions**

6.3.1. **Noise emissions for all rolling stock except passenger electric multiple unit trains**

All noise measurements shall be conducted in accordance with AS 2377.

Noise emission tests shall be conducted on locomotives, and on complete train consists, braking at various normal running speeds.

The external noise level at 15 m shall not exceed an LAmax,F value of 85 dB(A) in the following conditions:

- constant speed – 80 km/h coasting past the test area
- low speed acceleration
- high speed acceleration
- friction and regenerative braking (see Note 1)

The external noise measured under all operational conditions, and at any time during the pass by, shall be non-tonal such that the L1/3 Oct, max(F) maximum sound pressure level in each unweighted (linear) one-third octave band does not exceed the level of the adjacent bands on both sides as follows:

- by 5 dB or more if the centre frequency of the band containing the tone is above 400 Hz
- by 8 dB or more if the centre frequency is between 160 Hz and 400 Hz:
- by 15 dB or more if the centre frequency of the band containing the tone is below 160 Hz

The external overall unweighted Lmax,F noise level under all operational conditions, and at any time during the pass by, shall not exceed the overall A-weighted LAmax,F noise level by more than 15 dB.

The results of noise tests for locomotives shall be submitted to the EPA for approval. A copy of the EPA approval shall be supplied to TfNSW. The results of noise tests for all other vehicles shall be submitted to TfNSW for approval.

Noise tests of braking shall be conducted:

- on new trains with different combinations of brake rigging and brake block or disc pad material to that already in service
- when the material composition of brake blocks or disc pads is altered

TfNSW reserves the right to request and have noise emission tests carried out by the owner and operator where, in TfNSW's opinion, there is doubt to the vehicle or train complying with the noise limits specified in this document.
6.3.2. **Noise emissions passenger electric multiple unit trains**

All passenger electric multiple unit (EMU) trains detailed below are required to fully comply with the noise emissions requirements in this section:

- all new passenger EMU trains
- any passenger EMU trains which have been substantially modified
- any passenger EMU trains which are new to the rail networks in New South Wales

Passenger EMU trains shall comply with the following noise emission limits for the whole of their operational life:

a) external noise levels shall be measured in accordance with ISO 3095:2013 except where specified otherwise within this standard

b) all noise testing shall be conducted at locations that meet the site, environmental and track conditions of ISO 3095:2013. Moving tests shall be performed on track with concrete sleepers

c) vehicle and equipment conditions shall be in accordance with ISO 3095:2013 except where specified otherwise within this standard

d) for type approval tests, noise levels shall be measured on both sides of the vehicle at a reference distance of 7.5 m from the track centreline and at a height of 1.2 m above the upper surface of the rail, except where specified otherwise within this standard

e) audible warning devices (AWD) may be excluded from the measurements and are to be tested separately against applicable criteria

f) stationary tests shall be conducted in accordance with ISO 3095:2013 Section 5 and include measurements of the following acoustic quantities: LpAeq, LpAFmax, tonality, frequency spectrum and impulsiveness

g) constant speed tests shall be conducted in accordance with ISO 3095:2013 Section 6, at a constant speed of 80 km/h and maximum design speed (Vmax) and include measurements of the following acoustic quantities: LpAeq, LpAFmax, tonality, frequency spectrum and impulsiveness

h) acceleration tests shall be conducted in accordance with ISO 3095:2013 Section 7 and include measurements of the following acoustic quantities: LpAeq, LpAFmax, tonality, frequency spectrum and impulsiveness

i) braking tests shall be conducted in accordance with ISO 3095:2013 and include measurements of the following acoustic quantities: LpAeq, LpAFmax, tonality, frequency spectrum and impulsiveness
j) additional measurements shall be taken as necessary to determine vehicle maximum noise operating condition and noise levels of individual items of equipment

l) for type approval, the resulting measured noise levels shall not exceed the limits specified in Table 8 and Table 9

m) the testing authority shall provide a comprehensive test report in accordance with ISO 3095:2013

n) the complete set of measurements and final test results together with any adjustments shall be documented in the test report which shall clearly indicate the pass or fail status for each result

o) acoustic measurements that are not used in assessing pass or fail for type approval purposes (for example; for reference purposes) may be taken at other distances within the range 7.5 m to 30 m and distance-adjusted to the reference 7.5 m using the following distance-adjustments:

\[
L_{p,D2} = L_{p,D1} + 10 \log (D_1/D_2) \text{ for moving tests}
\]
\[
L_{p,D2} = L_{p,D1} + 20 \log (D_1/D_2) \text{ for stationary tests (except Stationary Maintenance noise tests)}
\]

Where \(D_1\) = noise measurement distance from track centreline in metres, and \(D_2 = 7.5\) m reference distance from track centreline.
### Table 8 - Electric multiple train unit external noise limits (stationary tests)

<table>
<thead>
<tr>
<th>Operating condition</th>
<th>Test condition</th>
<th>Metric</th>
<th>Distance from track centre (m)</th>
<th>Height above top of rail (m)</th>
<th>Measurement</th>
<th>Noise limit - pass / fail criteria (dB(A))</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stationary 1</strong></td>
<td>In accordance with ISO 3095:2013 section 5.4.2 'normal operating conditions' (with additional quantities) refer notes 2 and 3</td>
<td>LpAFmax</td>
<td>7.5</td>
<td>1.2</td>
<td>Noise limit</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LpAFmax</td>
<td>7.5</td>
<td>3.5</td>
<td>Noise limit</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LpAeq, T (where T ≥ 20 s)</td>
<td>7.5</td>
<td>1.2</td>
<td>Noise limit</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LpAeq, T (where T ≥ 20 s)</td>
<td>7.5</td>
<td>3.5</td>
<td>Noise limit</td>
<td>62</td>
</tr>
<tr>
<td><strong>Stationary 2</strong></td>
<td>In accordance with ISO 3095:2013 section 5.4.3 configured to give maximum noise operating condition (refer notes 1, 2, and 3)</td>
<td>LpAFmax</td>
<td>7.5</td>
<td>1.2</td>
<td>Noise limit</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LpAFmax</td>
<td>7.5</td>
<td>3.5</td>
<td>Noise limit</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LpAeq, T (where T ≥ 20 s)</td>
<td>7.5</td>
<td>1.2</td>
<td>Noise limit</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LpAeq, T (where T ≥ 20 s)</td>
<td>7.5</td>
<td>3.5</td>
<td>Noise limit</td>
<td>65</td>
</tr>
<tr>
<td><strong>Stationary 3</strong></td>
<td>In accordance with ISO 3095:2013 section 5.4.3 configured to vehicle presentation (cleaning) mode (refer notes 2, 3, and 4)</td>
<td>LpAeq, T (where T ≥ 20 s)</td>
<td>7.5</td>
<td>1.2</td>
<td>Noise limit</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LpAeq, T (where T ≥ 20 s)</td>
<td>7.5</td>
<td>3.5</td>
<td>Noise limit</td>
<td>59</td>
</tr>
</tbody>
</table>

Tonal noise: See note 5
Impulsive noise: See note 6
### Table 9 - Electric multiple unit train external noise limits (moving tests)

<table>
<thead>
<tr>
<th>Operating condition</th>
<th>Test condition</th>
<th>Metric</th>
<th>Distance from track centre (m)</th>
<th>Height above top of rail (m)</th>
<th>Measurement</th>
<th>Noise limit - pass / fail criteria (dB(A))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant speed tests</td>
<td>In accordance with ISO 3095:2013 section 6 (with additional quantities)</td>
<td>LpAFmax</td>
<td>7.5</td>
<td>1.2</td>
<td>Noise limit</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LpAeq, Tp</td>
<td>7.5</td>
<td>1.2</td>
<td>Noise limit</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Tonal noise</td>
<td>See note 5</td>
</tr>
<tr>
<td>Acceleration tests</td>
<td>In accordance with ISO 3095:2013 section 7 (with additional quantities)</td>
<td>LpAFmax</td>
<td>7.5</td>
<td>1.2</td>
<td>Noise limit</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LpAeq, T</td>
<td>7.5</td>
<td>1.2</td>
<td>Noise limit</td>
<td>80 (see note 7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LpAeq, T</td>
<td>25</td>
<td>3.5</td>
<td>Noise limit</td>
<td>72 (see note 7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Tonal noise</td>
<td>See note 5</td>
</tr>
<tr>
<td>Braking tests</td>
<td>In accordance with ISO 3095:2013 section 8 (with additional quantities)</td>
<td>LpAFmax</td>
<td>7.5</td>
<td>1.2</td>
<td>Noise limit</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LpAeq, T</td>
<td>7.5</td>
<td>1.2</td>
<td>Noise limit</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Tonal noise</td>
<td>See note 5</td>
</tr>
</tbody>
</table>

See note 8
The following are notes referenced in Table 8 and Table 9:

1. Vehicle equipment shall be configured to generate the vehicle maximum noise operating condition. Equipment configured to work at maximum noise condition shall typically include HVAC, compressed air and brake systems, cooling fans, power converters and other major noise contributors. Additional tests shall be conducted by the testing organisation as necessary to determine the vehicle maximum noise operating condition. The Test Report shall include the verification that the vehicle maximum noise operating condition has been characterised.

2. Cyclic intermittent equipment shall be included but AWD may be excluded.

3. For equipment that works intermittently: additional measurements shall be made in accordance with ISO 3095:2013 Section 5.7.

4. Presentation (cleaning mode): vehicle noise state when the vehicle is temporarily out of service for daily cleaning and maintenance with minimal equipment operating (typically low HVAC, power converters for GPO, doors, park brake and so on).

5. Tonal noise assessment: The external noise measured under the operational conditions set out above, and at any time during a pass by, shall be non-tonal such that the $L_{peq,T}$ or $L_{peq,Tp}$ noise level in each unweighted (linear) one-third octave band does not exceed the level of the adjacent bands on both sides as follows:

   a) by 5 dB or more if the centre frequency of the one-third octave band containing the tone is above 400 Hz;
   b) by 8 dB or more if the centre frequency of the one-third octave band containing the tone is between 160 Hz and 400 Hz; and
   c) by 15 dB or more if the centre frequency of the one-third octave band containing the tone is below 160 Hz.

   In accordance with ISO 3095:2013 noise spectra measurements shall be measured in one-third octave bands in the range of at least 31.5 Hz to 8 kHz.

   The external overall unweighted $L_{max,F}$ noise level under all operational conditions, and at any time during the measurement, shall not exceed the overall A-weighted $L_{Amax,F}$ noise level by more than 15 dB.

   For the Acceleration and Braking tests, the tonal noise assessment shall be conducted in two second increments (for example; $T = 2$ s increments) over the entire measurement period ($Tp$). All 2 second increments shall be assessed separately for tonal noise compliance.

6. Impulsive noise assessment: At the measurement position, the A-weighted noise level shall be measured both in Fast response ($L_{pA,F,T}$) and Impulse response ($L_{pA,I,T}$) simultaneously over short equal time intervals, and the difference between these two levels
shall be determined, for example;\( \Delta = L_{p_{AI,T}} - L_{p_{AF,T}} \). Generally, the higher the value of the impulse parameter, the more impulsive the sound is perceived to be. If \( \Delta \) is equal to or greater than 3 dB, then the sound may be classified as impulsive. The measured difference (\( \Delta \)), up to a maximum of 5 dB, shall be added as a correction to the measured time-averaged \( (L_{p_{Aeq,T}}) \) noise level.

The \( L_{p_{AI,T}} \) should only be used to determine whether or not the sound is impulsive or to rate the degree of impulsiveness. It should not be used as a substitute for the time-averaged A-weighted sound level or reported as a sound level measurement, even for sounds that are determined to be impulsive.

7. Acceleration testing distance, \( L_{p_{Aeq,T}} \): It is at the discretion of the testing organisation, to conduct testing at 7.5 m or 25 m in accordance with clause 7.5 or clause 7.6 of ISO 3095:2013 respectively.


The definition of terms used in this section is detailed in Table 10.

### Table 10 - Definitions of metrics used in noise emissions

<table>
<thead>
<tr>
<th>Type of noise assessment</th>
<th>Noise metric</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise limit</td>
<td>( L_{p_{AF_{max}}} )</td>
<td>Maximum A weighted noise level measured in Fast response</td>
</tr>
<tr>
<td>Noise limit</td>
<td>( L_{p_{A_{eq,Tp}}} )</td>
<td>Equivalent continuous A-weighted noise level time-averaged over train passby period ( T_p ) (( T_p ) defined in ISO 3095:2013)</td>
</tr>
<tr>
<td>Noise limit</td>
<td>( L_{p_{A_{eq,T}}} )</td>
<td>Equivalent continuous A-weighted noise level time-averaged over a period ( T ) (where ( T &gt; 20 ) s for Stationary tests or ( T ) = full operation cycle of equipment for Stationary Maintenance tests)</td>
</tr>
<tr>
<td>Tonal noise</td>
<td>( L_{pe_{q,Tp}} )</td>
<td>Equivalent continuous unweighted noise level time-averaged over train passby period ( T_p ) (( T_p ) defined in ISO 3095:2013) for tonal noise assessment</td>
</tr>
<tr>
<td>Tonal noise</td>
<td>( L_{pe_{q,T}} )</td>
<td>Equivalent continuous unweighted noise level time-averaged over a period ( T ) (where ( T &gt; 20 ) s for stationary tests; ( T = T_p ) for constant speed tests; and ( T = 2 ) s increments for acceleration and braking tests)</td>
</tr>
<tr>
<td>Impulsive noise</td>
<td>( L_{p_{AF,T}} )</td>
<td>A-weighted noise level measured in Fast response over a period ( T )</td>
</tr>
<tr>
<td>Impulsive noise</td>
<td>( L_{p_{AI,T}} )</td>
<td>A-weighted noise level measured in Impulse response over a period ( T )</td>
</tr>
</tbody>
</table>

### 6.4. Reporting forms – all vehicles except passenger electric multiple unit trains

The results of noise tests shall be submitted on the ASA standard noise test reporting forms as follows:

- EMS-03-WI-0019 *EPL 12208 DECCW Locomotive Approval*
- EMS-03-FM 0120 *EPL 12208 DECCW Locomotive Approval Declaration*
• Noise Report Requirements Appendix A Spreadsheet

6.5. **Vibration**

Ground borne vibrations shall not exceed 3 mm/sec at 15 m, in accordance with DIN 4150 Part 3 at 15 m from the track centreline on Class 1 track with vehicle operating at any speed within their operational range and at any loading. The test vehicles and test site shall be free of wheel tread and railhead defects and mechanical track joints.

6.6. **Emissions**


Vehicle owners and operators shall consult the EPA, the EPL holder, and TfNSW on the exhaust emission standards that do or will apply to a particular vehicle type, and shall demonstrate compliance with appropriate standards and regulations thereby nominated, prior to operation of the vehicle on the TfNSW network.

Road/rail vehicles shall comply with the *Australian Design Rules* (ADR) emission requirements for road motor vehicles.

6.7. **Waste**

Locomotives and passenger rolling stock shall comply with all the requirements of the POEO 2002 as amended in relation to the discharge, intentional or otherwise, of wastes on the rail corridor.

Owners and operators shall have positive means to prevent spillages (for example: fuel, oil, or coolant) plus manage, contain, and clean-up all environmental incidents resulting from their activities to ensure compliance with all requirements of the POEO 2002 as amended.

Locomotives and rolling stock that are provided with toilets shall be provided with holding tanks and decanting facilities. The toilet system shall not discharge untreated waste to track.

Owners and operators of existing locomotives and passenger vehicles that are fitted with toilets that discharge untreated waste to track shall develop an agreed program to retrofit such vehicles with holding tanks and decanting facilities.

6.8. **Vehicle attachments and loading**

All vehicle attachments such as generator sets, refrigeration units, LPG cylinders and air conditioning units, shall meet all relevant environmental requirements addressed elsewhere in this document and shall comply with the POEO 2002.
All vehicle loads, such as dangerous goods, containers fitted with refrigeration units, and generator sets, shall meet all appropriate regulatory requirements.

Owners and operators of fuel tanks for self contained generator sets, in-line refuelling, and refrigeration units fitted to vehicles or containers shall have positive means to prevent spillages (for example: fuel, oil, or coolant) plus manage, contain, and clean-up all environmental incidents resulting from their activities.

Vehicle owners and operators shall ensure that vehicles used for the transportation of environmentally hazardous loads or loads which present an environmental risk when spilt, are designed, manufactured, operated, and maintained to prevent load spillage.

6.9. **Ecologically sustainable development**

Owners and operators shall ensure that their rolling stock is designed, manufactured, operated, and maintained in accordance with the principles of Ecologically Sustainable Development (ESD) as defined in the *Protection of the Environment Administration Act 1991*.

Owners and operators shall, when designing new rolling stock or substantially modifying existing rolling stock, identify options for maximising energy efficiency and material reuse and recycling, and minimising non-renewable resource consumption, waste generation, water and energy consumption, and greenhouse gas emissions over the full life cycle of the asset.

Owners and operators shall periodically review the environmental impacts resulting from the operation and maintenance of their rolling stock in line with the principles of ESD.
7. Signalling interface – RSU 160

7.1. General

All vehicles and trains operating on the TfNSW network shall satisfactorily operate the existing signalling system or work under block working conditions. Refer to T HR SC 00006 ST Rolling Stock Signalling Interface Requirements.

To ensure the safe operation of all trains within the signalling limits, train braking performance shall not be less than the braking performances specified below.

7.2. Train detection

Tests shall be conducted to ensure that the vehicle or train is effectively detected by the signalling system. The types of signalling systems in use on the TfNSW network are described in T HR SC 00006 ST Rolling Stock Signalling Interface Requirements.

Track maintenance vehicles and road/rail vehicles that operate under special operating conditions do not need to shunt the signalling systems. Refer to T HR RS 00700 ST, Section 9 (RSU 717) for track maintenance vehicles that operate the signal circuits.

Refer to T HR RS 00300 ST, Section 7.2 (RSU 341) for requirements relating to de-sanding equipment.

Light engines, when travelling as a single unit or as a double consist, and one or two car DMU trains shall travel under block working conditions on lines nominated in the Train Operation Conditions (TOC) Manual.

Refer to T HR RS 00200 ST, Section 32 (RSU 295) for signal compatibility tests.

7.3. Signal interference

Tests shall be conducted on vehicles and trains to measure for possible vehicle generated disturbance effects in signalling track circuits, track side processor based signalling systems and equipment, telecommunication cables, and line side telecommunications systems. Refer to T HR RS 00860 ST (RSU Appendix F).

Refer to T HR RS 00200 ST, Section 33 (RSU 296) for signal and communication system interference tests.

7.4. Train braking requirements

The spacing of signals in the TfNSW network is determined by the braking characteristics of an average train for the terrain and track speeds relevant to the signal location.
Refer to T HR SC 00006 ST *Rolling Stock Signalling Interface Requirements* for train stopping distance requirements.

The service and emergency braking performance of all new multiple unit trains shall comply with T HR RS 00600 ST, Section 6 (RSU 641) in dry weather conditions.

The train stop braking distance, as a minimum, shall meet the ‘GE52A - 15%’ braking curve, that is brake distances 15% shorter than GE52A, in all weather conditions. New passenger rolling stock shall meet RSU 641 emergency brake performance for train stop braking distance. Where adhesion levels are less than desirable, an effective wheel slip protection system shall be employed to maximise the use of the available adhesion. The performance in wet weather shall be demonstrated through on track testing. Brake performance curves can be found in T HR RS 00830 ST *RSU Appendix C – Brake Performance Curves*.

Vehicles shall be maintained in a condition such that the braking performance as tested is maintained for the life of the vehicle.

Trains with stopping distances exceeding these limits shall be driven at reduced speeds to provide the ability to stop within the signalling distances.

At some locations ‘advisory speed signs’ have been displayed for XPT trains, Xplorer trains, Endeavour trains, express trains, and freight trains exceeding 1150 m in length. This is to ensure that these trains have sufficient distance to enable them to stop within the required signal spacing.

All vehicles shall be maintained such that braking performance does not deteriorate over time.

### 7.5. Train stops

Currently signals within the greater Sydney metropolitan area bounded by Woodville Junction, Newcastle, Bondi Junction, Cronulla, Lithgow, Richmond, Macarthur, and Bomaderry are fitted with trackside trip equipment.

Multiple unit passenger trains operating predominantly within the above area shall be fitted with trip gear equipment mounted on the left hand leading axlebox of the bogie below each driver’s cab.

Details of the trackside train stops are specified in T HR SC 00006 ST *Rolling Stock Signalling Interface Requirements*.

Trackside train stops are only fitted on the electrified lines. These are not fitted on the metropolitan freight lines.

### 7.6. Signal visibility

It has been conventional practice on existing TfNSW fleets to seat the driver on the left hand side of the vehicle.
The driver in a seated position shall have direct line of sight to the items described below in this Subsection.

Dwarf or ground signalling equipment located at all distances greater than 13 metres from the driver’s eye position and to a width of 2.5 metres from the adjacent rail running face on either side of the track. Refer to Figure 16.

![Figure 16 – Seated dwarf or ground signal visibility](image)

High or gantry signalling equipment located at all distances greater than 13 m from the driver’s eye position at a normal height of 6.7 m above rail level and within a width of two to five metres from the adjacent rail running face on either side of the track. Refer to Figure 17.

![Figure 17 – Seated high or gantry signal visibility](image)
The driver in a standing position shall have direct line of sight to dwarf and ground signalling equipment located at all distances greater than four metres from the driver's eye position and to a width of 2.5 m from the adjacent rail running face on either side of the track. Refer to Figure 18.

![Diagram of signal visibility](image)

**Figure 18 – Standing ground or dwarf signal visibility**

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 shall be accompanied by a second person who is qualified in safeworking.
8. Vehicle recovery interface – RSU 170

8.1. 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.

The owner's and operator's responsibility is to have incident recovery plans in place.

8.2. Lifting brackets

Although this Subsection is intended for freight rolling stock, consideration should be given to providing suitable provisions for lifting and towing functions for passenger rolling stock if considered necessary.

All vehicles should be fitted with lifting brackets to enable the vehicle to be lifted safely without damaging the vehicle.

The lifting brackets shall consist of pairs of vertical plates. TfNSW prefers that these are mounted at the ends of the body bolsters and located to align with bolster web plates. Each pair of lifting plates shall be capable of lifting one half of the mass of the fully laden wagon and be positioned such that they are accessible without causing obstruction. There shall be clearance for shackle swing. Means shall be provided to prevent a straight bar from being simultaneously placed through both lifting holes of a lifting bracket pair. Features to be incorporated in each lifting bracket are shown in Figure 19.

![Figure 19 – Lifting bracket basic dimensions](Reference: ROA Manual of Standards and Recommended Practices, Diagram 8-1)
8.3. **Towing fixtures**

Although this Subsection is intended for freight rolling stock, consideration should be given to providing suitable provisions for lifting and towing functions for passenger rolling stock if considered necessary.

All vehicles shall be fitted with facilities for towing in emergencies. Two emergency towing fixtures shall be attached to each headstock. Refer Figure 20.

![Figure 20 – Emergency towing fixture](image)

8.4. Jacking pads

All vehicles shall be fitted with jacking pads to provide a flat level surface from which a vehicle can be jacked up using jacking equipment.

Jacking pads should be located on the side frames near each corner of the vehicle and at a central location under the coupler at each end of the vehicle. The structure of the vehicle should provide adequate strength for the loaded vehicle to be lifted from any jacking pad.

The location of jacking pads should be clear of restrictions preventing the placement of jacking equipment under the jacking pads.

Figure 21 – Example showing location of jacking pads on bolster

Figure 22 – Example showing side jacking pads on underframe

[Reference: ROA Manual of Standards and Recommended Practices, Diagram 8.2]
8.5. Specialised recovery equipment

In the event of broken wheel, broken axle, seized bearing, or seized drive train the standard recovery method requires the use of a pony bogie.

The owner's and operator's responsibility is to become familiar with the pony bogie and its application as used by the TfNSW Rail Emergency Train Recovery Unit (RETRU) or other emergency response groups.
9. **Automatic equipment identification interface – RSU 180**

All rail bound vehicles shall be fitted with automatic equipment identification (AEI) tags.

The AEI tags shall be in accordance with T HR RS 00880 ST (RSU Appendix H) of this manual.

Road/rail vehicles and infrastructure maintenance vehicles that are transported between worksites by road do not require AEI tags.

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

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AEI tags shall be periodically checked to ensure that they are operable at all times.
10. **Train radio interface – RSU 190**

10.1. **General**

An approved train radio is required on all trains to permit communication between the driver and signallers or train controller or both whilst on the TfNSW network.

Five systems have been used, are currently in use, or are proposed for this train radio function:

- MetroNet (transponder or global positioning system (GPS))
- MetroNet handportable
- digital train radio system (DTRS)
- national train communication system (NTCS)
- CountryNet (now replaced by the NTCS)

Operators and prospective operators should confirm with TfNSW which is the appropriate system for their use, and the timing for introduction of DTRS as the mandatory system.

10.2. **MetroNet train radio system**

MetroNet is a train radio system specially designed to provide communications for high-density train services, such as in metropolitan areas. In general, the system covers the TfNSW network. It provides discrete voice communications between drivers and signallers or between drivers and train controllers.

MetroNet is a single integrated system using over 180 terrestrial base stations in the 408 MHz and 418 MHz frequency bands for all voice and data communications. One frequency from each band is used in each call to permit two-way conversation.

MetroNet is the current primary operating train radio system which provides coverage in the TfNSW network. It will be decommissioned following transition to the DTRS which is expected to be operational by mid 2015.

Operators and prospective operators should confirm with TfNSW which is the appropriate system for their use and the timing for introduction of DTRS as the mandatory system.

10.2.1. **MetroNet on-train equipment**

The MetroNet on-train equipment is installed in electric and diesel power cars. The installation between the two types of power cars is largely the same with the exception that the electric cars use a transponder based system for train position and the diesel cars use a GPS system.
MetroNet on-train equipment mainly consists of the following equipment:

- ruggedised operator handset and loudspeaker
- control head – train drivers user interface
- mobile radio unit
- 408 MHz to 420 MHz low profile “skate” antenna

MetroNet requires signaller area boundary location data to ensure calls are routed to the correct area signaller. Either MetroNet implements location interrogation with a transponder based system or a GPS based system.

### 10.2.2. MetroNet transponder based system

The transponder-based system is commonly referred to as Standard MetroNet.

When trains pass from one signalling or control area to another, the mobile radio normally switches automatically to the new area and is then advised of the frequencies to be used by information contained in the signalling (control) channel. Automatic area change is achieved through an interrogator on the train that activates passive track-mounted transponders, hence known as a transponder based system. Transponders are programmed with signaller area codes and after a train passes a transponder at the signaller boundary, the mobile will switch to the new area code.

In addition to the on-train equipment outlined in Section 10.2.1, trains with a transponder-based system require the following equipment:

- interrogator and reader unit
- under train transponder interrogator antenna

### 10.2.3. GPS MetroNet

GPS based system is commonly referred to as GPS MetroNet.

Trains fitted with GPS MetroNet do not rely on transponders to determine signaller boundary locations. A MetroNet transponder location database is used to store GPS location information and transponder data for every transponder in the TfNSW network. GPS location information is translated into transponder passes and connected to the radio in the same way as the transponder interrogator and reader unit.

A train is fitted with a GPS processor unit, which receives the train current GPS position data at one second intervals from a GPS receiver module. Every position fix is scanned through the transponder location database to build a list of transponders that are within 50 m of the current GPS location. If a transponder is found within 50 m, the GPS Processor unit will send a
“transponder passed” message to the MetroNet mobile radio. The mobile radio processes this message in the same way as in a transponder-based system.

In addition to the on-train equipment outlined in Section 10.2.1, GPS MetroNet requires the following equipment to be installed on rolling stock:

- GPS processor unit (includes GPS receiver module)
- roof mounted GPS antenna and cable

GPS MetroNet is mostly implemented in TfNSW’s passenger diesel fleet due to space constraints for installation of the under train interrogator antenna.

Both transponder and GPS based systems are accepted in the TfNSW network; however, the MetroNet transponder system is preferred.

MetroNet train radio is currently the preferred system for trains captive to the TfNSW network.

The approved MetroNet system is only available from Siemens.

For more details regarding MetroNet train radio system, refer to the MetroNet Equipment Specification TC 00131201 ES.

10.3. **MetroNet handportable train radio system**

MetroNet handportable train radio is appropriate for trains captive to a small section of the TfNSW network and for infrastructure maintenance vehicles.

TfNSW will consider use of MetroNet handportables on a case-by-case basis.

MetroNet handportables, by default, lock onto the strongest radio signal. They therefore may default to the wrong signaller. To avoid this, the driver may have to log onto the MetroNet “area” in which the train is operating.

Drivers shall follow the procedure for identifying themselves on the system at the start of each trip.

The approved MetroNet system is only available from Siemens.

MetroNet is the current primary operating train radio system which provides coverage in the TfNSW network. It will be decommissioned following transition to the DTRS which is expected to be operational by mid 2015.

Operators and prospective operators should confirm with TfNSW which is the appropriate system for their use and the timing for introduction of DTRS as the mandatory system.

10.4. **Digital train radio system (DTRS)**

TfNSW is at an advanced stage of rollout of the GSM-R based digital train radio system (DTRS) which will replace the existing analogue MetroNet train radio system. After the DTRS network is
commissioned, all trains traversing the TfNSW network shall be required to use the DTRS as their primary communications system within the TfNSW network.

The DTRS is expected to be operational by mid 2015, following which the MetroNet train radio system will be decommissioned.

Operators should confirm with TfNSW regarding the appropriate on-train DTRS equipment.

10.5. **CountryNet train radio system**

CountryNet satellite train radio was previously used for trains operating in both the TfNSW network and the Australian Rail Track Corporation (ARTC) network as the lesser preferred alternative to GPS MetroNet. CountryNet is an obsolete train radio system and Australian Rail Track Corporation (ARTC) has replaced CountryNet with their train communications system called the national train communication system (NTCS).

10.6. **National train communication system (NTCS)**

NTCS is a system implemented by ARTC and is designed primarily for use by freight and interstate locomotives for communications with train controllers across the ARTC interstate network. Additionally, freight locomotives are currently able to use the NTCS when operating on the Sydney metropolitan freight network. The NTCS system supports secure voice and data communications between train drivers and train controllers.

NTCS uses Telstra’s NextG network for communications and Telstra’s Iridium satellite network is used for redundancy. Telstra’s NextG network is used for primary communications and if there is no NextG coverage then the system switches over to Iridium satellite.

Trains are required to be fitted with appropriate in-cab communications equipment (ICE) to communicate on NTCS. The ICE is also equipped with a GSM-R module to allow for communications with future GSM-R systems, including the TfNSW Digital Train Radio System, DTRS.

Further details regarding the NTCS system should be sought from ARTC or refer to the NTCS Equipment Specification SPM 0179.

The NTCS system became operational in the TfNSW network in January 2011.