AUSTRALIAN RAIL TRACK CORPORATION LTD

Discipline: Engineering (Rolling Stock) **Category: Standard**

General Interface Requirements

WOS 01.100

Applicability

New South Wales	✓

Primary Source

RIC Standard RSU 100 Series Version 2.0

Document Status

Version	Date Reviewed	Prepared by	Reviewed by	Endorsed	Approved
1.2	29 October 2013	Standards	Stakeholders	Manager Standards	GM Technical Standards 31/10/2013

Amendment Record

Version	Date Reviewed	Clause	Description of Amendment
1.0	07 Dec 05	All	Reformatting to ARTC Standard and combining all 100 Series into one document
1.1	13 Aug 10		WOS 01.160 Signalling Interface superseded by ESD-32-01
1.2	29 Oct 13		Minor editorial updates on front page. Correction of 'Network Applicability'

Contents

WOS 01.100 - Introduction 3
[1] General 3

WOS 01.110 - Rolling Stock Outline Interface 4
[1] Introduction 4
[2] General 4
[3] Authority 4
[4] Standard Rolling Stock Outlines 5
[5] Equivalent Swept Path Rolling Stock Outlines 17
[6] Rolling Stock Outlines Authorised for Operation on a Track Section 18
[7] Special Load Outline Conditions 18
[8] Rolling Stock and Loading Infringements 18
[9] Physical Interface Requirements 24

WOS 01.120 - Track Interface 28
[1] Track 28
[2] P2 Force 28
[3] Platform Clearances 28

WOS 01.130 - Overhead Power Interface 29
[1] General 29

WOS 01.140 - Vehicle to Vehicle Interface 30
[1] General 30

WOS 01.150 - Environmental Interface 31
[1] General 31
[2] Noise 31
[3] Vibration 32
[4] Emissions 32
[5] Wastes 32
[6] Vehicle Attachments and Loadings 32
[7] Ecologically Sustainable Development 32
[8] Interstate Locomotives and Diesel Multiple Unit Trains 33
[9] Old Locomotives 33

WOS 01.160 - Signalling Interface 35

WOS 01.170 - Vehicle Recovery Interface 36
[1] General 36
[2] Specialised Recovery Equipment 36

WOS 01.180 - Automatic Equipment Identification Interface 37
[1] General 37

WOS 01.190 - Train Radio Interface 38

WOS 01.100 - Introduction

[1] General

1.1 Australian Rail Track Corporation has established interface requirements pertaining to vehicles operating on the Australian Rail Track Corporation network. The following are typical examples of where infrastructure and rolling stock interface.

1.2 Various interface requirements allow for vehicles to operate on the track without fouling bridges, tunnels and structures or passing rolling stock.

1.3 Requirements for vehicles dynamics are provided to ensure that vehicles do not cause undue damage to the track.

1.4 Some requirements allow for vehicles belonging to different operators to be coupled and operate together if necessary to clear a section in the case of failure.

1.5 Performance requirements allow for different rolling stock to operate in the same system safely. In particular, train braking performance must be compatible with the current signalling systems.

WOS 01.110 - Rolling Stock Outline Interface

[1] Introduction

1.1 This Rolling Stock Operation Standard describes and details the Rolling Stock Outlines that are authorised to operate on the Australian Rail Track Corporation network. Some corridors are constructed/maintained to a larger Rolling Stock Outline than the vehicles currently authorised for operation on that corridor, in order to provide potential for future business. Refer to the Train Operating Conditions manual for approved areas of operation for vehicle/load types.

1.2 This Rolling Stock Operation Standard aims to control the risk of infringement between vehicle and infrastructure to acceptable levels. This is achieved by setting out the aspects of vehicle design, construction, inspection and maintenance, which in combination with infrastructure design, construction, inspection and maintenance standards together with vehicle operations, affect the clearance between vehicle and trackside features or other vehicles.

1.3 These requirements must be followed by all owner/operators of vehicles operating on the Australian Rail Track Corporation network.

1.4 These requirements are the minimum conditions for the passage of vehicles operating on the Australian Rail Track Corporation network and do not preclude the owner of such vehicles imposing more stringent requirements in terms of design, construction, inspection or maintenance.

[2] General

2.1 There are a number of different Authorized Rolling Stock Outlines in use on Australian Rail Track Corporation track. These are detailed in Section 4. Each track section is categorised for the operation of one or more Authorized Rolling Stock Outlines. These are detailed in Section 6. Only vehicles conforming to one of the Authorized Rolling Stock Outlines for a particular track section, is permitted to operate unrestricted on that section.

2.2 Vehicles built to a Standard Rolling Stock Outline controlling dimensions, including cross-section, bogie centres (or wheelbase for non-bogie vehicles), body overhang, Rolling Stock tolerances and maintained to those dimensions and tolerances, is said to conform to that outline, and thus can be classified as meeting that Authorized Rolling Stock Outline.

2.3 Rolling Stock not built to a Standard Rolling Stock Outline or Rolling Stock tolerances, but under all circumstances, develops an Equivalent Swept Path to one of the Standard Rolling Stock Outlines, is said to conform to that outline, and thus can be classified as meeting that Authorized Rolling Stock Outline.

[3] Authority

3.1 A register of authorised vehicles (Train Operating Conditions Manual) is maintained by the Australian Rail Track Corporation. This register contains details of all vehicle types that are authorized to operate on the Australian Rail Track Corporation network.

3.2 All vehicles listed in the Train Operating Conditions Manual, either complies with the Rolling Stock Outline requirements for unrestricted operation or is identified by exception note for restricted operation.

3.3 Any new vehicle that conforms to a Standard Rolling Stock Outline, according to Section 4, can be classified as meeting that outline.

3.4 Any new vehicle that conforms to an Equivalent Swept Path Rolling Stock Outline, according to Section 5, can be classified as meeting that outline, but only with the approval of the Australian Rail Track Corporation.

3.5 Any item of equipment that is required to physically interface with Infrastructure requires the approval of the Australian Rail Track Corporation.

[4] Standard Rolling Stock Outlines

4.1 General

4.1.1 The Standard Rolling Stock Outlines are based on those outlines applicable to existing vehicles that have been operating on particular sections of track. Historically, vehicles have been constructed to one of the three (3) 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 8.

4.1.2 The following is a list of the names for each of the Rolling Stock Outlines that are authorised for operation on the Australian Rail Track Corporation network, and the outlines on which each is based. No other Rolling stock outlines are permitted.

- Narrow Non-Electric Narrow based
- Narrow Electric Narrow based
- Narrow Square Narrow based
- Narrow Container Narrow based
- Intersystem Narrow based
- Narrow Hopper Narrow based
- Double Stack Narrow based
- Medium Medium based
- Extended Medium Medium based
- Wide Wide based

4.13 A Special Load Outline operates under special conditions on some corridors, as detailed in Section 7.

4.14 An allowable infringement for rubber tyres on road/rail vehicles is detailed in WOS 01.723.

4.2 Description

4.2.1 Section 4.3 details the Standard Rolling Stock Outlines, including their dimensions and corresponding Rolling Stock Tolerances.

4.2.2 For vehicles to conform to a particular Standard Rolling Stock Outline, the following conditions must be met:

(a) The vehicle must not exceed the relevant Standard Rolling Stock Outline at any cross-section, under the following conditions:

(i) New wheel diameter together with tare spring height and the vehicle packed to compensate for future wheel wear, where applicable.

(ii) Condemned wheel diameter, combined with a solid suspension (including fully deflated air springs, where applicable).

(b) The vehicle must have body overhangs equal to, or less than the Standard Rolling Stock Outline.

(c) The vehicle must have bogie centres equal to, or less than the Standard Rolling Stock Outline.

(d) The Rolling Stock tolerances must not be greater than, and be maintained within, the dynamic Rolling Stock tolerances detailed in Section 4.3.2.

4.3 Rolling Stock Dimensions and Tolerances for Vehicle Design

4.3.1 Rolling Stock Cross-Sections, Bogie Centres, and Body Overhangs

(e) The following figures detail the maximum allowable Rolling Stock cross-section at any position along the length of the vehicle, the maximum bogie centres (or axle spacing for non-bogie vehicles), and the maximum overhang past the bogie pivot of any part of the body at, or near, the maximum cross-section. An extension of the Outline is

included for components mounted on the bogie which experience no centre or end throw.

(f) These maximum dimensions only apply when combined with the Rolling Stock tolerances detailed in Section 4.3.2. Vehicles having greater tolerances are required to have lesser dimensions according to Section 5.

(g) These figures also detail some items having Physical Interface Requirements according to Section 9.

"Narrow Non-Electric" Rollingstock
Outline Dimensions

Bogie Centres: 16155 mm
Body Overhang: 3353 mm

Coordinates

Point	Lateral	Vertical
A	0	75
B	940	75
C	940	152
D	1220	152
E	1450	345
F	1450	1120
G	1485	1120
H	1485	3580
I	1250	3916
J	1065	4040
K	760	4190
L	455	4270
M	0	4270

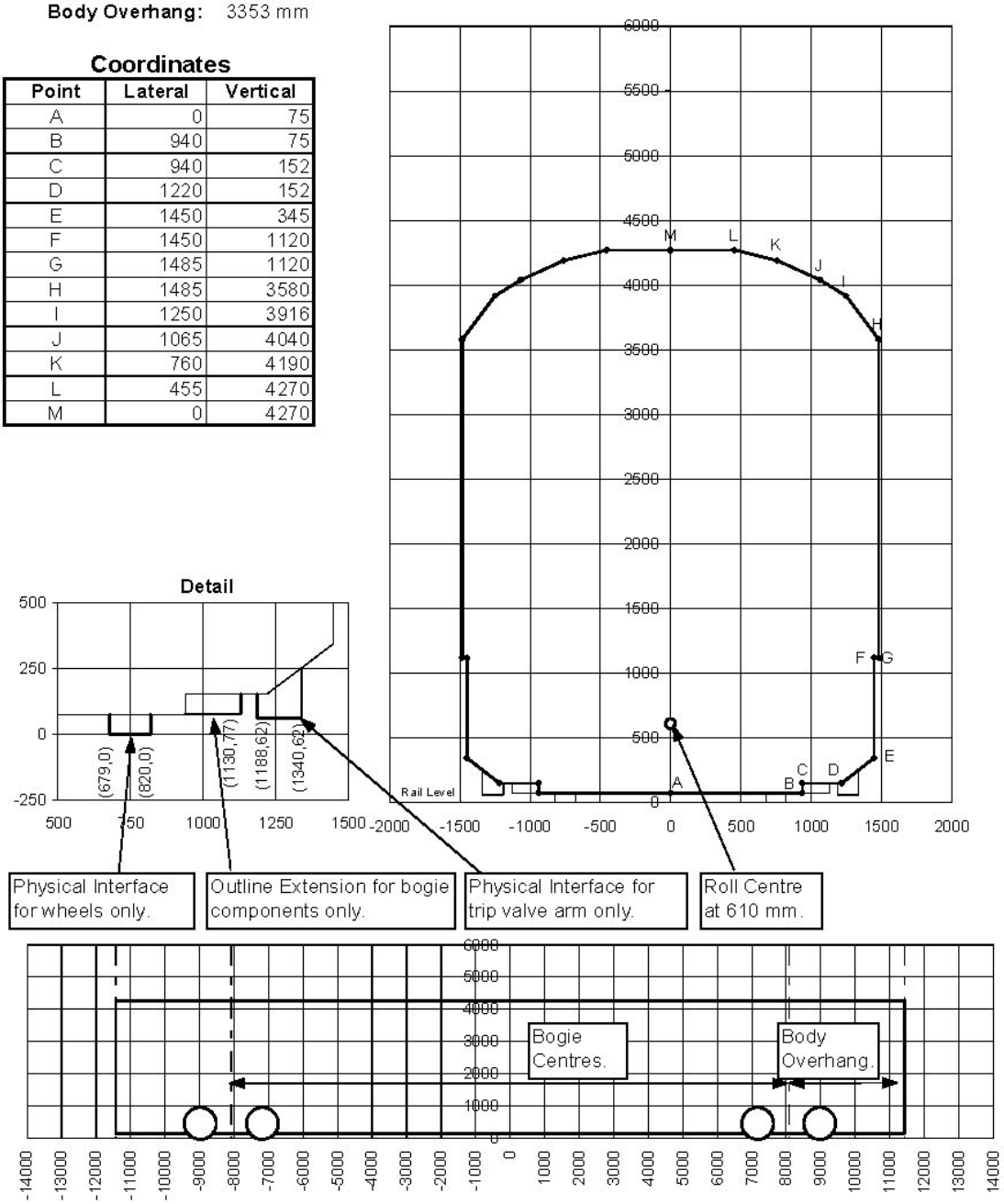


Figure 1

"Narrow Electric" Rollingstock Outline Dimensions

Bogie Centres: 16155 mm
Body Overhang: 3353 mm

Coordinates

Point	Lateral	Vertical
A	0	75
B	940	75
C	940	152
D	1220	152
E	1450	345
F	1450	1120
G	1485	1120
H	1485	3770
I	840	4420
J	0	4420

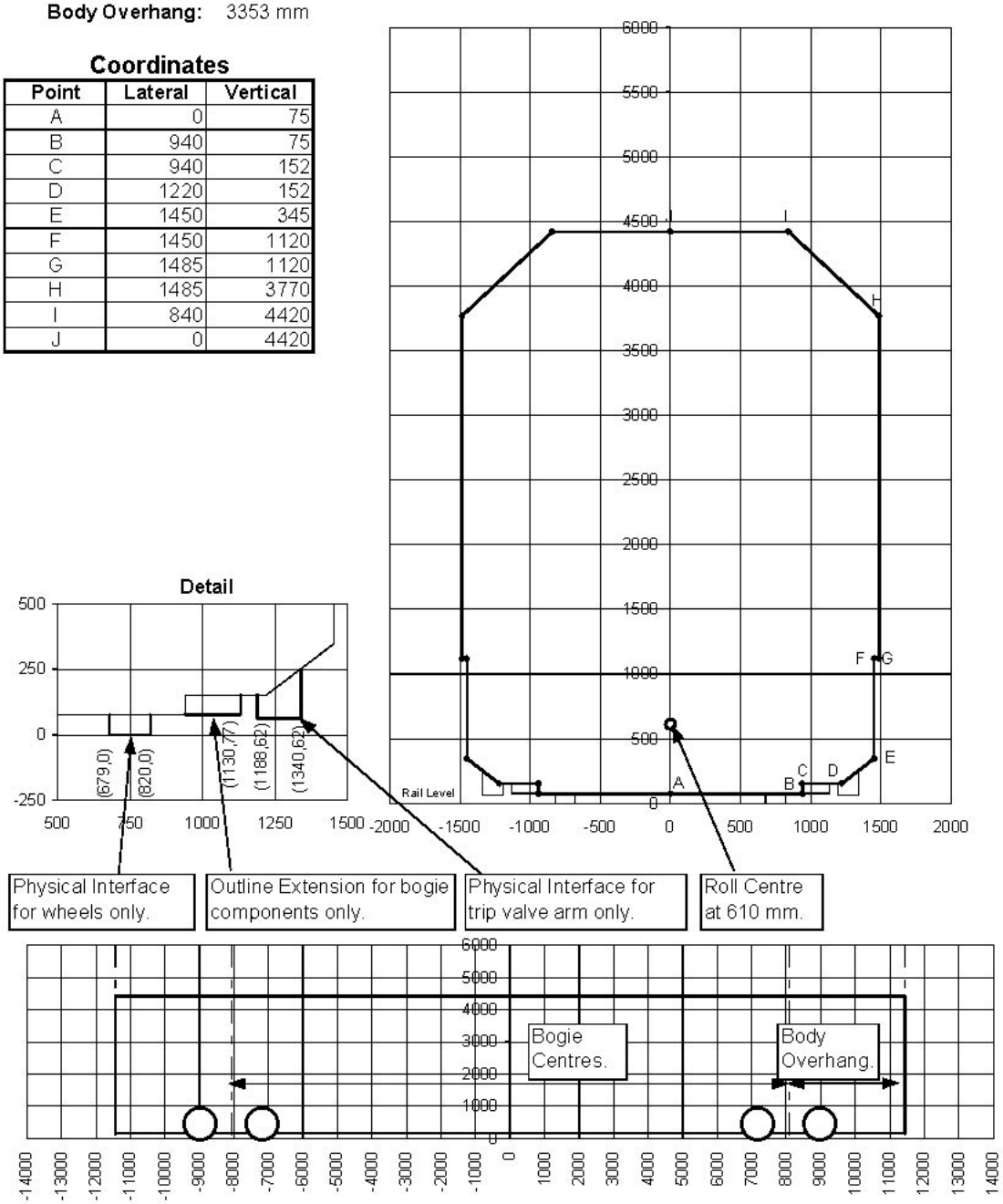


Figure 2

"Narrow Container" Rollingstock Outline Dimensions

Bogie Centres: 17300 mm
Body Overhang: 3603 mm

Coordinates

Point	Lateral	Vertical
A	0	75
B	890	75
C	890	152
D	1170	152
E	1400	345
F	1400	1120
G	1435	1120
H	1435	3580
I	1250	4030
J	710	4190
K	405	4270
L	0	4270

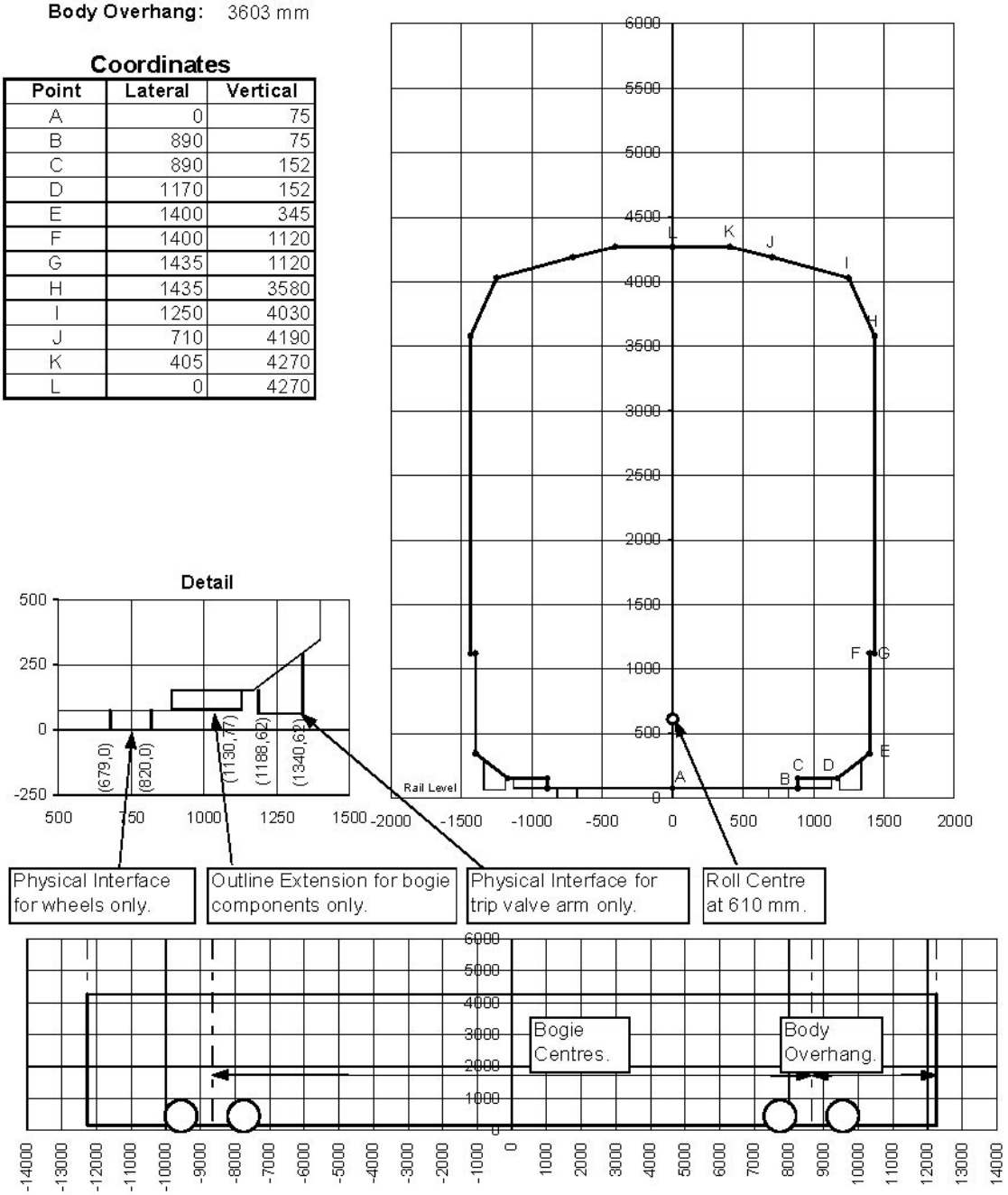


Figure 3

"Narrow Square" Rollingstock Outline Dimensions

Bogie Centres: 16155 mm
Body Overhang: 3353 mm

Coordinates

Point	Lateral	Vertical
A	0	75
B	940	75
C	940	152
D	1450	152
E	1450	1120
F	1485	1120
G	1485	3580
H	1250	3916
I	1065	4040
J	760	4190
K	455	4270
L	0	4270

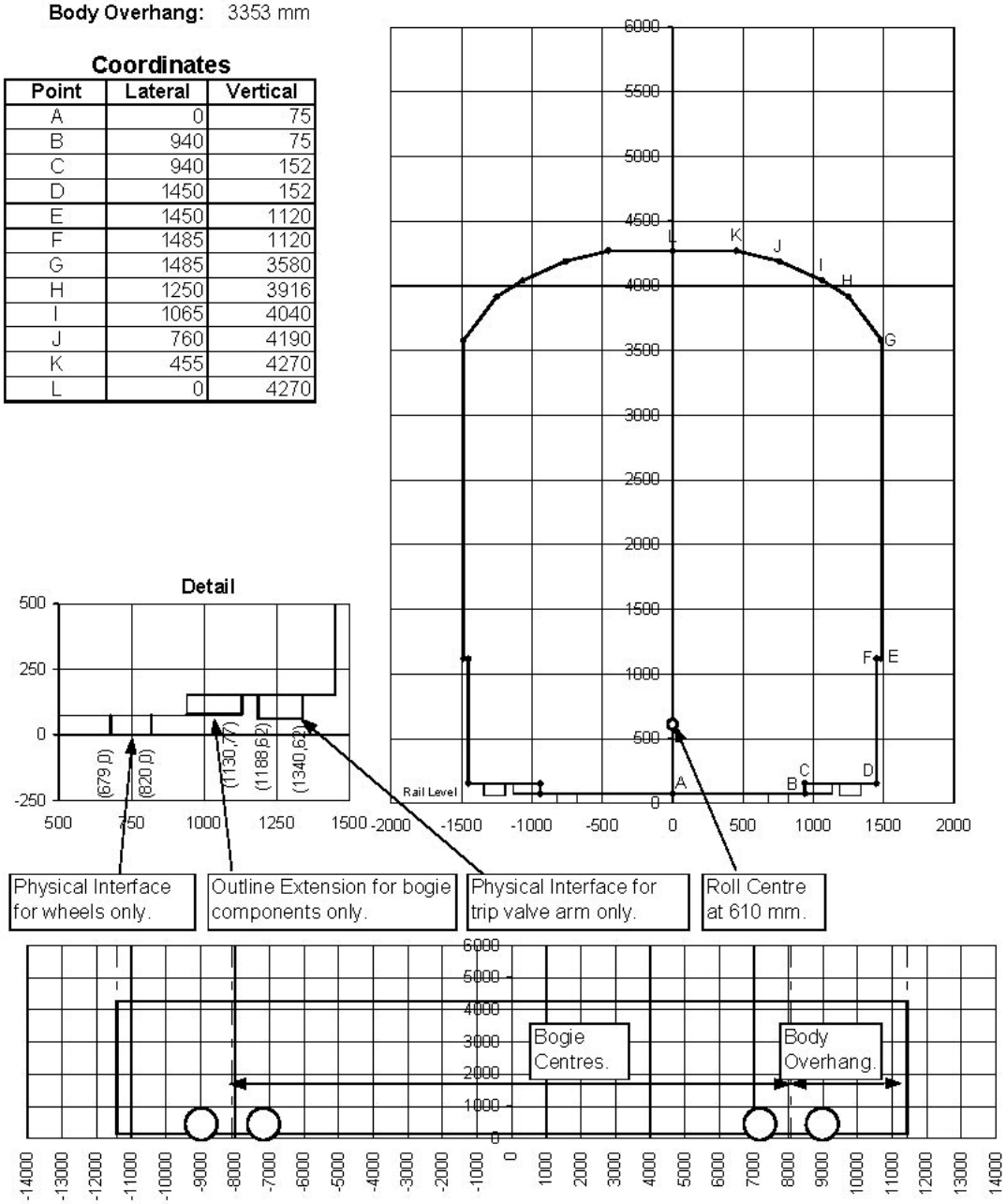


Figure 4

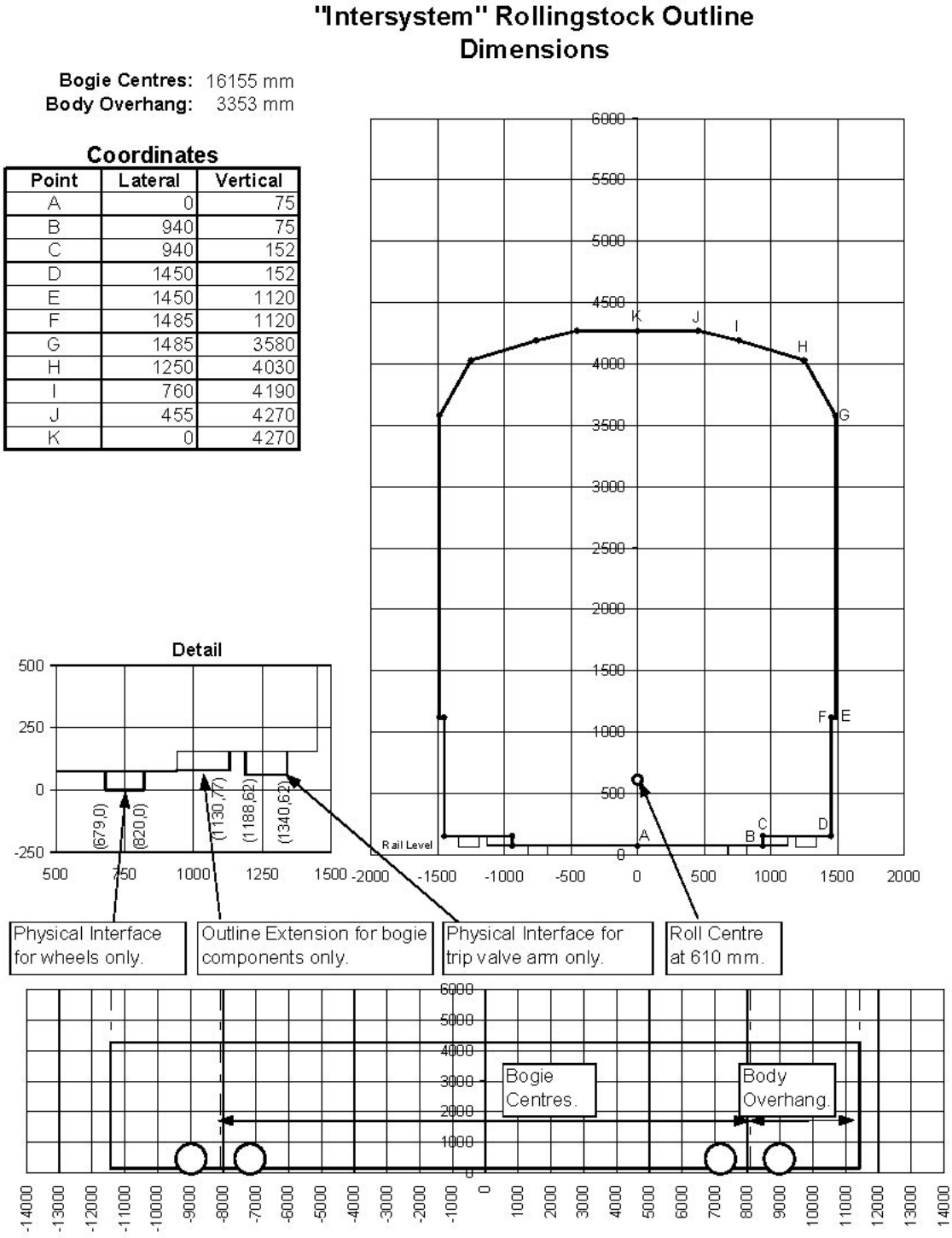

"Intersystem" Rollingstock Outline Dimensions
Bogie Centres: 16155 mm
Body Overhang: 3353 mm
Coordinates
Point | Lateral | Vertical
A | 0 | 75
B | 940 | 75
C | 940 | 152
D | 1450 | 152
E | 1450 | 1120
F | 1485 | 1120
G | 1485 | 3580
H | 1250 | 4030
I | 760 | 4190
J | 455 | 4270
K | 0 | 4270
Detail
(679,0)
(820,0)
(1130,77)
(1188,62)
(1340,62)
Rail Level
Physical Interface for wheels only.
Outline Extension for bogie components only.
Physical Interface for trip valve arm only.
Roll Centre at 610 mm.
Bogie Centres.
Body Overhang.

Figure 5

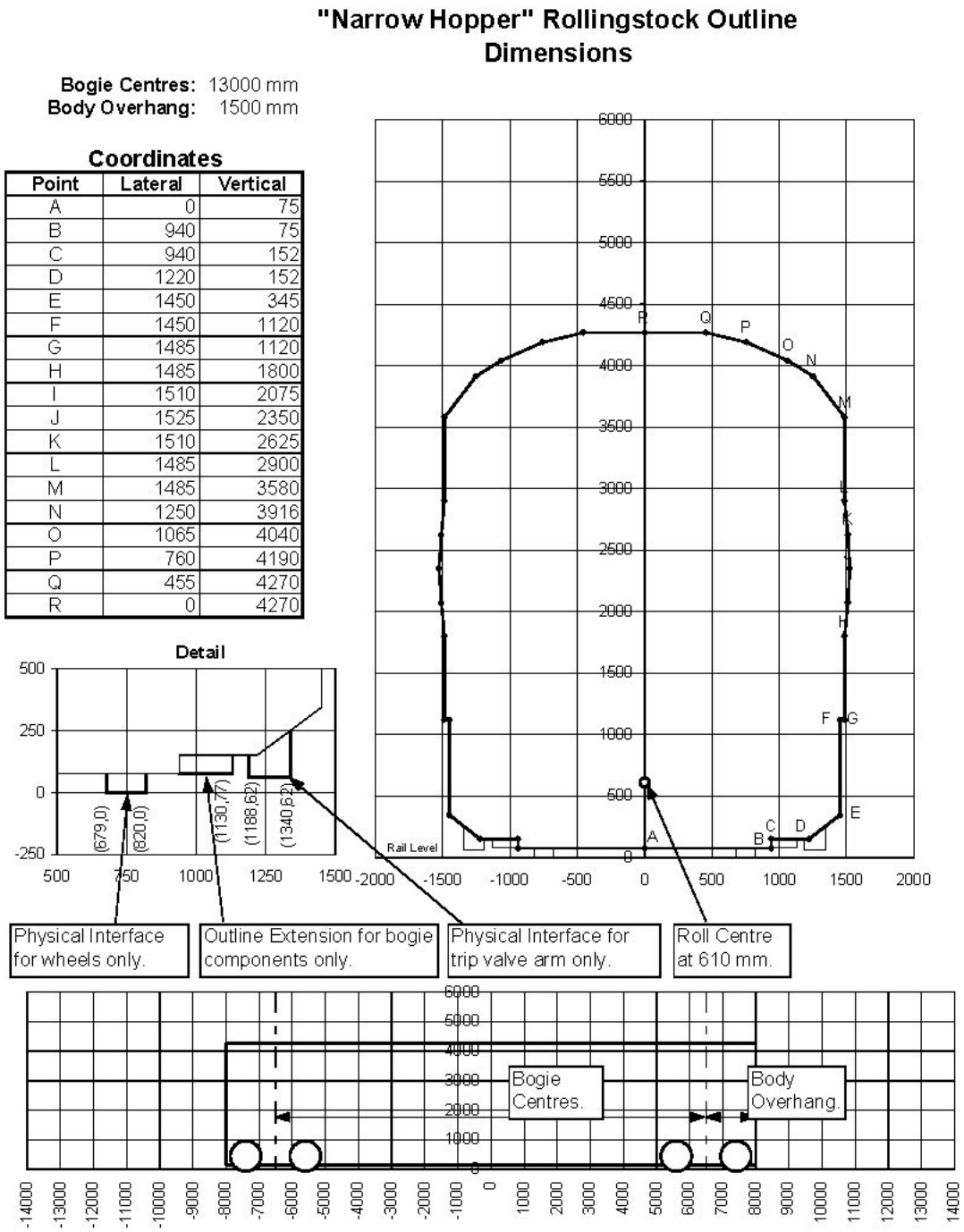

"Narrow Hopper" Rollingstock Outline Dimensions
Bogie Centres: 13000 mm
Body Overhang: 1500 mm
Coordinates
Point | Lateral | Vertical
A | 0 | 75
B | 940 | 75
C | 940 | 152
D | 1220 | 152
E | 1450 | 345
F | 1450 | 1120
G | 1485 | 1120
H | 1485 | 1800
I | 1510 | 2075
J | 1525 | 2350
K | 1510 | 2625
L | 1485 | 2900
M | 1485 | 3580
N | 1250 | 3916
O | 1065 | 4040
P | 760 | 4190
Q | 455 | 4270
R | 0 | 4270
Detail
(679,0)
(820,0)
(1130,77)
(1188,62)
(1340,62)
Rail Level
Physical Interface for wheels only.
Outline Extension for bogie components only.
Physical Interface for trip valve arm only.
Roll Centre at 610 mm.
Bogie Centres.
Body Overhang.

Figure 6

"Double Stack" Rollingstock Outline Dimensions

Bogie Centres: 17300 mm
Body Overhang: 3603 mm

Coordinates

Point	Lateral	Vertical
A	0	75
B	890	75
C	890	152
D	1170	152
E	1400	345
F	1400	1120
G	1435	1120
H	1435	3580
I	1250	5520
J	1250	5850
K	0	5850

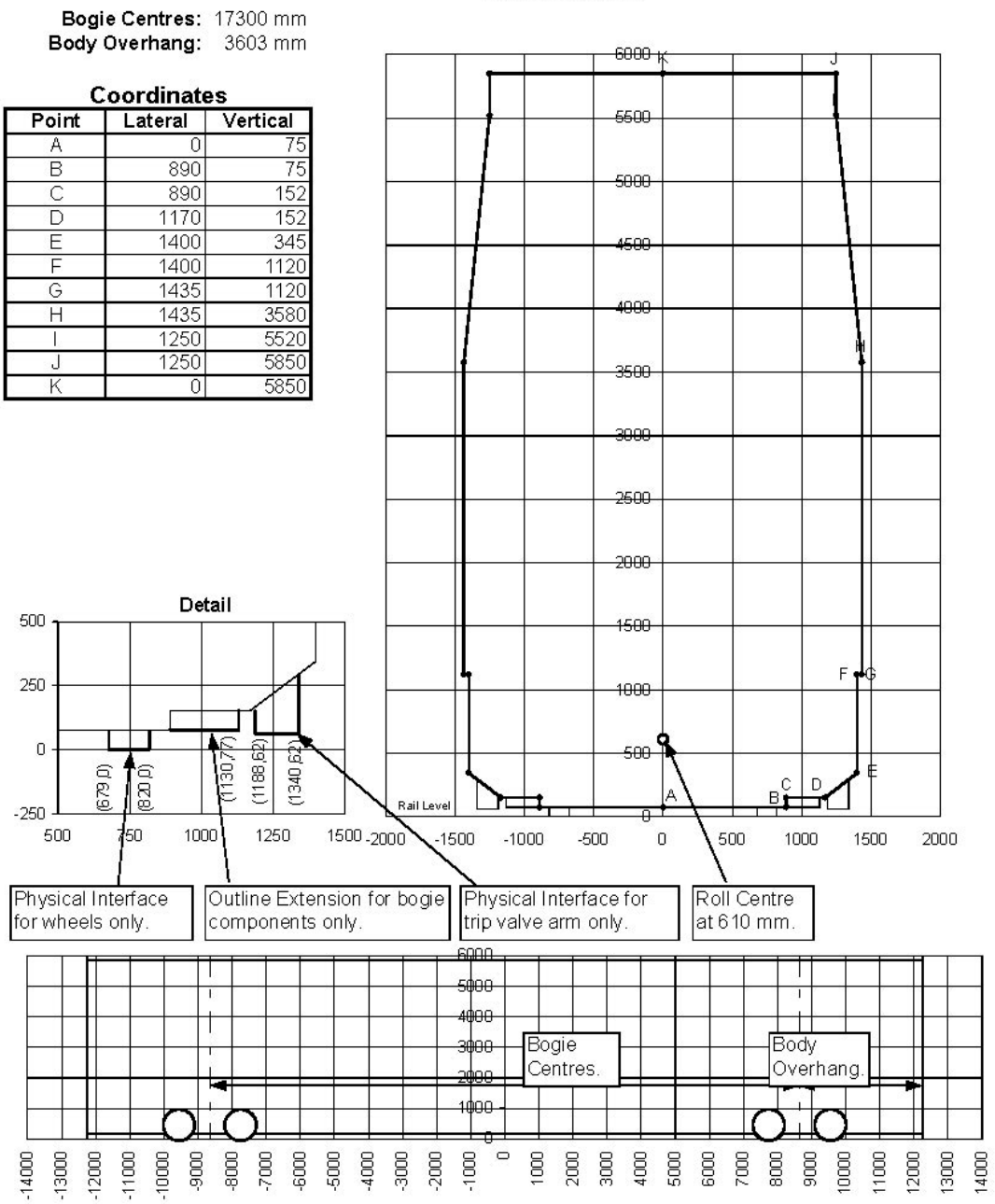


Figure 7

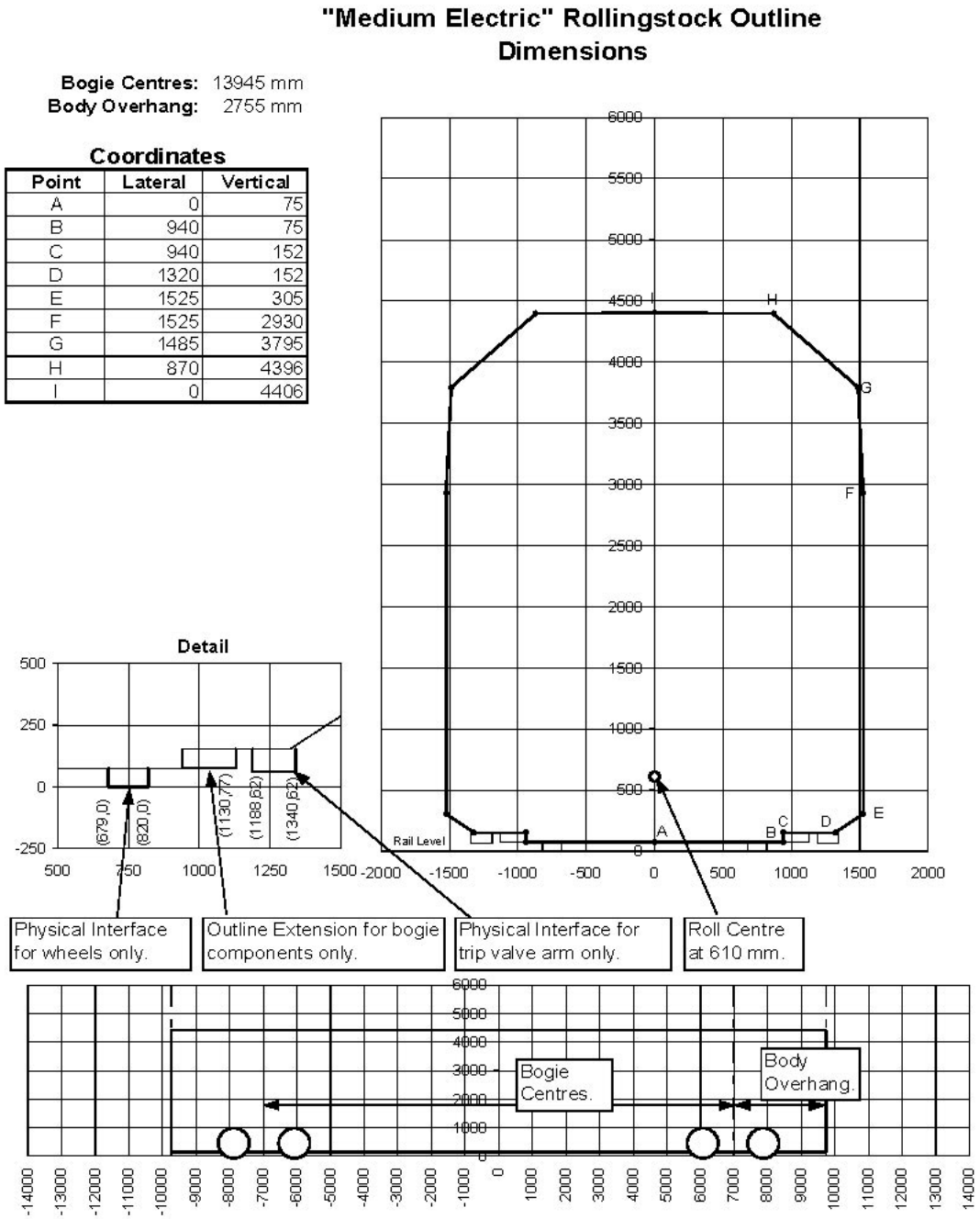

"Medium Electric" Rollingstock Outline Dimensions
Bogie Centres: 13945 mm
Body Overhang: 2755 mm
Coordinates
Point | Lateral | Vertical
A | 0 | 75
B | 940 | 75
C | 940 | 152
D | 1320 | 152
E | 1525 | 305
F | 1525 | 2930
G | 1485 | 3795
H | 870 | 4396
I | 0 | 4406
Detail
Rail Level
Physical Interface for wheels only.
Outline Extension for bogie components only.
Physical Interface for trip valve arm only.
Roll Centre at 610 mm.
Bogie Centres.
Body Overhang.

Figure 8

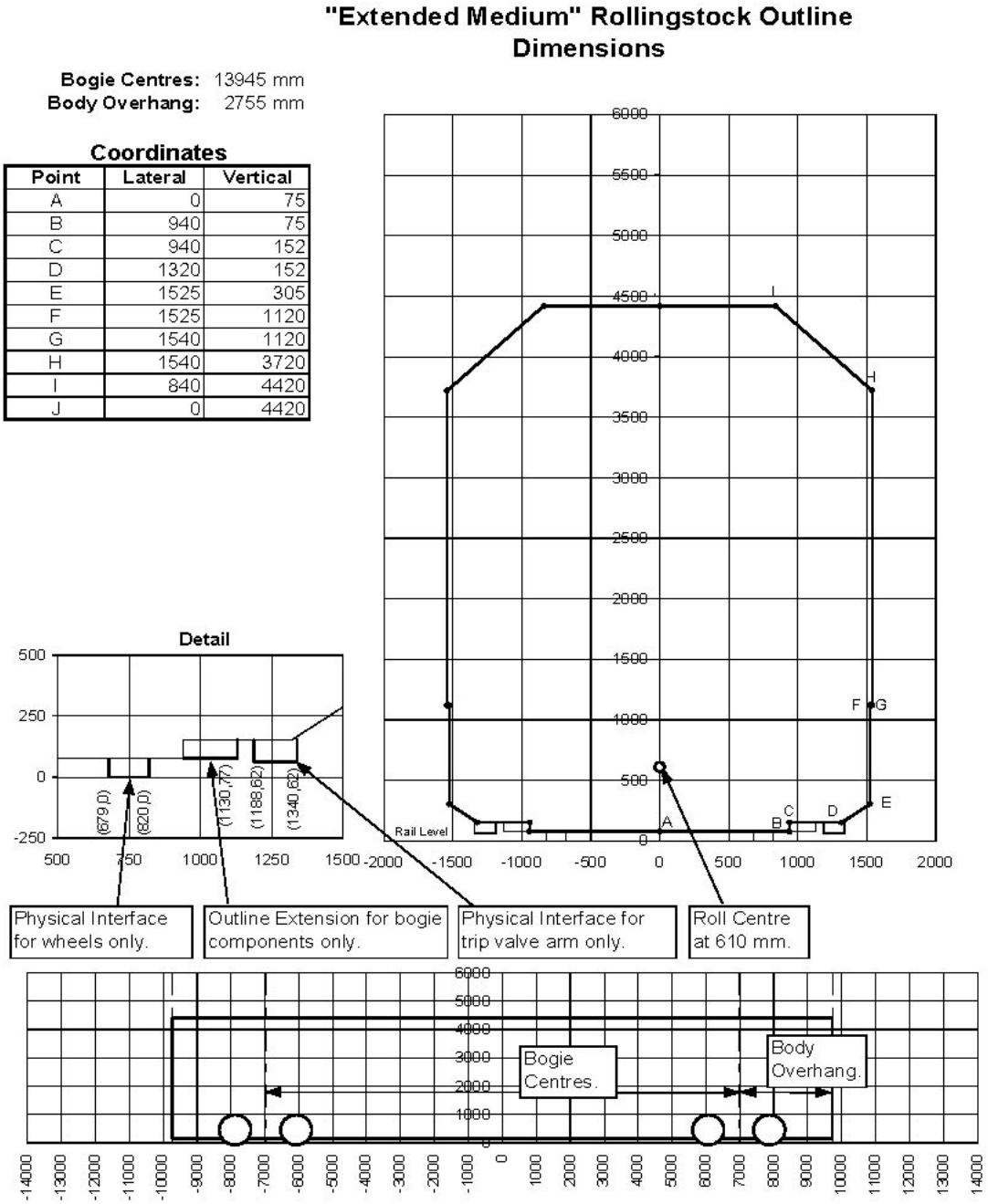

"Extended Medium" Rollingstock Outline Dimensions
Bogie Centres: 13945 mm
Body Overhang: 2755 mm
Coordinates
Point | Lateral | Vertical
A | 0 | 75
B | 940 | 75
C | 940 | 152
D | 1320 | 152
E | 1525 | 305
F | 1525 | 1120
G | 1540 | 1120
H | 1540 | 3720
I | 840 | 4420
J | 0 | 4420
Detail
Rail Level
Physical Interface for wheels only.
Outline Extension for bogie components only.
Physical Interface for trip valve arm only.
Roll Centre at 610 mm.
Bogie Centres.
Body Overhang.

Figure 9

"Wide Electric" Rollingstock Outline Dimensions

Bogie Centres: 13105 mm
Body Overhang: 2998 mm

Coordinates

Point	Lateral	Vertical
A	0	75
B	940	75
C	940	152
D	1320	152
E	1525	305
F	1525	1120
G	1600	1120
H	1600	3660
I	840	4420
J	0	4420

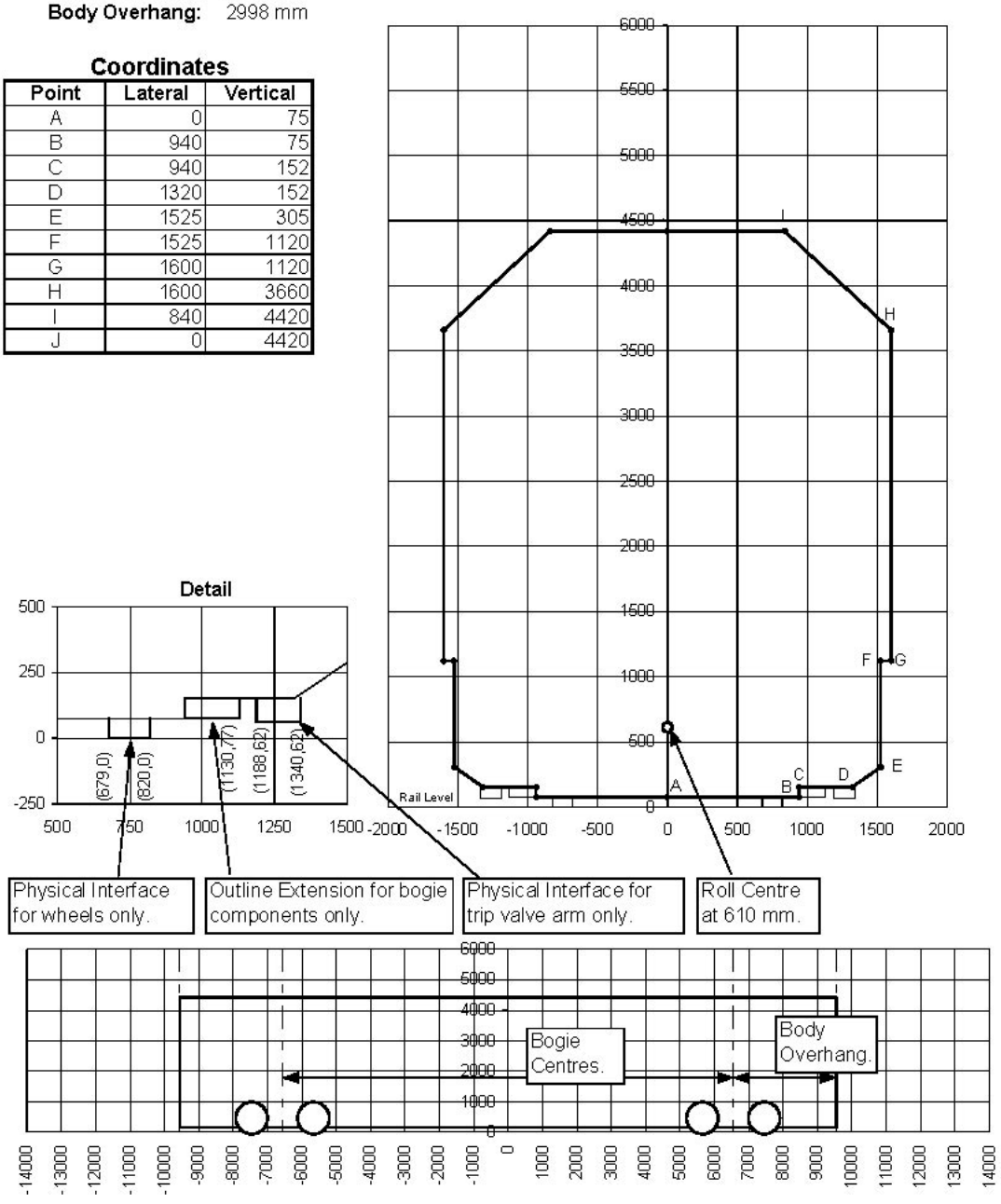


Figure 10

4.4 Kinematic Rolling Stock Outline

The kinematic rolling stock outline is the cross-sectional envelope produced by the applicable rolling stock outline displaced through maximum body roll and lateral movements.

Vehicles shall be designed, constructed and maintained within the limits specified in the following displacements:

4.4.1 Construction and maintenance tolerances must be accounted for in vehicle design such that the final vehicle dimensions do not exceed those prescribed by this standard.

4.4.2 Roll of the vehicle body with respect to the rail plane, about the vehicle roll centre.

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

(a) Bogie centre pin clearance

(b) Secondary suspension lateral clearance

(c) Primary suspension lateral clearance

4.4.4 Lateral displacement between wheelset and rail is made up of the following:

(a) Rail wear, which is controlled by Infrastructure Standards, and **need not be considered** in the Kinematic Rolling Stock Outline.

(b) Wheel flange wear which is controlled by WOS 01.212, Section 4.10, and **need not be considered** in the Kinematic Rolling Stock Outline.

(c) Wheel/rail design clearance which is controlled by Wheel Profiles detailed in WOS 01.211, Section 3.4, and by wheelset back to back dimensions detailed in WOS 01.230, Section (4), and **need not be considered** in the Kinematic Rolling Stock Outline.

Note: If the roll centre is not 610 mm above rail level, the vehicle must be considered under Section (5)

4.5 Absolute Maximum Kinematic Displacements

These displacements represent the maximums allowable. They shall not be exceeded under any theoretical conditions of vehicle design, construction tolerances, field wear, twist, maintenance or suspension displacement.

a)	Roll, body to rail plane	2 degrees
b)	Lateral shift, between body and wheelset	60 mm

[5] Equivalent Swept Path Rolling Stock Outlines

5.1 General

5.1.1 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 larger tolerances and/or a different roll centre height and/or longer bogie centres or a longer body overhang, than that of the Standard Rolling Stock Outline. To achieve this, the vehicle will require a smaller cross-section (or in some cases a smaller rolling stock kinematic displacement allowance).

5.2 Description

5.2.1 For vehicles to conform to a particular Equivalent Swept Path Rolling Stock Outline, the swept path developed by the vehicle must not be larger than the swept path developed by the Standard Rolling Stock Outline at any cross-section, under the conditions of:

(a) New wheel diameter together with tare spring height and the vehicle packed to compensate for future wheel wear, where applicable.

(b) Condemned wheel diameter, combined with a solid suspension (including fully deflated air springs, where applicable).

(c) Curves down to 100m radius.

(d) Maximum rolling stock displacements.

[6] Rolling Stock Outlines Authorised for Operation on a Track Section

6.1 Maps have been published in the Australian Rail Track Corporation's Train Operating Conditions manual to represent the track sections on which some specific Rolling Stock Outlines are authorized to operate.

6.2 These maps relate to areas of operation of Authorized Rolling Stock Outlines only. They do not imply an automatic authorization for a particular vehicle to operate on these track sections.

[7] Special Load Outline Conditions

7.1 General

7.1.1 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.

7.2 Authority

7.2.1 The conditions for the operation of out of gauge vehicles are issued by the Australian Rail Track Corporation.

7.3 Special Conditions

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

[8] Rolling Stock and Loading Infringements

8.1 General

8.1.1 The authorized Rolling Stock Outline for any track section can be infringed in two ways. These are as follows:

(a) Expendable items

(b) Out of gauge loads

8.1.2 No other infringement to the Standard Rolling Stock Outline, or equivalent swept path, will be allowed.

8.1.3 Any part of a vehicle which is outside of its classified Rolling Stock Outline, but has low consequences in the event of an infringement, can be treated as an Expendable Item, according to Section 8.2.

8.1.4 Vehicles or a load that would result in a swept path larger than any authorized Rolling Stock Outline on a track section must be treated as an Out-of-Gauge Load Item according to Section 8.3.

8.1.5 Vehicles or a load which would result in a swept path larger than any authorized Rolling Stock Outline on a track section, which is not being treated as an Out-of-Gauge Load, is considered to be a Foul Load Infringement Item according to Section 8.4.

8.1.6 Some existing vehicles may be operating outside of the requirements of this standard. This is a legacy of the past, and must be controlled in order to minimise risk.

8.2 Expendable Items

8.2.1 Some parts (generally items of equipment attached to the exterior) of vehicles project beyond the Rolling Stock Outline. These items can only be permitted if they are considered, and treated as, Expendable Items. This means that they are in an area of the transit space resulting in an acceptable risk of infringement. By their nature they must have low consequences in the event of contact at speed with infrastructure or other vehicles.

8.2.2 The following are some examples of potentially expendable items:

(a) Mirrors

(b) Blue Lights

(c) Speakers

(d) Handrails (in the designated handrail area only)

(e) Periscopes

(f) Antennae

(g) Roof guttering

8.2.3 It is the responsibility of vehicle owner/operators 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.

8.2.4 **Management**

8.2.4.1 New expendable items cannot be introduced, or existing items modified, such that they occupy an area not already used by a similar expendable item, without the authorization of the Australian Rail Track Corporation.

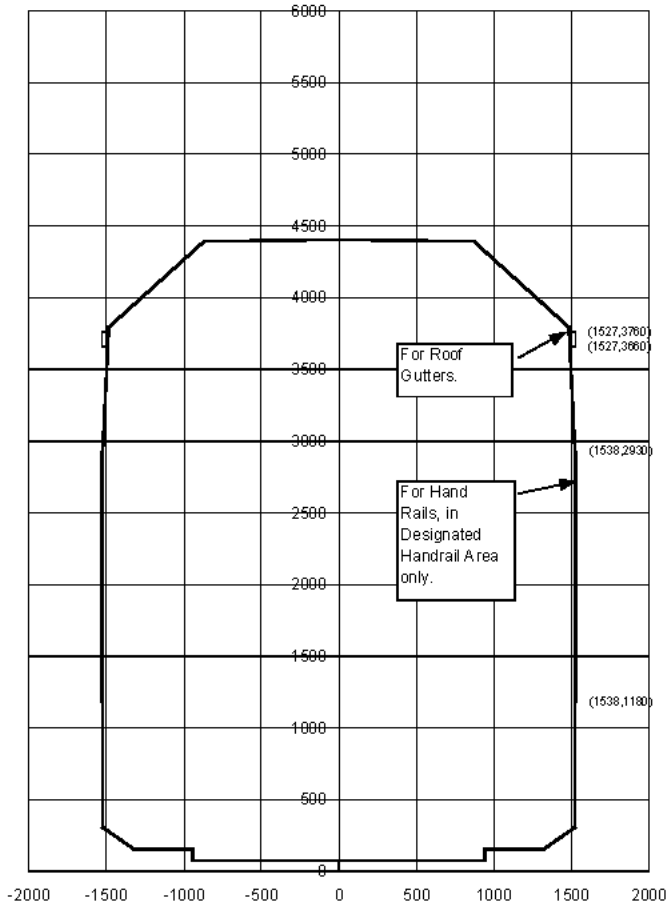
8.2.4.2 The following figure details some existing expendable items.

Expendable Items
Medium Electric Outline

Coordinates

Lateral	Vertical
1525	1180
1538	1180
1538	2930
1525	2930
-1525	1180
-1538	1180
-1538	2930
-1525	2930
1485	3660
1527	3660
1527	3760
1485	3760
-1485	3660
-1527	3660
-1527	3760
-1485	3760

Designated Handrail Area:
= Bogie Centre position ± 2250 mm



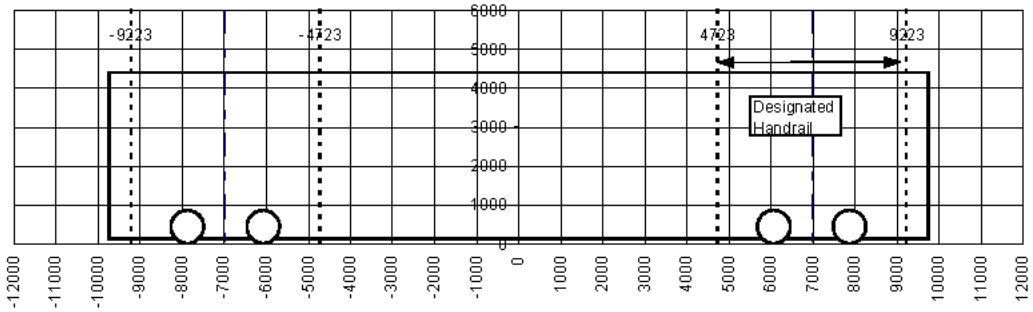


Figure 12

8.3 Out of Gauge Loads

8.3.1 Loads that do not conform to any of the Rolling Stock Outlines in this Rolling Stock Operation Standard are termed Out of Gauge Loads.

8.3.2 Authority to move any out of gauge loads can only be granted by the Australian Rail Track Corporation.

8.3.3 Out of gauge load movements are treated as specific movements and special operating conditions will apply. These special conditions are determined by the Australian Rail Track Corporation.

8.3.4 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.

8.3.5 Special and out of gauge loads are usually accompanied by a representative of the Australian Rail Track Corporation.

8.4 Foul Load Infringements

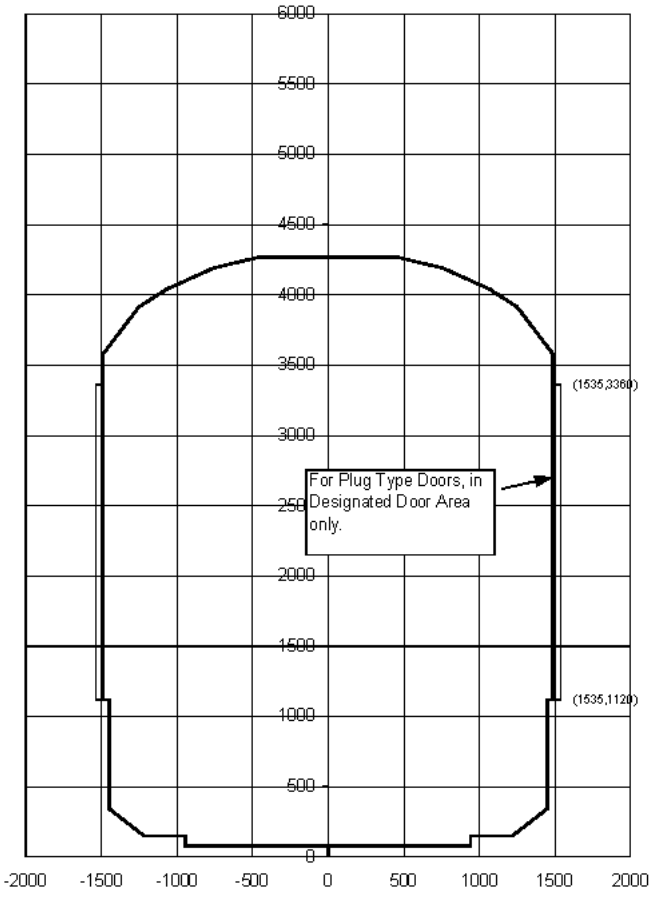
8.4.1 Loads identified as being foul must not be moved, and must immediately be brought to the attention of the local train control. Special authority will be arranged to deal with the situation, or special operating conditions will be placed on the vehicle.

8.4.2 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 authorized 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, existing special operating conditions can be applied, as per Tangara.

Existing Foul Load Infringements
Narrow Non-Electric Outline

Coordinates

Lateral	Vertical
1485	1120
1535	1120
1535	3360
1500	3360
-1485	1120
-1535	1120
-1535	3360
-1500	3360



Designated Door Area:
= Vehicle Centre line
+ 7377.5 mm to + 11132.5 mm

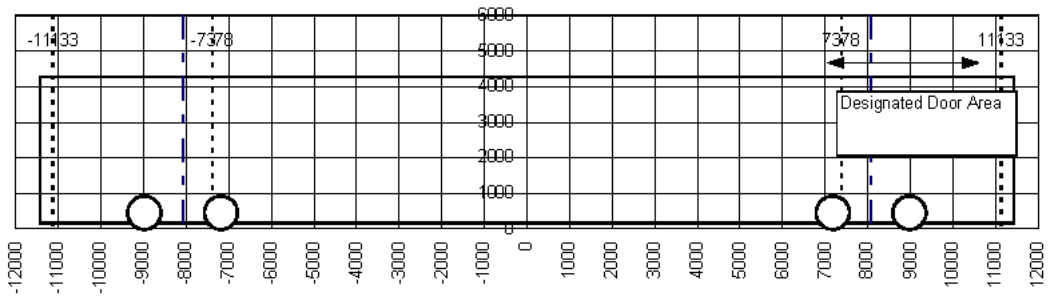


Figure 13

Existing Foul Load Infringements
Medium Electric Outline

Coordinates

Lateral	Vertical
1525	1120
1585	1120
1585	3360
1500	3360
-1525	1120
-1585	1120
-1585	3360
-1500	3360

Designated Door Area:
= Vehicle Centre line
+ 3195 mm to + 7865 mm

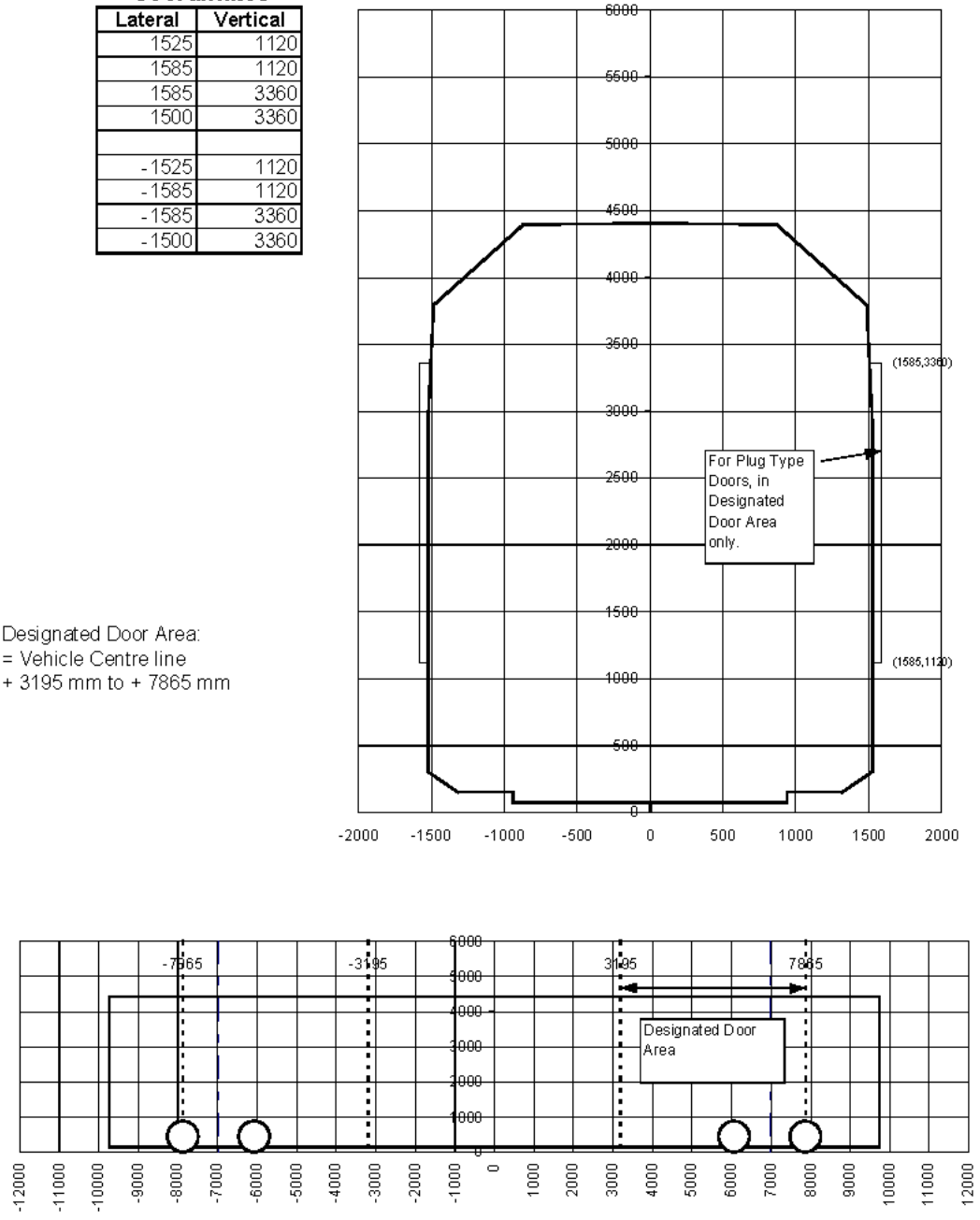


Figure 14

[9] Physical Interface Requirements

9.1 General

9.1 Portions of vehicles that are required to physically interface with Infrastructure are permitted to be outside the Rolling Stock Outline. These items can only be approved by the Australian Rail Track Corporation.

9.2.1 Items currently requiring physical interface include:

a)	Trip Valve Arms	This interface is detailed in the Section 4.3.1
b)	Wheels	This interface is detailed in the Section 4.3.1
c)	Pantographs	This interface is detailed in the Section 9.2

9.2 Pantograph

9.2.1 When in the lowered position, all parts of the pantograph must fit within the Rolling Stock outline, detailed in Section 4.3.1.

9.2.2 The following figures detail the maximum allowable pantograph head dimensions and minimum free height when fully extended, and the designated pantograph head position area along the vehicle. All other pantograph equipment must remain below, and narrower than the pantograph head.

9.2.3 These maximum dimensions only apply when combined with the Rolling Stock tolerances detailed in Section 4.3.2 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 according to Section 5.

9.2.4 These maximum dimensions only apply when combined with the maximum upward thrust detailed in WOS 01.130.

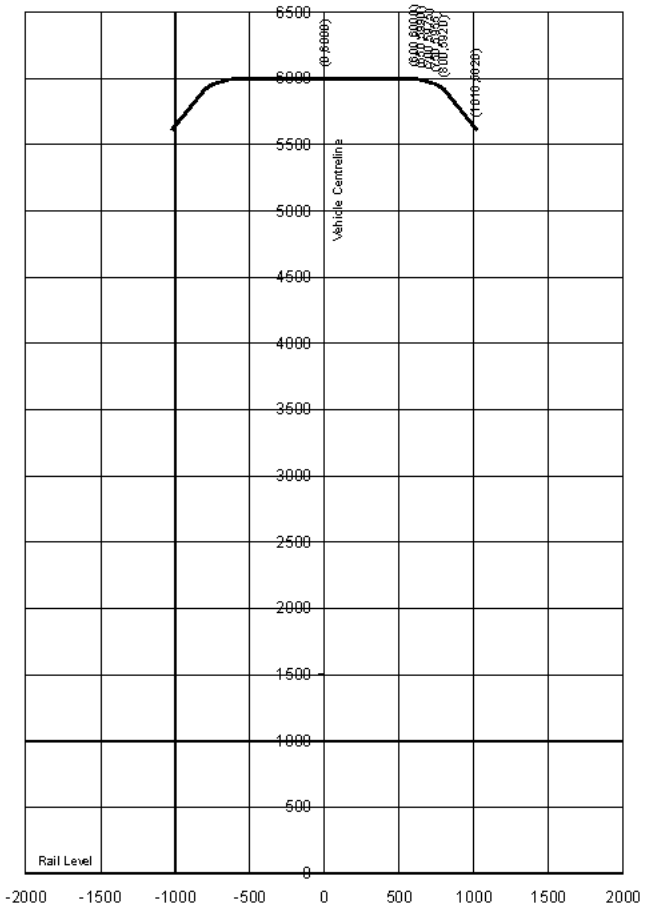
9.2.5 Vehicles having pantographs of lesser dimensions than the maximum, or pantographs mounted outside of the designated area, may fail to maintain contact with the wire. This is outside the scope of this Rolling Stock Operation Standard.

Passenger

Coordinates

Lateral	Vertical
0	6000
600	6000
650	5990
700	5975
750	5955
800	5920
1016	5620

Designated Pantograph Area:
= Bogie Centre position ± 1000 mm



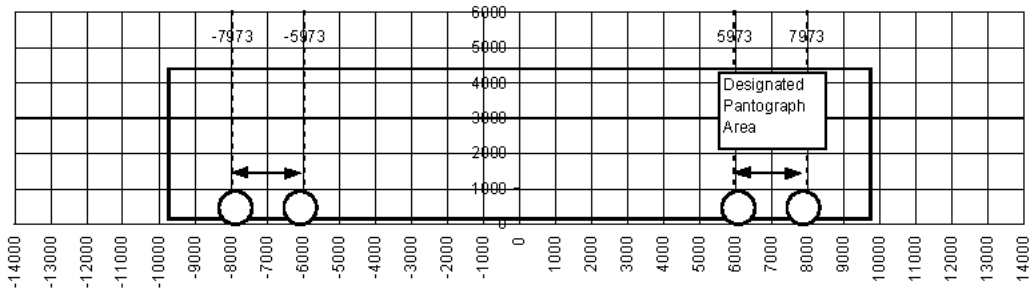
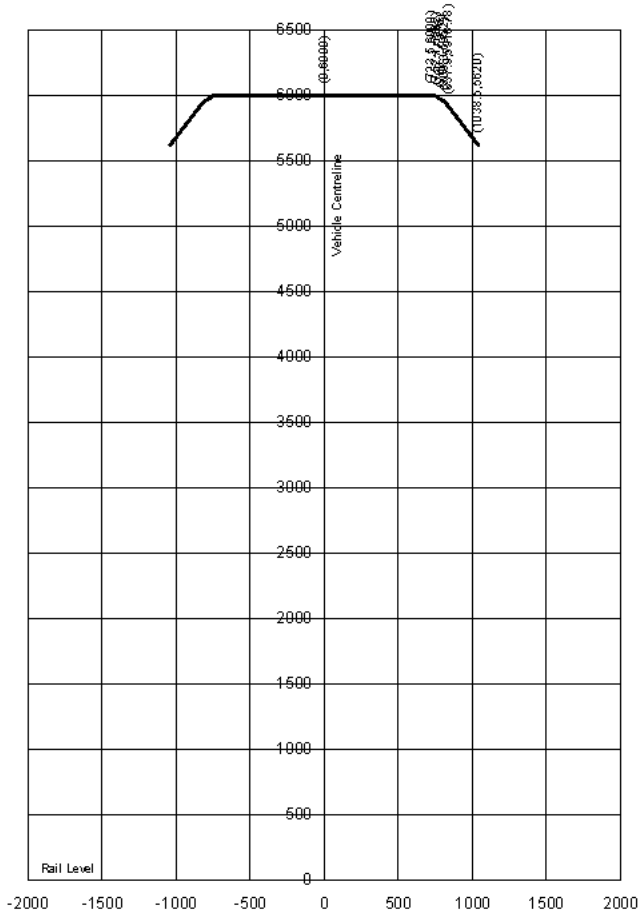


Figure 15

Locomotive 1

Coordinates

Lateral	Vertical
0	6000
724	6000
752	5992
781	5976
809	5952
838	5919
1039	5620



Designated Pantograph Area:
= Bogie Centre position ± 1000 mm

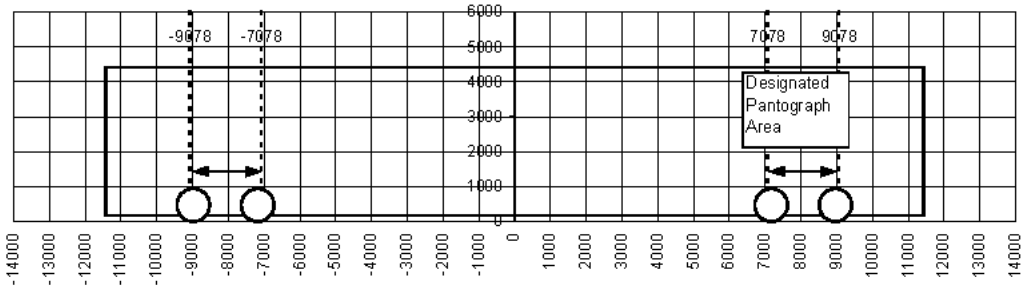


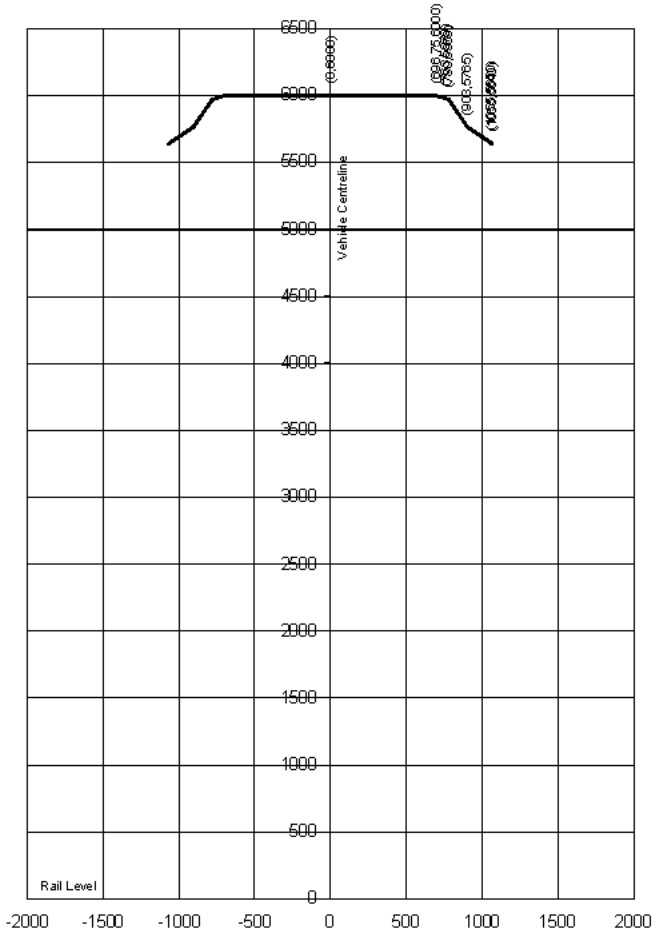
Figure 16

Locomotive 2

Coordinates

Lateral	Vertical
0	6000
697	6000
763	5979
780	5969
903	5765
1055	5650
1065	5640

Designated Pantograph Area:
= Bogie Centre position ± 1000 mm



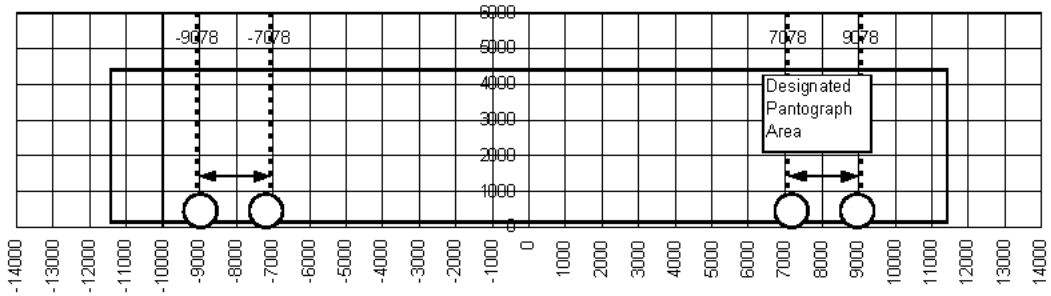


Figure 17

WOS 01.120 - Track Interface

[1] Track

1.1 The normal design and absolute limits for main line track geometry are specified Australian Rail Track Corporation Infrastructure Engineering Manual TDS 09 - Mainline Track Geometry.

1.2 Refer to TDS 06 for design of sidings.

[2] P2 Force

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

Track Class	Max P2 Force Locomotives (kN)	Max P2 Force Other Rolling Stock (kN)	Equivalent Track Stiffness Kt (MN/m)	Equivalent Track Damping Ct (kNs/m)	Equivalent Track Mass Mt (kg)
1XC	295	230	117	56	338
1X	295	230	117	56	151
1C	295	230	110	52.5	310
1	295	230	110	52.5	135
2	230	230	100	48	117
3	200	200	95.8	45.9	106
4	180	180	90.3	43.2	95
5	130	130	83.6	40	85

$$P_2 = P_0 + 2\alpha . v \left[\frac{M_u}{M_u + M_t}\right]^{\frac{1}{2}} x \left[1 - \frac{C_t \pi}{4[K_t(M_u+M_t)]^{\frac{1}{2}}}\right] x \left[K_t M_u\right]^{\frac{1}{2}}$$

Where:

P_2 = Force (kN)

P_0 = Vehicle static wheel load (kN)

M_u = Vehicle unsprung mass per wheel (kg)

2α = Total joint angle, 0.014 radians

v = 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] Platform Clearances

3.1 For platform clearances refer to ARTC Infrastructure Engineering Manual TS 00 00 00 00 TM Civil Engineering Specification BDS 16.

WOS 01.130 - Overhead Power Interface

[1] General

1.1 The requirements for the interface between the electric rolling stock and the overhead electric power supply is specified in Appendix E Specification for 1500V dc traction supply (WOS 01.E).

1.2 Vehicles that may operate in electrified areas must have an electrical safety inspection as specified in WOS 01.294.

1.3 Where appropriate, vehicles operating under the overhead wiring shall display suitable high voltage warning signage.

WOS 01.140 - Vehicle to Vehicle Interface

[1] General

1.1 For multiple unit locomotive coupling compatibility, the location of end equipment on locomotives shall be in accordance with Diagrams 13.12 and 13.13 of the ROA Manual of Engineering Standards and Practices.

1.2 The location of end equipment on locomotive hauled vehicles shall be in accordance wit the ROA Manual of Engineering Standards and Practices, Diagrams 7.12 or 7.13, unless otherwise approved by the Australian Rail Track Corporation. For vehicles fitted with main reservoir and/or independent brake the type and location of hoses should b such that they couple with locomotives and other vehicles.

1.3 Automatic couplings for locomotives and locomotive hauled vehicles shall conform to the requirements of Section 9 of the ROA Manual of Engineering Standards and Practices unless otherwise approved.

1.4 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 must be provided to interface mechanically with the standard AAR 10A contoured coupler and brake pipe and main reservoir air brake coupling hoses.

1.5 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 200m. Refer to WOS 01.285 for minimum curve radii for end equipment clearance requirements.

1.6 When vehicles are fitted with drawbars, buffers, buffer beams, gangway beams, or transition lugs, these shall be compatible in height and loading and under conditions of curving or dynamics they must not be capable of fouling or locking together. Refer to WOS 01.120 for minimum track standards.

1.7 Diaphragms fitted to the ends of vehicles must be compatible with adjacent coupled vehicles to ensure there is no fouling or locking together.

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

1.9 Coupler height shall be within the following limits:

Locomotives:

New condition, full provisions	880 to 890mm
In service condition	840 to 900mm

Freight Vehicles:

New condition	870 to 880mm
In service condition	780 to 915mm

Passenger Vehicles:

New condition	890 to 900mm
In service condition	875 to 915mm

WOS 01.150 - Environmental Interface

[1] General

1.1 Each vehicle shall comply with all legislative environmental requirements, including those relating to exhaust emissions, noise, waste removal and handling of fuel.

1.2 Vehicle owner/operators must consult with the Environment Protection Authority and the Australian Rail Track Corporation on the environmental standards that do or will apply to a vehicle type, and shall demonstrate compliance with the appropriate standards and regulations thereby nominated, prior to operation of the vehicle on the Australian Rail Track Corporation network. The same environmental standards will apply to the same vehicle type, irrespective of the owner/operator, except where a vehicle type has been substantially modified from its original configuration.

1.3 Owners/operators shall minimize all relevant environmental problems generated from rolling stock with the BATNEEC (Best Available Techniques Not Entailing Excessive Costs) principal.

1.4 Owners/operators must comply with the Environmental Protection Licence No. 3142 with respect to maintenance of plant and equipment.

[2] Noise

2.1 All rolling stock should comply with the noise requirements of the Protection of the Environment Operations Act 1997 as amended and the objectives of the Environment Protection Licence No. 3142.

2.2 Noise emissions shall not exceed 85 dB(A) for new or existing rolling stock, other than locomotives, when operating at a speed of 80 km/h and measured at 15 metres from the track centreline in accordance with the conditions as specified in Australian Standard 2377, Methods for the Measurement of Airborne Sound from Railbound Vehicles. Where wheel tread defects are present and result in non-compliance with the 85 dB(A) limit, this limit does not apply.

2.3 For locomotives and diesel multiple unit trains, noise emissions shall not exceed the following noise limits:

2.3.1 70 dB(A) at the 15 metre contour, when stationary and idle, with the compressor, radiator fans and air conditioning operating at maximum load occurring at idle.

2.3.2 87 dB(A) and 95 dB Linear at the 15 metre contour, when stationary and operating at all throttle settings, other than idle, under self load with the compressor, radiator fans and air conditioning operating.

2.3.3 87 dB(A) and 95 dB Linear, when operating under all service conditions, at speeds between 0 and 50 km/h, and when measured 15 metres from the track centreline in accordance with the conditions as specified in Australian Standard 2377, Methods for the Measurement of Airborne Sound from Railbound Vehicles. Where wheel tread defects are present and result in non-compliance with the 87 dB(A) or 95 dB linear limits, these limits do not apply.

2.4 Additionally, the presence of any significant tonal component, recorded whilst under any operating condition, shall not be permitted to exceed the following:

2.4.1 No third octave band below 160 Hz is to exceed 15 dB(A) above the average of the two adjacent bands.

2.4.2 No third octave band in the range 160 Hz to 400 Hz is to exceed 8 dB(A) above the average of the two adjacent bands.

2.4.3 No third octave band above 400 Hz is to exceed 5 dB(A) above the average of the two adjacent bands.

2.5 In addition, unless otherwise stated, the overall linear noise level shall not exceed the overall A-Weighted noise level by more than 15 dB.

2.6 Vehicle owner/operators shall ensure that their fleet is maintained to a standard such that, for each vehicle type, at least 85 percent of those vehicles comply with the noise limits specified in Clauses 2.2 or 2.3.3, as appropriate, irrespective of wheel condition.

[3] Vibration

3.1 Ground borne vibrations shall not exceed the requirements of DIN 4150 Part 3 at 15m from the track centreline on Class 1 track with vehicle operating at any speed within their operational range and at any loading. The test site shall be free of rail head defects and mechanical track joints.

[4] Emissions

4.1 Vehicle exhaust emissions shall comply with the requirements of the Protection of the Environment Operations Act 1997 as amended.

4.2 Vehicle owner/operators must consult with the Environment Protection Authority and Australian Rail Track Corporation 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 Australian Rail Track Corporation network.

[5] Wastes

5.1 Locomotives and passenger rolling stock shall comply with all the requirements of the Protection of the Environment Operations Act 1997 as amended in relation to the discharge, intentional or otherwise, of wastes on the rail corridor.

5.2 Owner/operators shall have positive means to prevent spillage of fuel, oil or coolant to ensure compliance with all requirements of the Protection of the Environment Operations Act 1997 as amended.

5.3 Locomotives and rolling stock that are provided with toilets shall be provided with holding tanks and decanting facilities, or, as a minimum, waste processing facilities. The toilet system shall not discharge untreated waste to track, and the discharge of processed waste shall be subject to the Environment Protection Authority and Australian Rail Track Corporation approval.

5.4 Owner/operators of existing locomotives and passenger vehicles which are fitted with toilets that discharge untreated waste to track shall develop an agreed programme to retrofit such vehicles with holding tanks and decanting facilities, or, as a minimum, waste processing facilities.

[6] Vehicle Attachments and Loadings

6.1 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 Unit and shall comply with the requirements of the Protection of the Environment Operations Act 1997

6.2 All vehicle loads, such as dangerous goods, containers fitted with refrigeration units and generator sets, shall meet all appropriate regulatory requirements.

6.3 Fuel tanks for self contained generator sets and refrigeration units fitted to vehicles or containers shall have positive means to prevent spillage of fuel, oil and coolant.

6.4 Vehicle owner/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 in order to prevent load spillage.

[7] Ecologically Sustainable Development

7.1 Owners/operators shall ensure that their rolling stock is designed, manufactured, operated and maintained in accordance with the principles of Ecologically Sustainable Development as defined in the Protection of the Environment Administration Act 1991 and in accordance with the Ecologically Sustainable Development strategies of the Australian Rail Track Corporation's Environmental Management System.

7.2 Owners/operators shall, when designing new rolling stock or substantially modifying existing rolling stock, identify options for maximizing energy efficiency and material reuse and recycling, and minimizing non-renewable resource consumption, waste generation, water and energy

consumption, and greenhouse gas emissions, and shall complement these options wherever possible.

7.3 Owners/operators shall periodically review the environmental impacts resulting from the operation and maintenance of their rolling stock in line with the principles of Ecologically Sustainable Development.

[8] Interstate Locomotives and Diesel Multiple Unit Trains

8.1 The requirements for interstate locomotives and diesel multiple unit trains are:

Locomotive Criteria:	Requirement to Operate on the ARTC Network:
Interstate locomotives and multiple unit trains built between 1 January 1984 and 30 June 2003 that do not comply with the requirements of Section 2	The operator must supply a noise mitigation plan aimed at achieving compliance with the requirements of Section 6.2 within two years from the date from which the vehicle was first used in NSW. This plan must be endorsed by the EPA prior to the vehicle commencing operation in NSW.

[9] Old Locomotives

9.1 Any locomotive or multiple unit train built before 1 January 1984 is classified by the EPA as an **old locomotive** and must meet the following criteria before operating on the Australian Rail Track Corporation network.

	Existing noise environment	Requirement to operate on the RIC network
1	The old locomotive has not been used in the designated area[1]	The noise limits of section [2] apply to the use of locomotives in the designated area.[1]
2	The old locomotive was in use previously but has not been in use in the designated area[1] for 12 months.	The operator must supply information to the EPA on noise emissions. Time of day and number of movements of the locomotive in the designated area. This is to be used as an assessment criteria to make a comparative assessment against existing locomotive usage for the designated area.[1] The assessment will identify whether a significant noise impact[2] is likely to occur. Written EPA endorsement will be required where assessment demonstrates significant noise impact.
3	The old locomotive of the designated type[3], is currently in use in the designated area[1] and where there is a significant level of increase in locomotive movements[4] within the designated area[1].	Written EPA endorsement is required.
4	Old locomotives of the designated type[3] are in use in the designated area1 but there would not be a significant increase in locomotive movements[4] within the designated area[1].	No written EPA endorsement is required.
5	Old locomotives of the designated type3 are in use in the designated area1 and the operator has a strategy in place to replace the old locomotive(s) within two years of the date from which the old locomotives is to be used.	New locomotives intended for introduction will require EPA endorsement and be required to meet noise limits outlined in section [2]. No written EPA endorsement is required for old locomotives.
6	Old locomotive(s) are proposed for use in the designated area but where there is little likelihood of causing noise impacts because there is no residential development close-by.	No written EPA endorsement is required.

1) 'Designated area' is the portion of the NSW railway network where the old locomotive is proposed to be operated.

2) A 'significant noise impact' is where the positive change in noise level is greater than an increase of 2 dB Leq(24hr) A weighted.

3) 'Designated type' – class of locomotive/diesel multiple unit nominated to operate on the NSW rail network.

4) A 'significant increase' in movements is where, as a result of the increase in locomotive movements, the predicted change in L_{eq}(24hrs) is greater than 2 dB A-weighted.

9.2 Locomotives intended to be used solely for heritage purposes, and classified as such by the Department of Transport, are exempt from these requirements.

WOS 01.160 - Signalling Interface

Refer to ESD-32-01 Signalling Rolling Stock Interface.

WOS 01.170 - Vehicle Recovery Interface

[1] General

1.1 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.

1.2 It is the owner/operator's responsibility to become familiar with the recovery equipment used by the Emergency Response Groups.

[2] Specialised Recovery Equipment

2.1 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.

2.2 It is the Owner/operator's responsibility to become familiar with the pony bogie and its application as used by the Emergency Response Groups.

WOS 01.180 - Automatic Equipment Identification Interface

[1] General

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

1.2 The AEI tags shall be in accordance with Appendix H (WOS 01.H) of this manual.

WOS 01.190 - Train Radio Interface

This unit is yet to be completed