TS 00180.4:1.0

Specification

Transit Space

Part 4: Network Specification for Sydney Metro Western Sydney Airport Line

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Document information

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Document history

Revision	Effective date	Summary of changes
1.0	15/07/2024	First issue

Preface

This specification is a first issue as TS 00180.4 *Transit Space – Part 4: Network Specification – Sydney Metro Western Sydney Airport*.

This specification forms part of the TS 00180 suite of standards related to transit space.

This specification defines the transit space requirements for the Sydney Metro Western Sydney Airport network.

Table of contents

1 Scope

This specification specifies the specific parameters, outlines and transit space design criteria for Sydney Metro Western Sydney Airport rail network, including the approved static outlines to be used as the basis for calculation of transit space and associated clearances.

2 Application

This specification is only applicable to Sydney Metro Western Sydney Airport network and its operation and is not intended for use on any other network.

This specification should be read in conjunction with TS 00180.1.

This document is intended for use by designers, operators. maintainers and regulators of the Sydney Metro Western Sydney Airport network.

3 Referenced documents

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

Transport for NSW standards

TS 00003.1 *Concessions to Transport Standards Part 1 – Concessions Process*

TS 00180.1 *Transit Space – Part 1: General Requirements*

TS 03610 *Buffer Stops*

Other referenced documents

Sydney Metro, *Sydney Metro Concessions Process* (This document is not publicly available. To obtain access email standards@transport.nsw.gov.au)

4 Terms, definitions and abbreviations

The following terms, definitions and abbreviations apply in this document:

AMB Asset Management Branch

ARL above rail level; vertical offset above the top of the low rail

CM contingency margin; specific additional clearance required from the KE to fixed infrastructure or other vehicles to account for other factors not mandated in the KE calculation and provide a buffer for network maintainability

FOCS flexible overhead contact system; flexible overhead contact system for 25kV traction power supply

KE kinematic envelope

line a continuous section of railway track

MCO minimum clear opening; the minimum internal diameter of tunnel sections

MSF metro services facility; the yard location where trains are maintained

network is the Sydney Metro Western Sydney Airport line, including any extension in development or operation

OCS overhead contact system; a collective term including both flexible and rigid bar systems that may be used interchangeably with OLE

OLE overhead line electrical equipment; collective term for all types of traction supply systems including overhead rigid conductor system and overhead flexible conductor system configurations

PEB platform edge barrier; half height platform screen and door systems used on outdoor platforms

POR plane of rail; the plane formed by connecting the top of the two rails in their design level and alignment position. This plane will rotate with applied superelevation. This plane is used as the vertical origin for transit space calculations

PSD platform screen doors; platform screens and door systems used on metro platforms

PSR permanent speed restriction; the speed at which the train will automatically apply emergency breaks

rail level the plane formed by joining the top contact surface of the two rails of a track

RIM rail infrastructure manager; In relation to rail infrastructure of a railway, means the person who has effective control and management of the rail infrastructure, whether or not the person –

(a) owns the rail infrastructure; or

(b) has a statutory or contractual right to use the rail infrastructure or to control, or provide, access to it

ROCS rigid overhead conductor system; rigid bar conductor 25 kV traction systems, primarily used in tunnel sections

RRSO reference rolling stock outline; the standard outline used for calculation of kinematic envelopes

SAD safe approach distance; the minimum clearance required to electrical infrastructure for electrical safety

SG structure gauge

spaceproofing the strategic reservation of space around the operating lines to support access and management of railway assets while retaining flexibility to support future operations

5 Authorised outlines

The RRSO and special outlines in Table 1 and Table 2 have been authorised to operate on the network.

Only unrestricted outlines shall be considered when undertaking transit space assessment for fixed infrastructure.

Table 1 – Approved rolling stock outlines

Outline name	Usage	Pantograph	Reference	Special requirements
Metro wide	Unrestricted	Metro 25kV pantograph	Defined in Appendix A.1	Nil

Table 2 – Special outlines

Outline name	Type	Reference	Usage
Metro 25kV pantograph	Pantograph	Defined in Appendix A.2	The pantograph outline shall be accounted for at the top of outlines nominated in Table 1

6 Dynamic parameters

6.1 General

Sections 6.2 to 6.5 set out the parameters and equations that shall be used in conjunction with the methodologies in TS 00180.1 for determination of kinematic envelopes and acceptance for the network. The dynamic allowances specified in Sections 6.2 to 6.5 require that the track geometry has been designed and constructed within the limits defined in Section 6.6.

6.2 Rolling stock dynamic allowances

Table 3 lists the rolling stock dynamic allowances for all track forms in the network.

Table 3 – Rolling stock dynamic allowances

Direction	Relative to	Description	Value
Lateral	Relative to POR (with any superelevation variation applied)	The sum of the following: • body to wheelset • wheel wear • wheel to rail free play.	±60 mm total
Vertical	Relative to the displaced vehicle centreline	Bounce upwards (body only)	+50 mm to –0 mm

Direction	Relative to	Description	Value
Vertical	Relative to the displaced vehicle centreline	Bounce down (bogie only)	0 mm
Rotational	Roll about the displaced roll centre of the rolling stock outline (body only)	Note: the roll centre moves laterally and vertically with the rolling stock outline	±2°

Equation 1, and Equation 2 shall be used to determine the coefficients for horizontal displacement due to track curvature.

$$K = \frac{14850^2}{8}$$

Equation 1 – Coefficient for determining horizontal displacement due to centre throw, K

$$M = \frac{27565}{Rh}$$

Equation 2 – Simplified coefficient for curve effects, M

Where

Rh = the horizontal curve radius being assessed

6.3 Track dynamic allowances

6.3.1 Slab track allowances

Table 4, Table 5 and Table 6 set out the parameters for slab track that shall be used in conjunction with the methodologies in TS 00180.1 for determination of KEs and acceptance for the network.

Table 4 – Slab track lateral allowances

Parameter	Description	Value
Rail variation	Rail wear	15 mm
Alignment (horizontal difference from design)	For all curves	±10 mm

Table 5 – Slab track vertical allowance

Parameter	Description	Value
Level	Vertical difference from design	+5 to –25 mm

Table 6 – Slab track rotational allowance

Parameter	Description	Value
Superelevation	Superelevation difference from design	±10 mm

6.3.2 Ballast track allowances

Table 7, Table 8, and Table 9 set out the parameters for ballast track that shall be used in conjunction with the methodologies in TS 00180.1 for determination of KE and acceptance for the network.

Table 7 – Ballast track lateral allowances

Parameter	Description	Value
Rail variation	Rail wear	15 mm
Alignment (horizontal difference from design)	All curves	±20 mm

Table 8 – Ballast track vertical allowance

Parameter	Description	Value
Level	Vertical difference from design	±50 mm

Table 9 – Ballast track rotational allowance

Parameter	Description	Value
Superelevation	Superelevation difference from design	±10 mm

6.3.3 Maintenance facilitiy and yard allowances

Table 10, Table 11 and Table 12 set out the parameters for maintenance facilities and yards that shall be used in conjunction with the methodologies in TS 00180.1 for determination of KE and acceptance for the network.

Table 10 – Maintenance facility and yard lateral allowances

Parameter	Description	Value
Rail variation	Rail wear	15 mm
Alignment (horizontal difference from design)	All areas	±32 mm

Table 11 – Maintenance facility and yard vertical allowances

Parameter	Description	Value
Level	Vertical difference from design	±50 mm

Table 12 – Maintenance facility and yard rotational allowances

Parameter	Description	Value
Superelevation	Superelevation difference from design	±10 mm

6.4 OLE parameters

Table 13 defines the uplift parameters that shall be used for the OLE configurations on the network when calculating pantograph KE.

Table 13 – OLE dynamic allowances

Parameter	Value
Uplift, FOCS	+75 mm
Uplift, ROCS	0 mm

6.5 Contingency margins

Table 14 and Table 15 set out rolling stock contingency margins that shall be used for review and acceptance of transit space clearances on the network.

Table 14 – Body and bogie contingency margins (CM)

Direction	Additional clearance required
Lateral	+100 mm
Vertical	+100 mm

Table 15 – Pantograph contingency margins (CM)

Direction	Additional clearance required
Lateral	+150 mm
Vertical	+150 mm

6.6 Track geometry limits

Governing limits for horizontal and vertical curvatures and superelevation on the network are available from the RIM.

7 Infrastructure design requirements

Sections 7.1 to 7.4 set out specific requirements that shall be accounted for in designs when constructing new infrastructure in the corridor that encompasses the network.

Due to the nature and configuration of the network the structure gauges for the tunnel areas have been specified separately to the at-grade areas in Section 7.2 and 7.3 respectively.

Specific requirements for clearances and gauging at rail level applicable to all sections are stated in Section 7.4.

7.1 Infrastructure service requirements

The infrastructure service requirements in Sections 7.1.1 to 7.1.4 define the minimum requirements for the positioning of permanent trackside and overhead structures, and for the minimum clear space between adjacent tracks.

All dimensions are given relative to the design track centre line horizontal position and height relative to the low rail.

7.1.1 Horizontal service requirements

For sections of main line or crossing loops outside of tunnel areas the minimum horizontal dimension between the face of the structure closest to the track and design track centreline shall be as detailed in Table 16.

Note: An allowance for track curvature and superelevation has been included in the clearances listed in Table 16.

Table 16 – Horizontal minimum infrastructure service requirements

Structure	At grade
Minimum horizontal clearance to structures and structure footings to one metre below design rail level to allow for operation of ballast cleaners.	2450 mm
Overhead wiring structure (OHWS) masts adjacent to a track.	3000 mm
Unattended operation segregation fence.	3000 mm
Temporary construction works adjacent to a track.	3000 mm
Piers, columns, deflection walls between tracks.	3500 mm
Bridge substructures and deflection walls (except between tracks). Cuttings with no road access at track level. Station buildings. Columns, footbridges.	4300 mm
Other structures and cuttings located adjacent to electrified tracks where road access is required between the infrastructure and the track. Bridges or airspace developments where an overhead wiring or signal mast is required within the structure limits.	6200 mm

For infrastructure within tunnel areas a minimum clearance of KE+CM shall be maintained.

The type of vehicle and the intended use of the access roads shall be considered in establishing clearances.

If roads are used for maintenance access, sufficient clearance shall be provided in consultation with the RIM taking into account the vehicles using the roads, the maintenance activities intended and intended arrangements for track possession.

7.1.2 Vertical service requirements

For all track in electrified areas the minimum vertical dimensions between the design minimum height of the overhead conductor that contacts the pantograph (including maximum sag conditions at worst operating temperatures) above the design maximum height of the low rail shall be as detailed in Table 17.

Table 17 – Vertical minimum clearance requirements to OLE equipment

Structure	Dimension
Tunnel sections	4325 mm
At-grade sections	4700 mm
MSF maintenance centre	4700 mm

The OLE design height is determined from the lowest OLE position by considering worst-case conditions including maximum sag conditions at worst operating temperatures (not applicable for ROCS areas).

The highest OLE position is determined from the design OLE height and shall be derived by removing all allowance for sag, using operating temperatures that result in the maximum wire height and maximum uplift of the wire caused by the maximum upwards thrust imposed by a pantograph.

For all track in electrified areas the minimum vertical dimension between the underside face of non-energised equipment and the design maximum height of the low rail shall be as detailed in Table 18.

Table 18 – Vertical minimum infrastructure clearance requirements

Structure	Dimension
ROCS in tunnel sections	KE+CM
ROCS in station boxes	5000 mm
FOCS attached to structures	6000 mm
FOCS not attached to structures	6500 mm

Vertical minimum infrastructure clearance for infrastructure in tunnel areas is highly constrained by the tunnel diameter and shall be coordinated with electrical safe clearances and ensure clearance of no less than KE+CM.

7.1.3 Track centres

Minimum design track centres for new works shall be in accordance with Table 19 and are governed by the track geometry at the section being assessed. The governing track shall be whichever results in the larger track centre dimension.

Table 19 – Track centre requirements

Horizontal design	Circumstance	Minimum track centre dimension (mm)
Straight track and curves ≥ 1000 m radius	Everywhere	4000
Curves < 1000 m radius	Where (Ea_o – Ea_i) > 0	3973 + 2M +2.5 (Ea_o – Ea_i)
Curves < 1000 m radius	Where (Ea_o – Ea_i) ≤ 0	3973 + 2M

Note: In Table 19, new variables are defined as follows:

- Ea_o = applied superelevation of the outside track
- Ea_i = applied superelevation of the inside track
- M = the curving effect parameter, defined in Equation 2

The track centre limits in Table 19 account for curved parallel tracks with different applied superelevation.

On curved tracks where the design superelevation of the adjacent tracks would cause the gap between passing trains to reduce, that is the design superelevation on the inner track is less than the outer track, the track centres shall be increased as defined in Table 19. Where the design superelevation would result in a larger gap, no additional clearance is required.

For the network MSF and sidings where cleaning and inspection of passenger vehicles is undertaken, design clearance requirements shall be developed to address local access requirements.

7.1.4 Tunnel walkways

Walkways within the network tunnel system have been designed to align to the sides of trains and enable, in emergency situations, side detrainment. To enable this, walkways shall be designed to a horizontal offset shown in Table 20 or KE + 50 mm whichever is greater, in accordance with design interface defined in Section 10. The nominal position of the walkways on tangent level track is shown in Figure 1 and the nominal design parameters for tunnel walkways is given in Table 20.

Table 20 – Nominal design parameters for tunnel walkways

Design feature	Parameter value
Horizontal offset on tangent track (nom)	1780 mm
Vertical	1100 mm

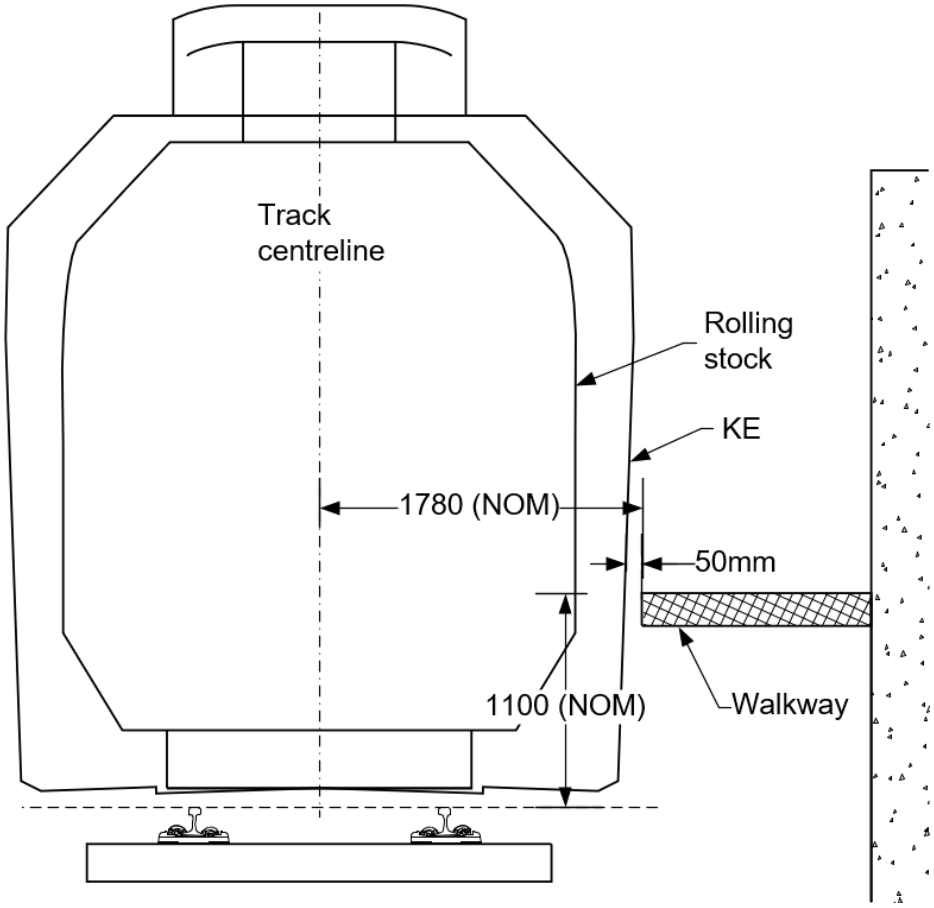

Figure 1 – Tunnel walkway representation

7.2 General structure gauge – tunnel sections

Structure gauge for the tunnel sections of the network is highly constrained. Figure 2 shows the general structure gauge of tunnel sections of the network. Due to the highly constrained and controlled, environment structure gauge in tunnel sections shall be defined as KE+CM. Structure gauge at rail level shall be in accordance with Section 7.4.

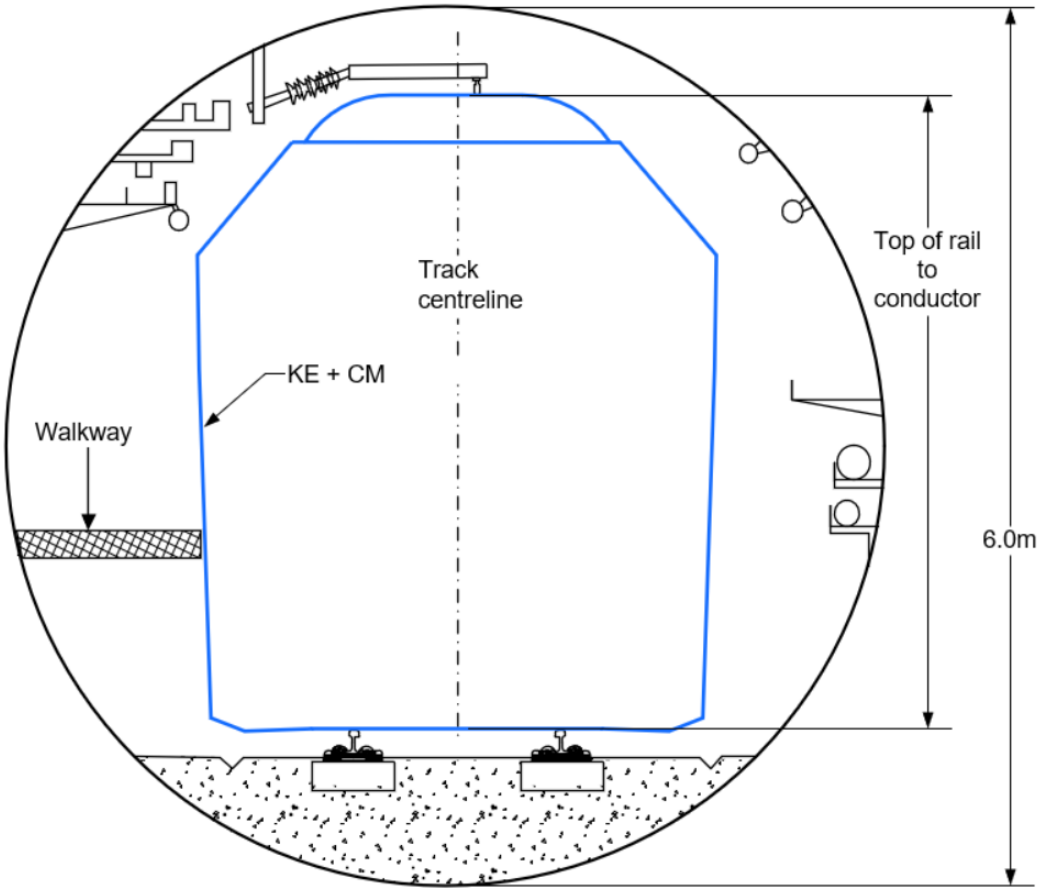

Figure 2 – General structure gauge – tunnel sections

7.3 General structure gauge – open air sections

For sections of alignment outside tunnels a simpler general structure gauges shall be applied, as shown in Figure 3. This is the base minimum distance required from the track centre line to new or modified infrastructure, in order to provide safe transit for all authorised outlines and spaceproofing for future network uses. General structure gauge is shown in Figure 3.

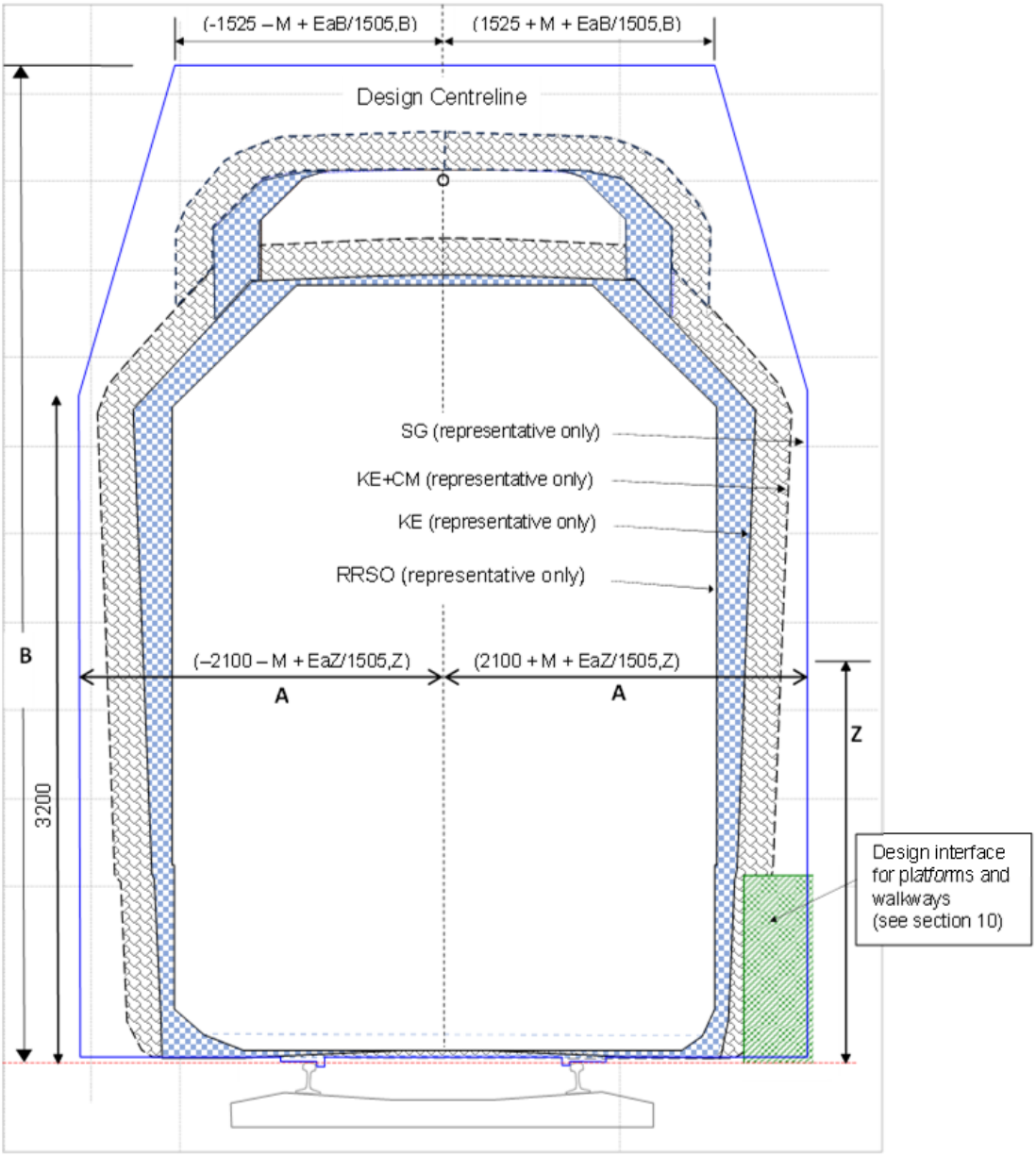

Figure 3 – General structure gauge (SG) for non-tunnel sections

Where:

- Ea is the applied superelevation (right rail in diagram is low rail)
- A is the horizontal clearance as per Table 21
- B is the vertical clearance to overhead structures, defined in Section 7.1.2
- Z is the vertical height above the design low rail where clearance is required
- M is the curving effect parameter, defined in Equation 2.

7.3.1 Horizontal clearances

The requirements in Section 7.1.1 specify the minimum horizontal dimension from design track centreline to a structure (dimension A).

The minimum horizontal dimension A shall be as detailed in Table 21 up to a height above design rail level of 3200 mm..

Table 21 – Horizontal clearance dimension A

Location	Dimension (mm)
Straight track	2100
On the inside of curves	$2100 + M + {}^{EaZ}/_{1505}$
On the outside of curves	$2100 + M - {}^{EaZ}/_{1505}$

7.3.2 Vertical clearances

The vertical distance from the rail to an item of infrastructure is governed by the height of the OLE in electrified areas. The OLE and associated energised equipment are a designed physical interface.

Before designing or constructing infrastructure around the OLE system the RIM shall be consulted for minimum SAD requirements and electrical safe clearances to non-energised equipment and other equipment above the track (dimension B in Figure 3).

The minimum vertical clearance between the lowest OLE position and the maximum height of the low rail shall be in accordance with Section 7.1.2.

7.4 Rail level structure gauge

Figure 4 outlines the structure gauge that applies at rail level on all lines of the network. The SG line at rail level provides spaceproofing for track and related infrastructure to be installed under the path of travelling rolling stock.

POR in the diagram is based on design rail level, assuming new rail.

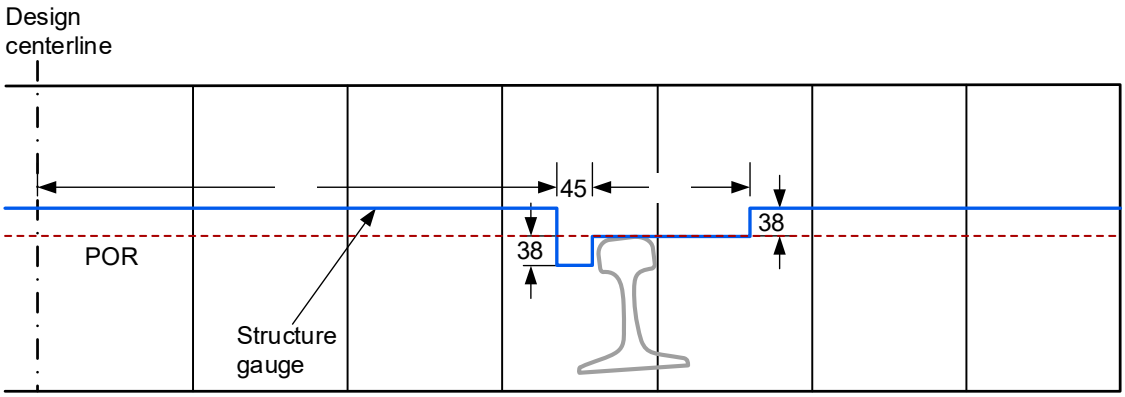

Figure 4 – Under train structure gauge (SG)

Rail level structure gauge coordinates are in Table 22.

Table 22 – Structure gauge coordinates at rail level

Horizontal (mm)	Vertical (mm)
0	38
673	38
673	–38
718	–38
718	0
821	0
821	38
2100	38

8 Rolling stock

Section 8 sets out requirements that ensure that any rolling stock operating on the network fits within the space available.

Rolling stock shall be assessed in accordance with the process outlined TS 00180.1.

Rolling stock assessments shall be completed using the dynamic parameters defined in Section 6 and the rolling stock compared with chosen authorised RRSO or combinations of authorised RRSOs listed in Section 5.

Type testing may be demonstrated through either the use of computer simulation and modelling or physical measurement.

Where desktop techniques are used they shall be supplemented by physical measurements completed on a minimum of one example of each type of rolling stock being considered representative of the fleet being assessed.

Testing shall consider all degraded modes of operation and consider operation up to the maximum operational speed for the network in consultation with the RIM.

Additional checks and re-validation shall be completed in accordance with rolling stock maintenance manuals.

8.1 Elements exceeding the reference rolling stock outline

Any equipment affixed to the rolling stock that does not comply with the authorised RRSO shall:

- be frangible in nature and deform or detach in a safe manner on contact with surrounding infrastructure
- be identified as either of the following:
  - an approved design interface listed in Section 10
  - managed as a concession in accordance with TS 00003.1 and *Sydney Metro Concessions Process.*

All exceeding items shall be identified on the rolling stock certification.

8.2 Restricted operations

Where a vehicle is to be operated under restricted conditions, dynamic testing may be reduced by agreement with the RIM. The reduced dynamic testing shall be documented on the rolling stock approval, along with the associated operational restrictions.

The restrictions shall be recorded on the approved rolling stock register.

9 Platforms

Table 23 sets out the required platform design offsets of hard platform edge from track centreline and covers passenger platforms and access platforms for maintenance staff.

Frangible elements may be installed to the face of the platform edge that infringe into the KE in accordance with the design interface specified in Section 10.

Construction limits for the platform area are given in Section 12.

Table 23 – Platform design offsets

Platform type	H (mm)	V (mm)
Passenger platforms	1690	1135
Maintenance platforms	1720	1135
Elevated access platforms	1720	3400

Note: The platform offsets listed in Table 23 are nominal offsets and shall be modified to compensate for curving and superelevation effects.

9.1 Passenger platform design

New passenger platforms shall be designed in accordance with design conditions as follows:

- track through platforms shall be straight and level with no applied superelevation or vertical curvature
- the straight track section shall extend for at least 20 m beyond the platform with no transition elements within this distance
- vertical curves shall not start until at least 10 m beyond the platform
- trackform transitions shall not be located within the platform area nor within 20 m beyond their start or end
- track form shall be slab track.

The design platform offsets to be adopted for new platforms are in Figure 5.

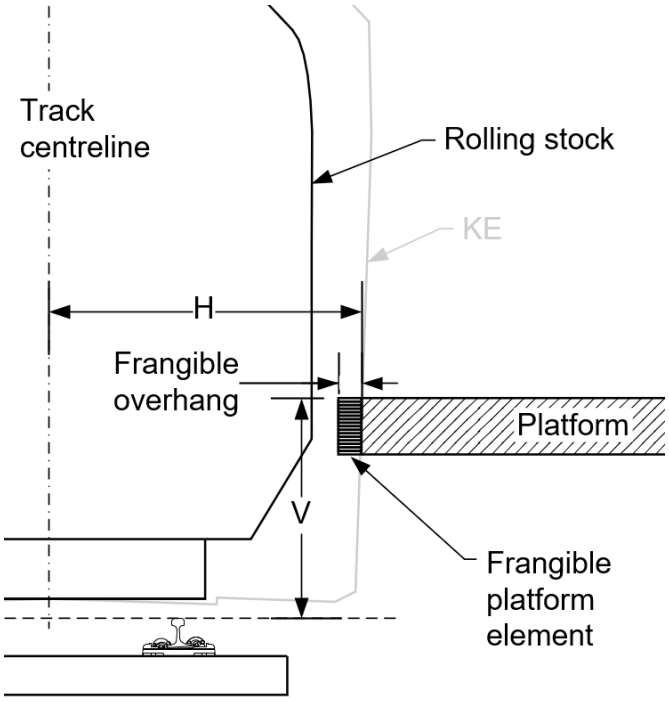

Figure 5 – Platform dimensions

9.2 Platform screens and doors

PSDs shall be installed on all passenger platforms in the network to protect the boundary of the unattended train operation (UTO) zone.

PSDs shall be designed to minimise the gap between the doors and rolling stock in order to reduce entrapment risk. A typical configuration is shown in Figure 6.

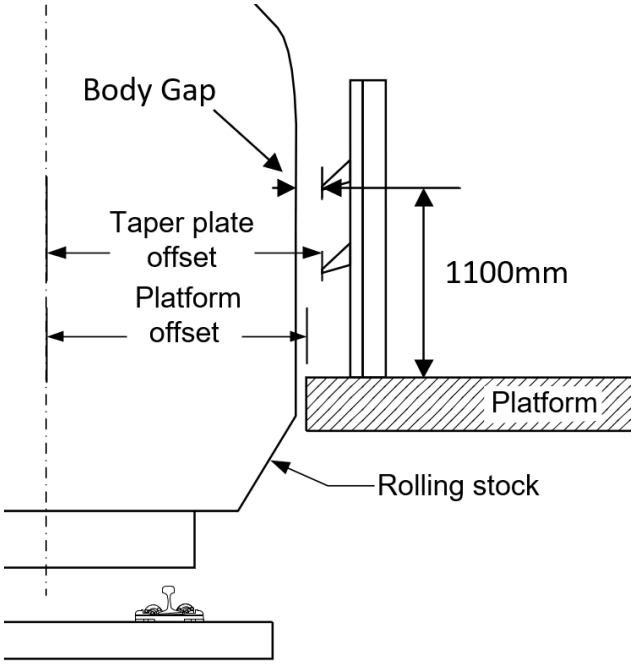

Figure 6 – Typical platform screen and door configuration

Platform screen and door systems shall be designed with a setback from the hard platform edge sufficient to achieve minimum clearance required by design interface in Section 10.

Body gap is the distance between the edge of the taper plates and the extremity of the train bodyside and is a critical dimension for assessing the risk of entrapment between the rolling stock and the PSD. Body gap is assessed at a vertical offset of 1100 mm above the platform standing surface.

Taper plates may be installed to the track side face of the doors to reduce the risk of entrapment. The extension of the taper plate towards the track is governed by the design interface specified in Section 10.

9.3 Maintenance and service platforms

Where maintenance and service platforms are required for network operations they shall be installed to the offsets provided in Table 23 and modified if required for non-tangential geometry.

Edge infills shall be designed to manage the risk to operation and maintenance staff within the design interface allowed for in Section 10.

Where maintenance and service platforms are installed within yard limits requirements for additional inspection and maintenance shall be developed in consultation with the RIM.

9.4 Platforms on non-tangential geometry

Where the track geometry through the platform is not straight additional clearance shall be provided to manage dynamic effects and the impact of body throw.

Additional KE allowance shall be included to compensate for increased body roll and track effects such as rail wear.

Detailed analysis of the curving affects shall be undertaken to manage dynamic clearance requirements and static stepping gaps.

Assessment shall be completed to document the changes to KE and the revised horizontal offsets and collated as part of design acceptance by the RIM

10 Design interfaces

The design interfaces in Table 24 have a physical or operational interface with rolling stock that requires them to be within the SG. The maximum infringement and any specific controls are listed with the item.

Table 24 – Approved infringements for the network and applicable conditions

ID	Item	Approval	Details
1	OLE and associated energised electrical equipment	Clearances as per Section 7.1.2	Design of OLE system shall be in compliance with RIM requirements for 25kV traction power
2	Buffer stops	Block end of line	Design and construction to be in accordance with TS 03610.
3	Rolling stock frangible door steps	May infringe into the kinematic outline to KE – 20 mm	Deformable lengths of frangible elements may extend into the KE to a maximum infringement of KE-20 mm. Non-deformable length shall comply with KE +0.
4	Passenger platforms	May approach to the kinematic outline down to KE + 0 mm	Platforms are a design interface with special installation and maintenance tolerances as detailed in Sections 9 and 12.2.
5	Platform edge frangible elements	May infringe into the kinematic outline to KE – 20 mm	Deformable lengths of frangible elements may extend into the KE to a maximum infringement of KE –20 mm. Non-deformable length shall comply with KE +0.

ID	Item	Approval	Details
6	PSDs	May approach to the kinematic outline down to KE + 0 mm	PSDs are established very close to the platform edge to reduce entrapment risk. As they are part of the pedestrian platform they may infringe as described. PSD system elements including header boxes, but excluding frangible elements of taper plates, shall be clear of the kinematic gauge including under all combinations of pressure loadings due to train aerodynamics and tunnel ventilation effects.
7	PSD frangible taper plates	May infringe the kinematic outline to KE – 20 mm	Taper plates are used to reduce the entrapment risk at platform doors. If these elements are made from a frangible or deformable material they may infringe as described. Non frangible components shall maintain clearance of KE + 0 mm.
8	Axle counters	May be set to interact with the wheel in accordance with OEM design	Design to be set against top of rail, with an appropriate maintenance program.
9	Lineside friction modifier applicators	May be set to interact with the wheel in accordance with OEM design	Installation tolerances as stated in maintenance manual.
10	Tunnel walkways	Design clearance of KE + 50 mm	Tunnel walkways are designed to align with the train and provide for side detrainment. As such reduced clearance is required. Walkways shall not be used alongside ballasted track. Technical maintenance plan shall include examination of clearances between track and the walkway.

10.1 Frangible items

Items identified in Table 24 as being frangible shall be either of the following:

- Deformable in nature and deflect when contacted by a moving vehicle with no damage to either the frangible element or the vehicle.
- Be designed to be sacrificial and safely wear in contact with passing vehicles. Items of this type shall have a maintenance plan including required inspections and replacement intervals.

11 Approval of clearances

Any infrastructure that does not comply with the minimum infrastructure limits or structure gauge requirements specified in this document shall be approved prior to operations in accordance with TS 00003.1 and *Sydney Metro Concessions Process.*

11.1 Narrow clearances management

Any infrastructure that does not achieve the minimum infrastructure limits and structure gauge requirements shall be recorded in the narrow clearances register maintained by the RIM.

The narrow clearances register shall form part of the technical maintenance plan for the network and identify any additional maintenance or inspection requirements for these sections.

12 Acceptance limits

12.1 Construction tolerances at structures (other than platforms)

Physical construction of structures adjacent to track infrastructure shall not reduce the transit space safety margins. Design of structures shall consider worst case construction tolerances when establishing clearance requirements.

12.2 Tolerances at platforms

Platform measurement conventions are shown in Figure 7. Horizontal measurements with a positive number mean a larger gap between train and platform, while a negative number is a reduced gap. For vertical measurements a positive value means an increase in the distance between the platform surface and the design rail level, or a larger step down into the carriage.

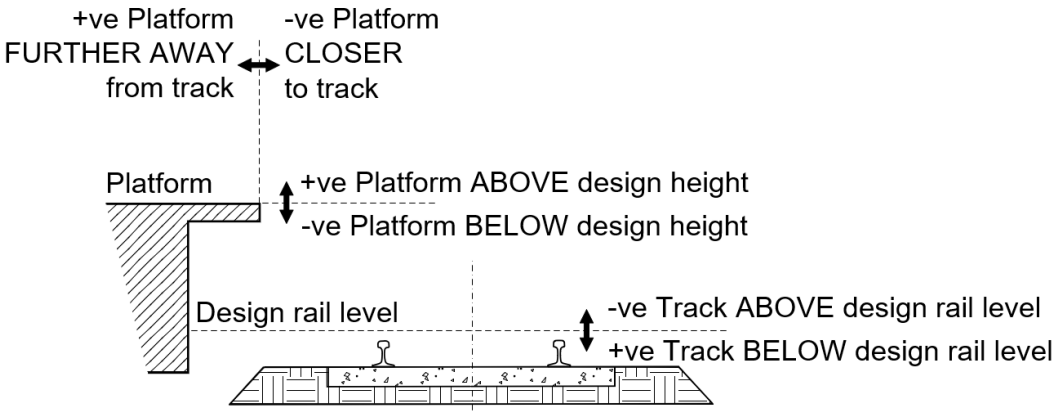

Figure 7 – Platform measurement conventions

The tolerances set out in Table 25 apply to the construction or renewal of platforms and the construction, renewal or maintenance of track through platforms and for a distance of no less than 20 m to either side of the platform.

Table 25 – Acceptance tolerances at platforms

Scenario	Vertical tolerance (mm)	Horizontal tolerance (mm)	Superelevation tolerance (mm)	Comments
Construction or renewal of platform	+0 to –5	+5 to –0	N/A	Relative to design hard coping edge position
Construction of track at platform	±5	±5	±2	Relative to design rail position
Maintenance of track at platform	±5	±5	±5	Relative to design rail position

Appendix A Authorised outlines (normative)

A.1 Metro wide outline

Figure 8 shows the metro wide outline and the following should be noted:

- 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
- all dimensions are in millimetres
- point A – E and A’ to E’ are considered to define the body for tolerance application
- points E – M and E’ to M’ are considered to define the body for tolerance application.

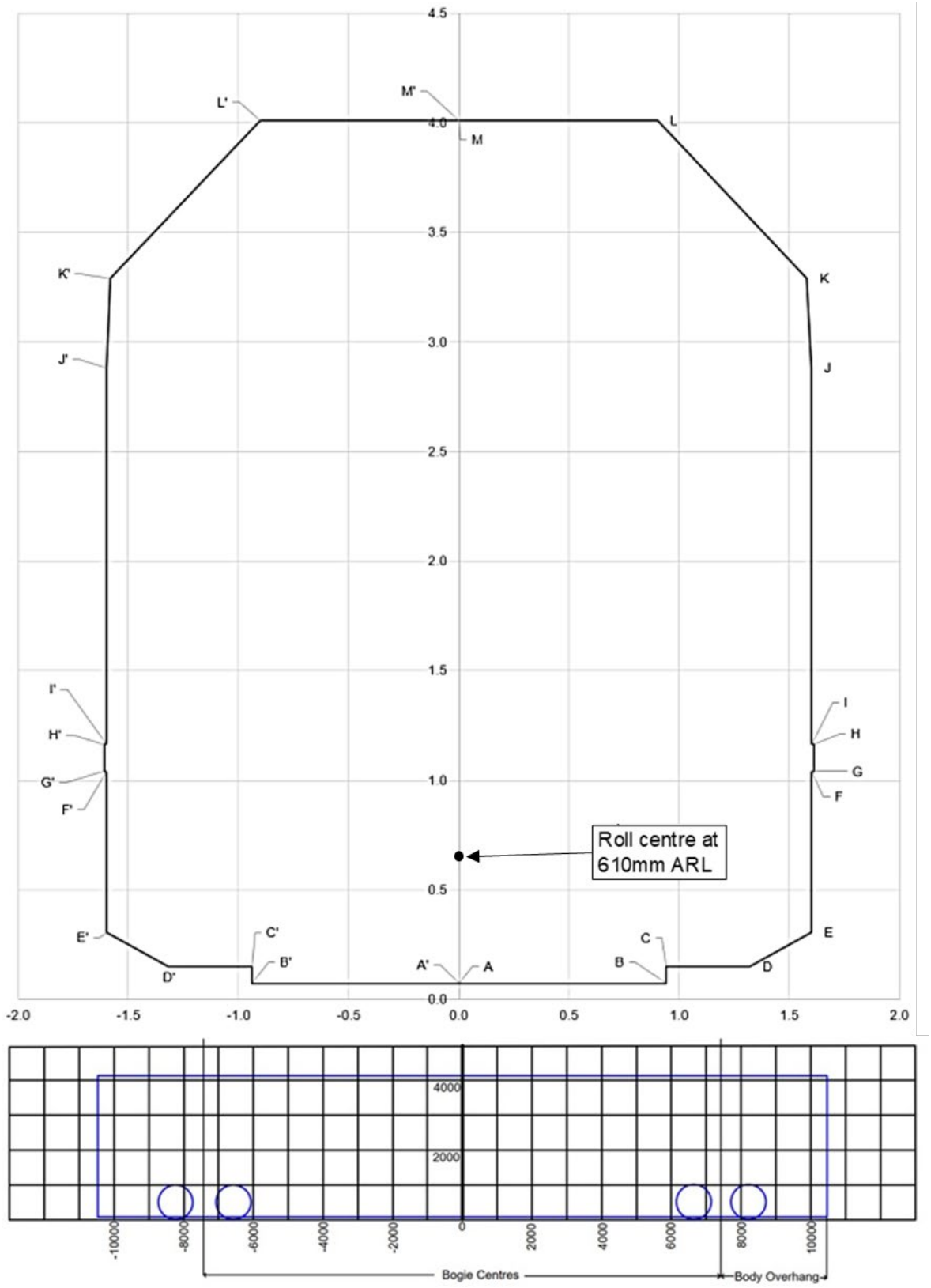

Figure 8 – Metro wide outline

Table 26 sets out the dimensions of vehicle features for the metro wide outline static profile shown in Figure 8.

Table 26 – Metro wide vehicle dimensions

Vehicle feature	Dimension (mm)
Bogie centres	14,850
Body overhang (symmetrical)	3320
Vehicle width	3200
Vehicle length	21,490
Roll centre (ARL)	610

Table 27 sets out the coordinates of points in the metro wide outline static profile shown in Figure 8.

Table 27 – Metro wide static profile

Point	Lateral (mm)	Vertical (mm)
A	0	75
B	940	75
C	940	152
D	1320	152
E	1600	305
F	1600	1040
G	1610	1040
H	1610	1165
I	1600	1165
J	1600	2880
K	1580	3290
L	900	4010
M	0	4010

A.2 Metro 25kV pantograph.

Figure 9 depicts the metro 25 kV pantograph.

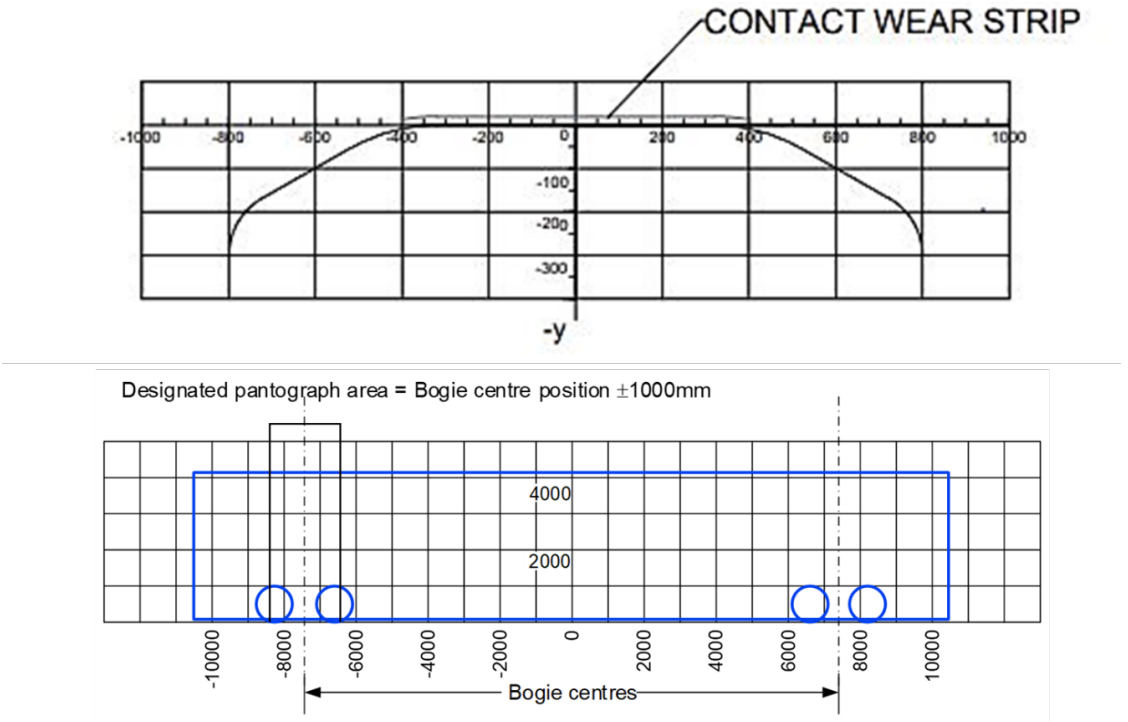

Figure 9 – Metro 25 kV pantograph

In Figure 9, the following conditions apply:

- all cross-section dimensions are symmetrical about the vehicle centreline
- the origin for all horizontal coordinates is the vehicle centreline
- the origin for all pantograph vertical coordinates is the contact position with fully worn contact brushes
- roll centre shall be taken from the vehicle outline
- all dimensions are in millimetres.

Table 28 sets out the coordinates for points on the metro 25 kV pantograph shown in Figure 9.

Table 28 – Metro 25 kV pantograph

Horizontal (mm)	Vertical (mm)
0	0
400	–8
497	–41
597	–97
665	–136
750	–188
800	–300