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Amendment Record

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1.0	19 Oct 23		Updated to include content from ETN-07-03 and ETN-07-02 Aligned Document with current format (definitions table etc) Clarified clearance definitions and requirements Added network wide platform design content Added clearance point definitions Added design vehicle G Review of structure outlines (added D, H, F2 outline)

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7 Section 7: Clearances

7.1 General

This Section applies to clearances between

1. Rolling stock and structures; and
2. Rolling stock on adjacent tracks.

Structure outlines are provided for the purpose of rolling stock operation and train passage only. This standard does not provide provision for access or egress (emergency or otherwise), rolling stock clearances to people, plant or equipment, projection of parts of the body from rolling stock, risks from derailed rolling stock, other health and safety reasons, service, maintenance and future clearance upgrades.

Where a guard rail has been fitted to provide protection to a structure in the event of a derailment the structure outline shall be widened by the distance between the gauge faces of the running rail and guard rail to accommodate the back of the wheel of the derailed rolling stock running against the guard rail.

Clearance requirements for electric aerials are covered by EEG-00-01.

For rolling stock outlines and permitted areas of operation refer ARTC RAS – Route Access Standard (RAS) and RAS Appendix A - Rolling stock Outlines and Loading Requirements.

7.1.1 Reference Documents

The following documents support this Standard:

- ARTC RAS – Route Access Standard (RAS)
- AS7507 - Rolling Stock Outlines
- AS 7522 - Access and egress
- ETS-05-00 Section 5: Track Geometry
- EGP-02-01 Engineering Waiver Management
- ETE-07-01 Examination of Track and Structural Clearances
- RAP 5135 Inspection of Track Clearances – Procedure
- ARTC RAS Appendix A - Rolling stock Outlines and Loading Requirements
- OPE-PR-029 Application for Out of Gauge Train Notice
- EEG-00-01 Requirements for Electric Aerials Crossing ARTC Infrastructure
- ETI-07-05 Special Inspection of Clearance Points
- AMT-GL-001 Approved Operational Infringement Management

7.1.2 Definitions

The following terms and acronyms are used within this document:

TERM OR ACRONYM	DESCRIPTION
AMS	Asset Management System (e.g. Ellipse)
Asset Management Authority	The authority within the operating business unit responsible for Asset Management / Strategy. Typically, this will be the same authority that endorses engineering waivers.
Clearance Point	The point along a track where one vehicle is able to pass another on the adjacent converging track with sufficient clearances under this standard.
Contingency Margin	The additional clearance allowance applied to the kinematic envelope.
Design Reference Vehicle	The rolling stock outline(s) used for the purpose of determining clearance requirements.
Engineering Waiver	A variation from an ARTC Engineering Standard as per EGP-02-01.
Infringement Waiver	A waiver specifically for clearance infringements recorded in AMS as per AMT-GL-001.
Kinematic Envelope (KE)	The area representing the maximum considered range of occupancy of the rolling stock, taking into account all track and rolling stock movement tolerances.
May	These clauses are suggestion and do not require a justifcation to deviate from.
Permanent Structure	A structure that is not able to altered or relocated without significant works, such as bridge members, rock faced cuttings and tunnels.
Permitted Infringement	An infringement explicitly stated as able to be approved as per 7.2.2.
RAS	Route Access Standard
Rolling stock Profile	The static outline of a vehicle, these are listed in the ARTC RAS. Often referred to as a “plate”.
Shall	A mandatory requirement set by ARTC. These may only be waived through use of an engineering waiver
Should	A recommendation. These are not mandatory. The decision to not adopt a recommendation may only be made by ARTC personell. Non-ARTC personall shall treat these requirement as mandatory unless approval is provided by ARTC.
Structure	Any structure, including (but not limited to) retaining walls, rock faced cuttings, bridge members, tunnel walls, overhead wiring mast, signalling infrastructure and equipment.

7.2 Design

7.2.1 Clearance Outlines

The following outlines are used at ARTC to manage clearances.

These outlines are illustrated in Figure 7-1

7.2.1.1 Static Rolling Stock Outline.

The cross-sectional outline of a maximum size vehicle at rest.

7.2.1.2 Kinematic Envelope

May be referred to as KE or KE+0.

The area representing the maximum considered range of occupancy of the rolling stock. It includes the effects of vehicle centre and end throw, track tolerances and dynamic rolling stock limits described in the general procedure in Appendix A.

Note: Most of the factors used to determine the KE are not dependent on speed and still apply to stationary vehicles. E.g. Full Body roll while stationary is still possible in response to a track fault and track factors are all independent of rolling stock movement.

7.2.1.3 Absolute Contingency Outline

May be referred to as KE+100.

The outline which may be infringed only in special circumstances and subject to there being no exceedance of the appropriate track tolerances for clearance. Typically infringements to this outline require more stringent controls.

In ARTC the absolute contingency outline shall be taken as the Kinematic Envelope plus 100mm.

Note: This was previously referred to as the Base Operating Standard.

7.2.1.4 Standard Contingency Outline

May be referred to as KE+200

Equivalent to the “contingency outline” defined in AS 7507. This is the threshold that typically requires maintenance actions to be taken to restore clearances to a standard such that no operating restrictions are required.

In ARTC the standard contingency outline shall be taken as the Kinematic Envelope plus 200mm.

Note: This was previously referred to as the Maintenance Intervention Standard.

7.2.1.5 Structure Outline

May be referred to as structure gauge.

The outline at which no structure should be constructed inside of.

7.2.1.6 Application of outlines

The kinematic envelope, absolute contingency outline and standard contingency outline are measured relative to the plane of the track, that is the relative alignment of the two rails. The kinematic envelop applies below top of rail.

The structure outline is measured to the plane of gravity and is independent of the alignment of the two rails. In curves the structure outline is aligned to the high rail. The structure outline does not apply below top of rail.

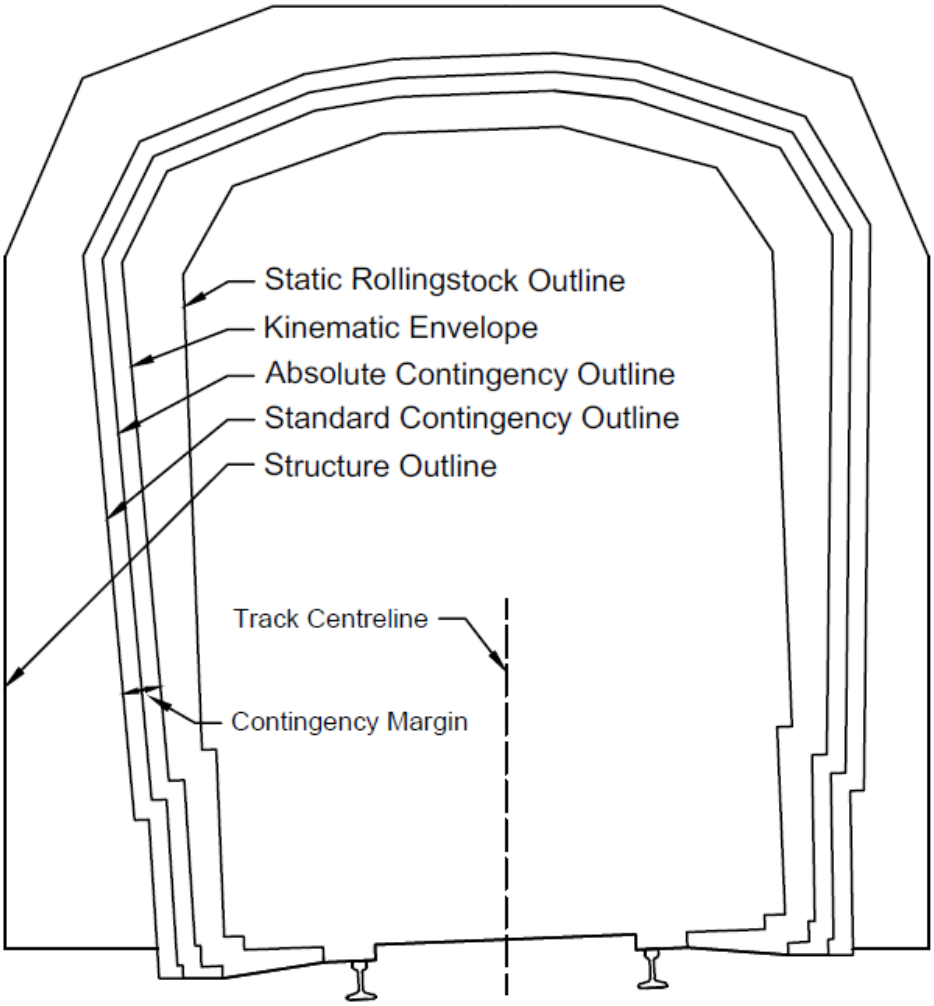


Figure 7-1 Schematic of Clearance Outlines

Note: *Figure 7-1 shows a static outline rotated to match design superelevation.*

The structure outline is not rotated with the track. It is aligned with the top of rail or high rail in curved track.

The structure outline shown is for curved track, this is wider on the low rail side

7.2.2 Minimum Clearance Requirements

Appendix A outlines the method that shall be used to calculate the appropriate kinematic envelope. These procedures may be used for the specification of clearance standards listed in Clause 7.2.1 when considering both new and existing combinations of structures and rolling stock. The standards determined should represent the worst-case combination of structure and rolling stock for the track section under consideration.

Appendix A uses the static rolling stock outline as the starting point for determining the clearance outlines listed in 7.2.1.

The minimum clearance shall not be employed in a particular situation if more clearance can be reasonably provided.

When determining the clearance standards, the following clearance management practices shall apply.

7.2.2.1 Static Rolling Stock Outline

Rolling stock that exceeds the static rolling stock outline (including out of gauge loads) shall be subject to approval by the Operational Standards Manager.

7.2.2.2 Kinematic Envelope

Infringement of the Kinematic Envelope shall not be permitted in normal operations and shall be treated as a track obstruction.

Note: Some platform offsets may infringe the maximum kinematic envelope

7.2.2.3 Absolute Contingency Outline

The temporary and permanent infringement of the absolute contingency outline for clearances shall only be permitted in special circumstances, such as at platforms.

Platforms designed and maintained to the tolerances prescribed in this standard shall be considered compliant.

Note: Normal practice is to locate platforms as close as possible to the train for passenger safety. This may be achieved by allowing the platform to be built to the kinematic envelope of the largest swept path envelope of rolling stock using the route. The track may need higher inspection or maintenance levels than for open track.

In some circumstances structural elements of underbridges may infringe the Absolute Contingency Outline.

7.2.2.3.1 Rail / Sleeper mounted Equipment

Clearances for rail or sleeper mounted equipment such (e.g. points machines, wayside equipment) may be reduced down to the kinematic envelope.

A flangeway of 60mm width and 40mm depth shall be provided.

Equipment that infringes these requirements (e.g. lubricators, turnout components) should be assessed on a case by case basis as part of its design or approval.

For further detail refer to Appendix B: B10

Adherence to this clearance outline does not eliminate the risk of equipment being struck. Sensitive equipment should consider additional clearance to reduce risk of being struck.

7.2.2.4 Standard Contingency Outline

No structure or track shall be designed, or have a change in configuration, which will result in a contingency margin less than 200mm.

Permanent infringements of the standard contingency outline shall be subject to increased rates of scheduled inspection in accordance with 7.4.1.

Permanent infringement to the standard contingency outline is subject to approval by as per 7.3.4.3

7.2.2.5 Structure Outline

All structures should be wholly located outside of the adopted structure outline.

No permanent structure shall be constructed inside of the adopted structure outline.

A structure, that is not a permanent structure, may be constructed inside the structure outline with approval from the Asset Management Authority.

Where an infringement of the structure outline occurs, the structure shall be placed on a clearance register by the asset owner and subject to scheduled inspection in accordance with 7.4.1.2.1.

Note: Structures that do not infringe structure outline do not require clearance records be maintained and may be actioned by exception.

7.2.2.6 Adjacent Tracks

The contingency margin between rolling stock kinematic envelopes on adjacent tracks shall not be less than 200mm.

Where turnouts adjacent to another track (e.g. third roads) the full kinematic outline throughout the turnout, including centre and end throw effects shall be considered.

7.2.2.7 Infringement to the Minimum Clearance Requirements

Requirements for approving infringement to the clearance standards are covered in 7.3.4.

Approval may be subject to conditions such as speed restriction or tightened track tolerances and inspection requirements.

7.2.2.7.1 Documentation

All clearance locations inside the adopted structure outline shall be entered into a register in the AMS as per AMT-GL-001. General inspections should be carried out with reference to this register.

Documentation should include clearance classification of each track section in terms of the clearances adopted.

7.2.3 Design Requirements

Design Reference Vehicles F and G have been derived to represent a single outline that encompasses all current and future rolling stock outlines and provides the extreme outline in all conditions for either single or double stack operations.

Design Reference Vehicle G has been assigned to corridors that are not identified for long term double stack operating in the ARTC Infrastructure Master Plan.

Table 7-1 Ultimate Design Reference Vehicles

CORRIDOR	DESIGN REFERENCE VEHICLE	STRUCTURE HEIGHT
Hunter Valley (HHN and Non-Coal)	G	5.3 m
Glenfield to Flemington / Botany	G	5.3 m
Tottenham to Spencer Street	G	5.3 m
All Other Corridors	F	7.1 m

Existing rolling stock references profiles can be found on the ARTC Route Access Standard. This also includes information as to the area of operation of each profile.

7.2.3.1 New Structures

All new structures shall be constructed to the full clearance requirements of 7.2.2 for the design references vehicles as per Table 7-1, unless otherwise formally approved to use an alternate rolling stock outline by the appropriate ARTC Group Executive. Where this approval is required the design requirements of the approved alternate outline shall apply.

7.2.3.1.1 Exceptions for Non-Permanent Structures

In existing corridors, structures which are not permanent structures may be designed to reference vehicles other than those in Table 7-1 provided the structure meets the clearance requirements for each rolling stock profile currently used on the corridor.

7.2.3.1.2 Clearance for Rail Underbridges

For rail under-bridges on straight track (where there is no end or centre throw in effect) the minimum distance from inside of kerb to track centre shall be 1700mm. These kerbs shall not be higher than 250mm above design top of rail. A kerb complying with this requirement is not does require any approval or an infringement record.

7.2.3.2 Existing Structures

Where track re-alignment works or modification to existing structures occurs, the existing structure shall meet the requirements of the 7.2.2 for each rolling stock profile currently used on the corridor.

Where existing structures are replaced the requirements of 7.2.3.1 shall apply.

7.2.3.3 Track Centres

All track clearances for new construction and upgrade works (including main lines, passing tracks etc) shall be designed in accordance with below.

1. For all greenfield sites, the track clearances shall meet the minimum clearance requirements of 7.2.2.6 using the design reference vehicle as per Table 7-1, unless otherwise formally approved by the appropriate ARTC Group Executive.
2. For existing corridor works, the maximum kinematic envelope of a track should not infringe the structure outline of the adjacent track for the largest rolling stock profile

currently used on each track. Where this cannot be achieved the maximum kinematic envelope for the largest rolling stock on each track shall meet 7.2.2.6.

7.2.3.4 Existing Approved Infringements

Where there is an existing documented approval for a clearance infringement, it may be relied on for design/construction of the same track with approval from the asset management authority.

7.2.3.5 Construction Tolerances

Design shall incorporate construction tolerances into clearance distances such that a design clearance distance considers the structure is located at the extremity of its allowable construction tolerance.

Example: A structure with +/- 20mm in allowable construction tolerance shall be designed to a provide KE+220mm at its design position to be considered a compliant design for KE+200mm.

The intent of this is to prevent a structure from being designed outside of KE+200mm and being considered compliant, then constructed inside of KE+200mm.

7.2.4 Profile Determination

7.2.4.1 Structure Outlines

For applicable rolling stock outlines the corresponding structure outlines in Appendix B – Clearance Diagrams shall be adopted.

7.2.4.2 Kinematic Envelope – Rolling stock Factors

The kinematic envelope of a design reference vehicle shall be determined using Appendix A and the factors in this section.

Table 7-2 Dynamic Rolling stock Limits

FACTOR[4]	ASSUMED LIMITS
Lateral translation [1]	± 40 mm
Body roll [2]	
Rolling stock outlines (except double stack containers)	±2°about a roll centre 610 mm above rail level
Rolling stock outlines (double stack containers).	±2.5° about a roll centre 440 mm above rail level
Bounce [3]	+50 mm / -0mm
Wheel clearance (worn wheel to new rail) [1]	±20 mm (refer to Appendix B: B9)

Notes:

1. *± means linear displacement parallel to the plane of the top of the rails to each side of rolling stock centreline.*
2. *± means angular displacement clockwise and anti-clockwise about the roll centre on the rolling stock centreline.*
3. *+ means upward linear displacement normal to the plane of the top of the rails.*
4. *All factors except for bounce are independent of speed or movement and cannot be reduced for slow or stationary vehicles.*

7.2.4.3 Kinematic Envelope – Track Factors

The values in Table 7-3 shall be used to determining the kinematic envelope of a design reference vehicle. Where a factor can be reduced by a design or maintenance practice the reduced factor may be used instead, provided the reduced values are validated as part of the design, or the maintenance practice is recorded in the AMS.

Table 7-3 Track Tolerances

FACTOR	ASSUMED TOLERANCES (MM) [1]		
	STRAIGHT TRACK	> 300 M RADIUS	<300 M RADIUS
Rail side wear [2]	± 5	+ 25, - 5	+ 25, -5
Gauge widening [2]	± 0	± 0	+0, -15
Gauge – Timber Sleeper Track[2]	± 20	± 20	± 25
Gauge – Concrete Sleeper Track[2]	± 10	± 10	± 10
Track alignment (from design) [3]	± 50	± 50	± 75
Cross-level (from design) [4]	± 30	± 30	± 30
Rail Level [5]	± 100	± 100	± 100
Reduced Track Tolerances at Platforms [6]			
Gauge (from 1435 mm) [2]	± 5	Not Applicable – use full tolerances from above	
Track alignment (from design) [3]	± 15		
Cross-level (from design) [4]	± 10		
Rail Level	± 25		

Notes:

1. *These geometry tolerances are intended for the purpose of calculating clearances only. Where design reduces the range of these tolerances (e.g. direct fixation track) these tolerances may be reduced to the expected value range.*
2. *On straight track ± means linear displacement parallel to the plane of the top of the rails to each side of the design centreline of the track.*

   On curved track, + means linear displacement to the outside of the curve and - means linear displacement to the inside of the curve parallel to the plane of the top of the rails.
3. *On straight track ± means horizontal linear displacement each side of the design centreline of the track.*

   On curved track, + means horizontal linear displacement to the outside of the curve and - means horizontal linear displacement to the inside of the curve.
4. *± means vertical displacement of the left and right rails respectively resulting in a clockwise and anti-clockwise rotation of the track in the vertical plane normal to the track.*
5. *± means vertical linear displacement above (+) and below (-) design rail level. This includes the effect of both track position and rail wear. E.g. The use of slab track shall only reduce (-) factor to the rail wear limit.*
6. *Reduced track tolerance at platforms shall only be used track is maintained within these tolerances where maintenance actions are linked to the reduced tolerances.*

7.2.5 Design of Platform Offsets

The platform offsets in this section are intended to comply with basic platform access as per AS/RISSB 7522.3.

Platform offsets outside of Table 7-4 shall be approved by the Manager Track and Civil Standards.

New platforms shall be located on straight track.

7.2.5.1 Platform Offsets

Table 7-4 details design platform coping offsets for straight platforms. These platform offsets are suitable for rolling stock no wider than 1450mm from track centre at a height of up to 1120mm above top of rail. Alternate platform offsets shall be used for wider vehicles.

Table 7-4 Standard Clearance (offset) of Standard Platform Coping

REGION	H_s (MM) [1]	V_s (MM) [2]
Hunter Valley Heavy Haul	1580	1060
Inland Rail Route	1620	1200
All Other ARTC	1575	1065
Other New Design	Seek ARTC Advice	

Notes:

1. *Indicates the horizontal distance between track centreline and platform coping edge.*
2. *Indicates vertical distance between top of rail and platform coping edge.*
3. *These values are for new design. Existing platforms should be maintained as per their design values.*
4. *These values have been assessed against Rolling stock Profile D and where any infringement with that outline occurs, it has been deemed acceptable.*
5. *Where track is redesigned past existing platforms the horizontal and vertical offset should be within the allowances in Table 7-6*

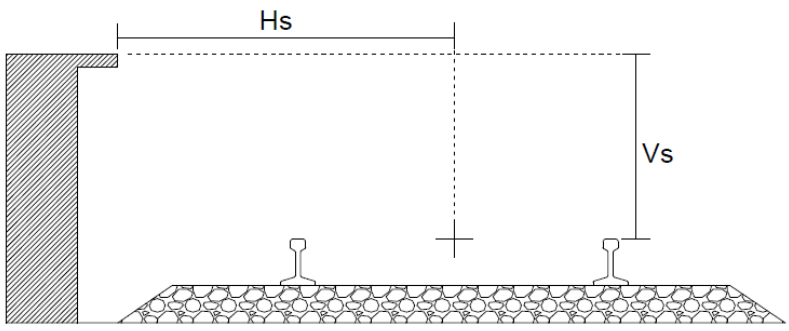


Figure 7-2 Straight Platform Coping Offsets

Alignment shall be determined from the point of coping closest to the nearest running face of rail, taking into consideration coping may not be straight.

7.2.5.1.1 Platforms on Curved Track

The height of a platform coping from the low rail shall be modified from the values in Table 7-4 as below.

For a concave platform: $$V_c = V_s + 1.7E_d$$ **(Equation 7-1)**

For a convex platform: $$V_v = V_s - 0.7E_d$$ **(Equation 7-2)**

The horizontal offset of a platform coping from track centreline shall be modified from the values in Table 7-4 as below.

For a concave platform: $$H_C = H_S + E - \left(\frac{V_s}{1435} E_d\right)$$ **(Equation 7-3)**

For a convex platform: $$H_V = H_S + C + \left(\frac{V_s}{1435} E_d\right)$$ **(Equation 7-4)**

Where:

C = Centre throw as per Appendix A

E = Centre throw as per Appendix A

E_d = Design Superelevation

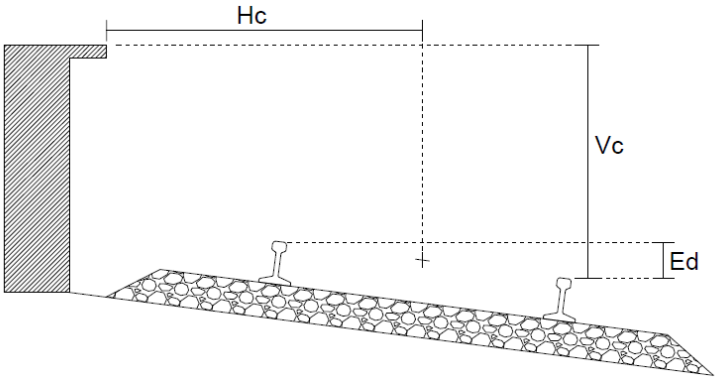


Figure 7-3 Concave Platform Coping Offsets

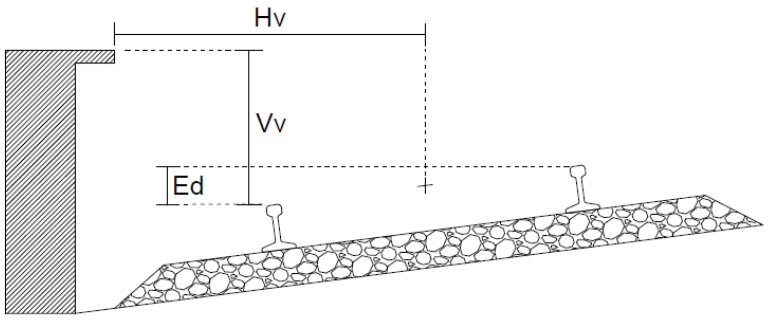


Figure 7-4 Convex Platform Coping Offsets

7.2.5.1.2 Platforms on Transitioned Track

The clearances to platforms adjacent to transition curves, or within a vehicle length of a transition curve, are determined from modified forms of the above formulae. The radius used is the effective radius at the point in the track being analysed, and the super-elevation used is the effective super-elevation at the point in the track being analysed.

for concave platform $$H_c = H_s + \frac{E}{R_e} - \frac{V_s}{1435} E_{ae}$$ **(Equation 7-5)**

for convex platform $$H_v = H_s + \frac{C}{R_e} + \frac{V_s}{1435} E_{ae}$$ **(Equation 7-6)**

The effective super-elevation (E_{ae}) for a **concave** platform is the average super-elevation of two points on the track, which are a distance of $\frac{L + B_c}{2}$ and $\frac{L - B_c}{2}$, in the direction of increasing super-elevation, from the point in the track being analysed.

The effective super-elevation (E_{ae}) for a **convex** platform is the average super-elevation of two points on the track, which are a distance of $\frac{B_c}{2}$, in each direction, from the point in the track being analysed.

The effective radius (R_e) for a **concave** platform is the average radius of two points on the track, which are a distance of $\frac{L + B_c}{2}$ and $\frac{L - B_c}{2}$, in the direction of tightening radius, from the point in the track being analysed.

The effective radius (R_e) for a **convex** platform is the average radius of two points on the track, which are a distance of $\frac{B_c}{2}$, in each direction, from the point in the track being analysed.

The average radius of two points can be determined using the following formula:

$$R_e = \frac{2}{\left(\frac{1}{R_1} + \frac{1}{R_2}\right)}$$ **(Equation 7-7)**

Where R_1 and R_2 are the radii at each of the two points.

The clearances to platforms adjacent to non-transitioned curves, or within a vehicle length of a non-transitioned curve are considered complex, the designer shall consider the swept path of the vehicle.

7.2.6 Clearance Points

The clearance point between two converging tracks is the point where one vehicle is able to pass another on the adjacent track with sufficient clearances.

7.2.6.1 Determination of clearance Point

The clearance point for new or updated design shall be taken as the location where there is at least 200mm contingency gap between the applicable kinematic envelopes of the vehicles on each track, including any applicable centre and end throw.

For greenfield works, the design vehicles for determining clearance points shall be based on the adopted design vehicles as per 7.2.2. For existing corridor works or existing clearance points, the design vehicle shall be that with the widest kinematic envelope in use on the corridor.

The following standard drawings are provided to represent standardised clearance point design for new passing loops where 4.5m track centres are required.

Table 7-5 Clearance Point Standard Drawings

STD-C0017	250:10.5 STRAIGHT END INFILL AT 40KM/H
STD-C0018	300:9 STRAIGHT END INFILL AT 45KM/H
STD-C0019	300:12 STRAIGHT END INFILL AT 45KM/H
STD-C0020	500:15 STRAIGHT END INFILL AT 60KM/H
STD-C0021	1200:18.5 STRAIGHT END INFILL AT 85KM/H

7.2.6.1.1 Alternate Determination of Clearance Point for Existing Tracks

For existing tracks, the clearance point may be taken as the location where there is at least 450mm between the static profiles (including allowances centre end throw) of the relevant rolling stock outlines for the corridor. The application of this criteria shall be endorsed by the asset management authority and recorded in the AMS.

Where this alternate clearance point is used, track shall be maintained to the same tolerances as required for platforms in ETS-05-00 Track Geometry.

This criteria may not be used for operation of Plates E1, F1, F2 or H.

7.2.6.2 Other Requirements

The clearance point should be clearly marked with an indicator as per drawing STD-C0038. Where the appropriate signage isn't in place, the use of a white peg or similar may be used.

The clearance points may be protected by use of catchpoints, fixed signals, track circuits and insulated joints.

A catchpoint shall be designed in such a way that a derailed vehicle does not infringe the structure gauge of any mainline or loop track.

The insulated joint at a clearance point shall be no closer than 3000mm to the clearance point, such that a vehicle stopped at the insulated joint will still be clear of the clearance point.

7.3 Construction and Maintenance

7.3.1 New or Relocated Structures

Any new or relocated structure adjacent to track shall be checked after completion to ensure it meet the design clearance requirements it was approved for.

Structures that do not meet their clearance requirements shall be corrected or an engineering waiver sought as per 7.3.4.

7.3.2 Track Alignment Works

Clearances shall be checked following any track alignment altering works undertaken at;

- any platform,
- any location where there is an infringement of the structure gauge, or
- any other location where the adjustment exceeds the tolerances of Table 7-3

7.3.3 Platforms

Track position adjacent to platforms shall be maintained as below.

Where these values are checked relative to platform coping, this should be compared to actual coping offset design for an individual platform, as the values in Table 7-4 may not apply to every platform.

The values in Table 7-6 are measure relative to the design track position.

Table 7-6 Maintenance Tolerances at Platforms

PARAMETER	TOLERANCE (MM)	
	INTERSTATE	HUNTER VALLEY
Gauge (from 1435 mm)	± 5	± 5
Track alignment (from design)	± 15	± 15
Cross-level (from design)	± 10	± 10
Rail Level	± 25	- 0 / + 70

7.3.4 Infringement Records

7.3.4.1 Infringement Waivers

All infringement waivers shall be endorsed by the Manager Engineering or equivalent.

The final approver should specify a timeframe to review the waiver, if applicable.

Infringement waivers shall be recorded and entered into the AMS as per AMT-GL-001, with the following information as a minimum;

- Location
- Standard required clearance(s)
- Permitted clearance(s) (E.g. Minimum acceptable distance from object)
- Controls
- Duration of waiver

The infringement record in AMS shall provide sufficient information that a location can be measured and compared to its permitted range of measurement to easily determine compliance.

The asset management authority shall maintain these records and waiver documents for the duration of the waiver.

7.3.4.2 Structure Outline Infringements

INFRINGEMENT RECORDS
Where any object infringes the structure outline it shall be recorded in the AMS as per AMT-GL-001.

7.3.4.3 Approval Requirements

The information below serves as a consolidation of approval requirements for clearance infringements stated elsewhere in this document.

Table 7-7 Summary of Approval Requirements

INFRINGEMENT TYPE	DESIGN OR CONSTRUCTION	MAINTENANCE[Note]
Any permanent structure within the Structure Outline	Engineering Waiver	N/A
Any non-permanent structure within the Structure Outline	Acceptance by Asset Management Authority	N/A
Any adjacent track clearances with less than 200mm contingency margin between kinematic rolling stock outlines	Engineering Waiver	Manager Engineering
Standard contingency outline (KE+200)	Engineering Waiver	Manager Engineering or Civil Engineering Representative
Absolute contingency outline (KE+100)	Engineering Waiver	Manager Engineering

Note: Maintenance refers to infringements identified in operational tracks by the asset team.

7.4 Inspection and Assessment

7.4.1 Scheduled Clearances Inspection

7.4.1.1 Patrol inspection

The purpose of a patrol inspection for clearances is to identify obvious visible clearance infringements and to report any structure or adjacent track that is damaged, unsound or of changed geometry.

PATROL INSPECTION	
Applicability	As per ETP-00-03. All mainlines, sidings, crossovers and loops
Frequency	7 days where not specified by ETP-00-03 Technical Maintenance Plan
Reference Procedure	ETE-00-02 Track Patrol, Front of Train, and General and Detailed Inspections
Competency Required	Track Examiner & Certifier

Track patrol inspections should keep a lookout for obvious clearance infringements and conditions (i.e. indicators of infringements) that may affect train operations including the following:

1. Track obstructions;
2. Obvious changes in track or structure location since previous inspection;
3. Visible markings or damage to structures, including platform edges;
4. Horizontal and vertical alignment past or through structures;
5. Debris on or near the track which may indicate rolling stock collisions with other rolling stock on adjacent tracks or structures;
6. Evidence of recent or current movement;
7. Clearance point markers are not visible, conspicuous or performing the function intended;
8. Other obvious defects that may affect clearances.

7.4.1.2 General Inspections

General inspections shall confirm compliance with the clearance standards and be able to detect the following:

1. Structures infringing the structure outline
2. Structures infringing standard contingency outline
3. Structures infringing absolute contingency outline
4. Insufficient clearance at clearance points
5. Adjacent tracks without sufficient contingency margin

General inspections shall also ensure that approved infringements inside standard contingency outline are located within their permissible infringement range.

These inspections should identify locations of clearance degradation requiring action and determine the need for further inspection if required.

Note: The structure outline may be substituted with a KE+350mm outline.

7.4.1.2.1 Inspection Frequency

The following rates of scheduled general inspection shall apply unless otherwise specified by ARTC e.g. in an approved Technical Maintenance Plan:

1. A general inspection of shall be undertaken as follows:
    a. Annually on passenger lines and lines carrying 10 million gross tonnes or more
    b. Every 2 years non-passenger lines carrying less than 10 million gross tonnes and sidings with a speed exceeding 25km/h
    c. Every 4 years on sidings with a speed of 25km/h or less
2. An inspection of approved infringements inside standard contingency, including platforms shall be undertaken at twice the frequency of the above.
3. Structures located outside of the adopted structure outline do not require records of clearance to be taken and can be managed by exception when detected during a general inspection

A general inspection including determination of the available clearances should also be carried out when there are suspected defects following work affecting the location of the track(s) or structure or defects are identified from patrol inspections.

7.4.1.2.2 Inspection requirements

General inspections of clearances shall be carried either manually or by electronic survey. The Asset Management Authority may stipulate measurement increments in a published asset management document. In the absence of such document measurements shall not be taken at increments greater than;

- Every 250m for track centreline clearance on straight track
- Every 50m for track centreline clearance on curved track
- Every 50m for the length of any infringement, including platforms

Records of these inspections shall be recorded in the AMS.

The scheduled inspections should include the tasks of the patrol inspection in addition to the measurement of the following:

1. Vertical distance infringing objects measured from top of rail;
2. Horizontal distance to infringing objects measured from the gauge point;
3. Distance between track centrelines (including fouling clearances/clearance points at turnouts);
4. Track superelevation;

These measurements shall be compared to the allowable limits based on adopted rolling stock outlines and curvature of the track. Where clearance waivers are in place these measurements shall be compared to the allowable limits in the waiver.

In order to simplify the inspection process, the Asset Management Authority should determine the required clearances and record this information in the AMS, such that an inspector (or inspection system) is only required to check the actual measurement against the minimum permitted.

Electronic surveys shall comply to the requirements of AMT-GL-103 where applicable.

7.4.2 Assessment and Actions

7.4.2.1 General

Clearances shall be assessed against the clearance standards adopted for each line section.

The results of inspections shall be assessed to determine whether the structure (or the maximum kinematic rolling stock outline on adjacent tracks) infringes the standard or absolute contingency outlines for clearances, and action taken as set out in 7.4.2.3 and 7.4.2.4.

Appendix C details the requirements of standard and absolute contingency outlines for various rolling stock profiles.

7.4.2.2 Movement relative to datum point or last known position

Where a datum point exists (e.g monument, plaques etc) or last position is known, any track measured outside of the allowable tolerances in ETS-05-00 shall be checked for infringement to the standard and absolute contingency outlines and actioned as per 7.4.2.3 or 7.4.2.4.

Where neither standard is infringed but the tolerances of ETS-05-00 have been exceeded the location should be recorded as a known condition for correction.

7.4.2.3 Infringement of the standard contingency outline

Where the standard contingency outline is infringed, either;

1. Action should be taken to restore the clearances such that the standard contingency outline is not infringed, with clearances monitored (e.g. during patrols) until this action is completed; or
2. Approval should be sought as per 7.3.4

Note: The increased rate of general inspection guidelines in 7.4.1.2.1 *shall apply where the infringement is accepted.*

7.4.2.4 Infringement of the absolute contingency outline

Where the absolute contingency outline is infringed, either;

1. Action should be taken, prior to the passage of the next train, to restore the clearances such that the absolute contingency outline is not infringed by either adjusting the track or the infringing object, see Note; or
2. Restrictions should be applied to operations, prior to the passage of the next train, until action can be taken to restore clearances.
3. Approval should be sought as per 7.3.4

Track clearances measured to be less than required in Appendix C shall be treated as an infringement to the absolute contingency outline.

Note: If this action does not restore clearances such that the standard contingency outline is not infringed, actions from 7.4.2.3 should then be implemented for infringement of the standard contingency outline.

7.4.2.5 Approved infringements

Where an approved infringement for clearances has been permitted, the results of inspections shall be assessed to determine whether the infringement has exceeded their allowable range detailed in their infringement waiver, see Note 1.

Platforms are considered an approved infringement and shall be maintained within the tolerances specified in 7.3.3

Where the infringement has exceeded its allowable range, either;

1. action should be taken prior to the passage of the next train, to restore the track position such that the track tolerances are not exceeded; or
2. restrictions should be applied to operations, prior to the passage of the next train, until action can be taken to restore the track position.

Notes:

1. This may be achieved using datum markers on structures, however where this is not the case the relative position of track and structure (or track and adjacent track) should be checked against the infringement record at the location.

Appendix A – Clearance Design Procedures

A1 Static Rolling stock Outline

The static rolling stock outline for the rolling stock operating on a track section should be determined in conjunction with operators.

The static rolling stock outline should be met by the rolling stock under all maintenance and loading conditions (e.g. at all wheel diameters in the range for new and condemnable worn wheels).

A2 Vehicle Swept Path

The centre throw (C in mm) and end throw (E in mm) of rolling stock on circular curved track may be calculated as follows:

$C = B^2 / 8R$ …**(Equation 7-8)**

and

$E = (L^2 - B^2) / 8R$ . . . **(Equation 7-9)**

where:

B = length between pivot centres of bogies (mm)

L = overall length of vehicle (mm)

R = radius of curve (mm)

The swept path should be based on the static rolling stock outlines operating on the section of track under consideration as follows:

1. On straight (tangent) track the swept path should not be less than the static outlines of the rolling stock.
2. On circular curved track down to 100 m radius the swept path should not be less than the static outlines of the rolling stock plus allowance made for centre and end throw.

A3 Track Tolerances

Track tolerances should be determined for the line section being considered for the following:

1. Rail side wear.
2. Gauge widening on curved track.
3. Gauge from 1435 mm.
4. Track alignment from design.
5. Cross level from design.
6. Rail level from design.

Note: The design track position should be known as well as these tolerances.

These tolerances are covered in Table 7-3

A4 Dynamic Rolling stock Limits

The dynamic rolling stock limits should be determined in conjunction with operators for the following displacements:

1. Linear, to each side of the vehicle centreline and parallel to the plane of the top of the rails for lateral translation and for wheel clearance (worn wheel to new rail).
2. Angular, clockwise and anti-clockwise about the roll centre, for body roll.
3. Upward linear displacement normal to the plane of the top of the rails, for bounce.

Note: These tolerances are covered in Table 7-2

A5 Kinematic Rolling stock Outline

The kinematic envelope for an item of rolling stock is intended represent the real largest realistic profile it can assume under adverse conditions.

It should be determined for the particular track section using the following procedures:

1. Determine the static rolling stock outline (on straight, non-superelevated track) for the rolling stock operating on the line section.
2. For each point on the static rolling stock outline, apply horizontal displacements to widen the outline on each side of its vertical centreline for—
    i. rolling stock lateral translation;
    ii. wheel clearance (worn wheel to new rail);
    iii. rail side wear;
    iv. gauge widening of the track;
    v. gauge tolerance of the track; and
    vi. centre and end throw of the rolling stock on curved track.
3. From Step 2, apply vertical displacements to extend the outline vertically for rolling stock bounce.
4. From Step 3, apply angular displacements about the point of cant rotation for cant.
5. From Step 4, apply angular displacements about the left hand rail for cross level tolerance.
6. From Step 4, apply angular displacements about the right hand rail for cross level tolerance.
7. From Steps 5 and 6, apply angular displacements about the roll centre of the vehicle for body roll. (In the case of tilt trains, apply additional angular displacements about the tilt centre for body tilt.)

Note: Roll centre is displaced by previous steps

8. From Steps 5, 6 and 7, apply horizontal displacements for track alignment tolerances, and vertical displacements for rail level tolerances.
9. The maximum envelope from steps 5, 6, 7 and 8 defines the maximum kinematic rolling stock outline.

A6 Contingency Margin Provision

The provision of a contingency margin between the maximum kinematic rolling stock outline and structures (or maximum kinematic rolling stock outlines on adjacent tracks, see Note) should take into account the following:

1. Absolute contingency outlines, standard contingency outlines, and structure outlines.
2. Inspection intervals.
3. Variations in and rates of change of the parameters used to determine the maximum kinematic rolling stock outline.
4. Potential for movement of the structure.

Note: For a given line section the maximum kinematic rolling stock outline on an adjacent line may be treated in a similar way to a structure over the line.

Appendix B – Clearance Diagrams

Rolling stock profile diagrams can be found in the ARTC Route Access Standard.

Kinematic outlines provided on the Route Access Standard are based upon the full track tolerances for straight track with timber sleepers.

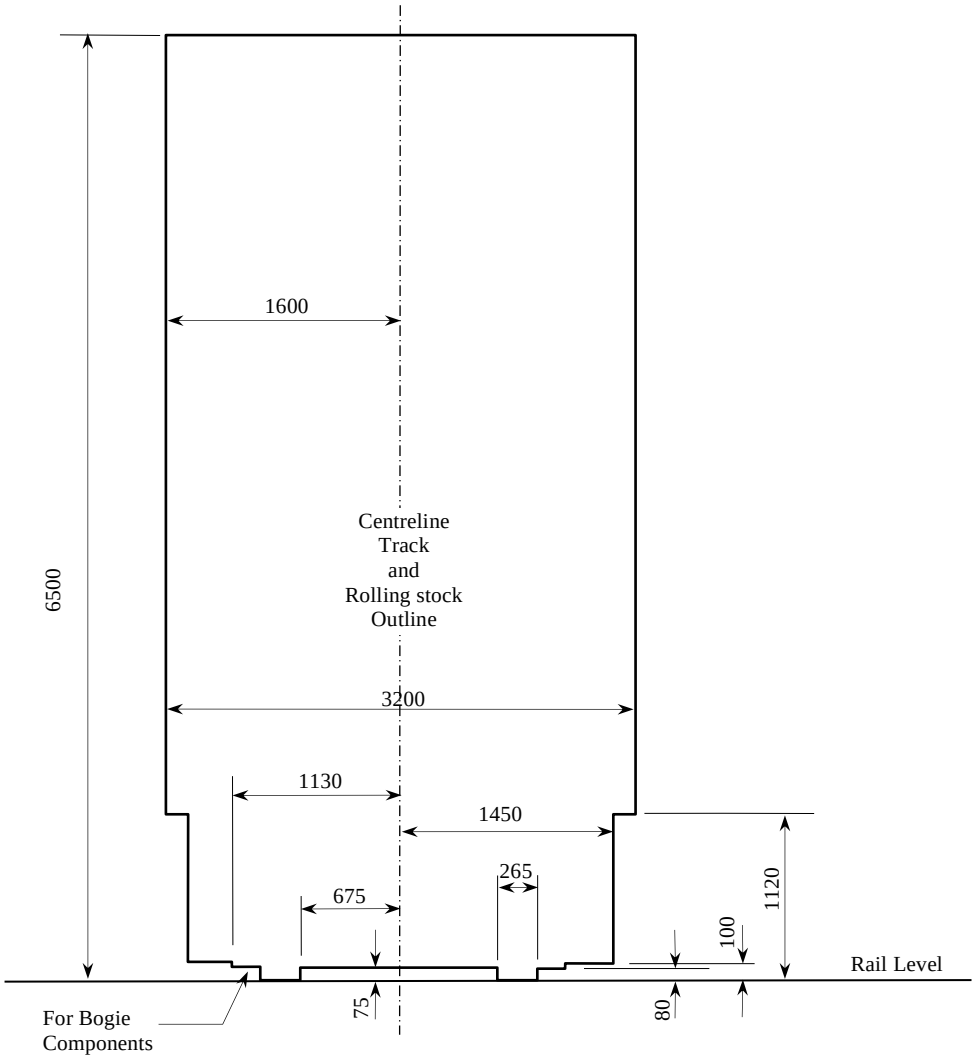
Design Reference Vehicles F and G are included in this Appendix as they do not represent real vehicles that can applied in operation.

https://www.artc.com.au/customers/standards/route/access/

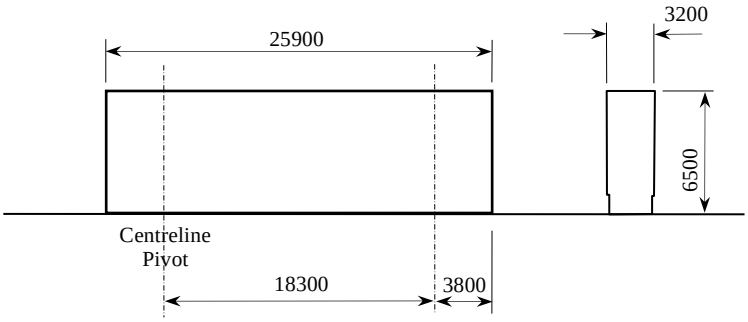
These structure outlines have been derived from the corresponding static rolling stock outlines by applying the following:

1. Dynamic rolling stock limits from Table 7-2.
2. Track tolerances from Table 7-3.
3. 150 mm and 0 mm cant elevation to provide for clearances on the inside and outside rail respectively of curved track.
4. For curves of 300 m radius or greater, centre and end throws based on 300 m radius.
5. For curves of radius 100 m and greater but less than 300 m radius, centre and end throws based on 100 m radius.
6. 200 mm air gap

B1 Design Reference Vehicle F



End View

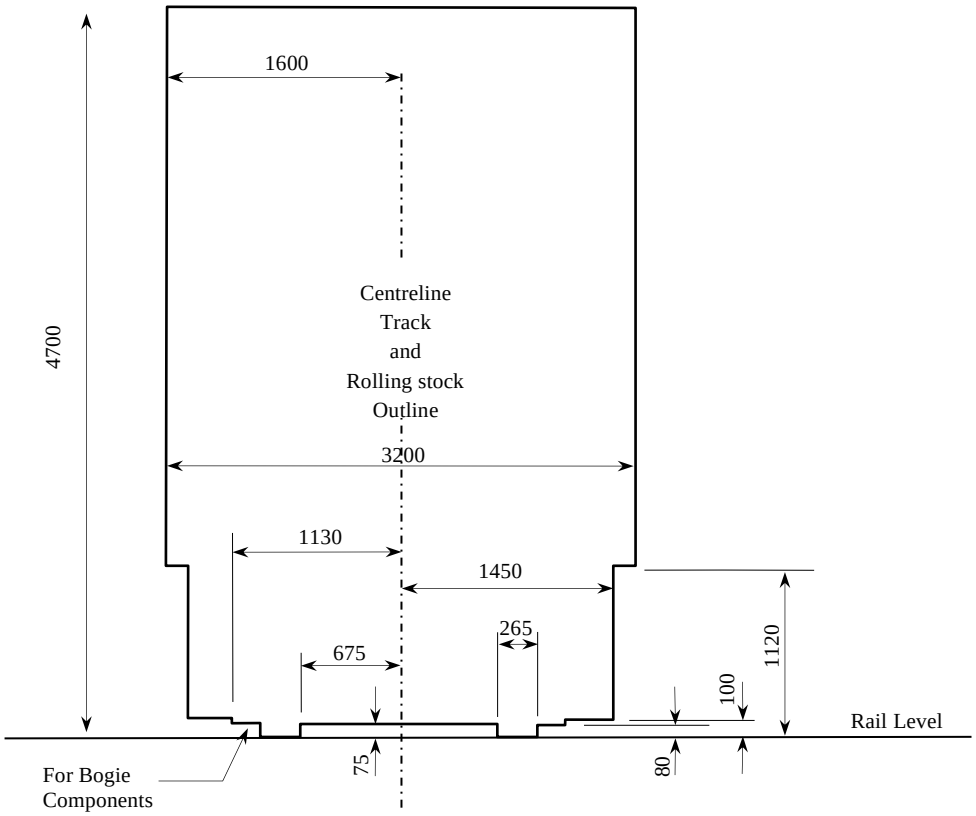


Design Vehicle Configuration

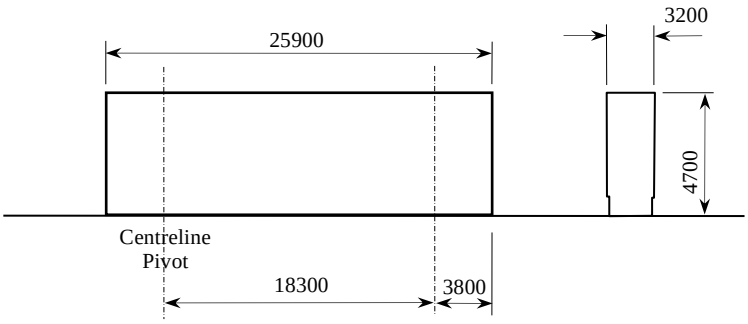
Note: This reference vehicle is used for civil design only. It represents a single outline that encompasses all other rolling stock outlines and provides the extreme outline in all conditions.

This outline cannot be used for operational purposes.

B2 Design Reference Vehicle G



End View



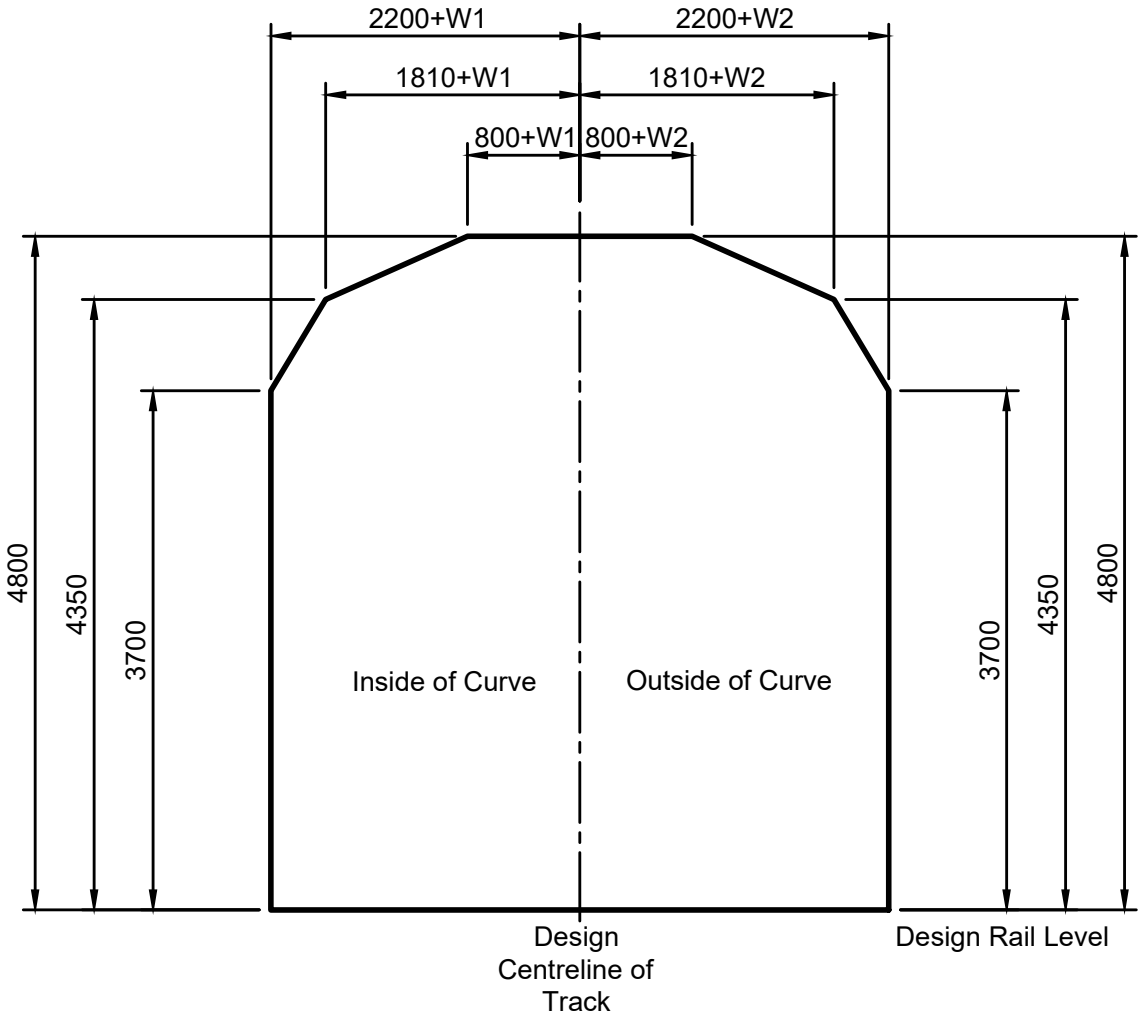
Design Vehicle Configuration

Note: This reference vehicle is used for civil design only. It represents a single outline that encompasses all other single-stack rolling stock outlines and provides the extreme outline in all conditions.

This outline cannot be used for operational purposes.

B3 Structure Outline ABCD

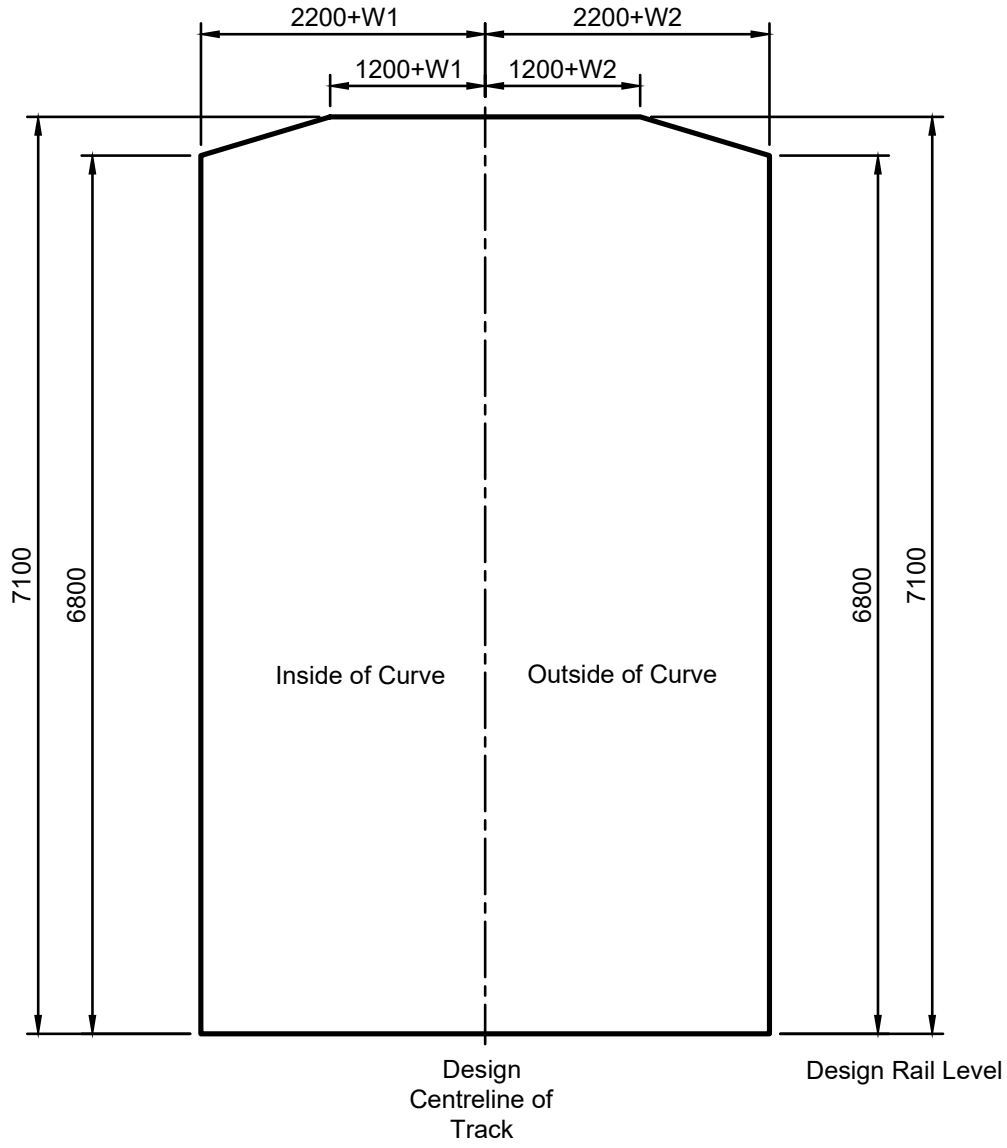
Used for Rolling stock Outlines ABC & D



CURVE ALLOWANCE		
RADIUS	**INSIDE OF CURVE**	**OUTSIDE OF CURVE**
	W1	**W2**
100 to <120	650	350
<140	575	275
<180	550	250
<225	500	200
<300	450	150
<450	425	125
<900	375	75
<1800	350	50
>1800	325	25
Tangent	0	0

B4 Structure Outline D H F2

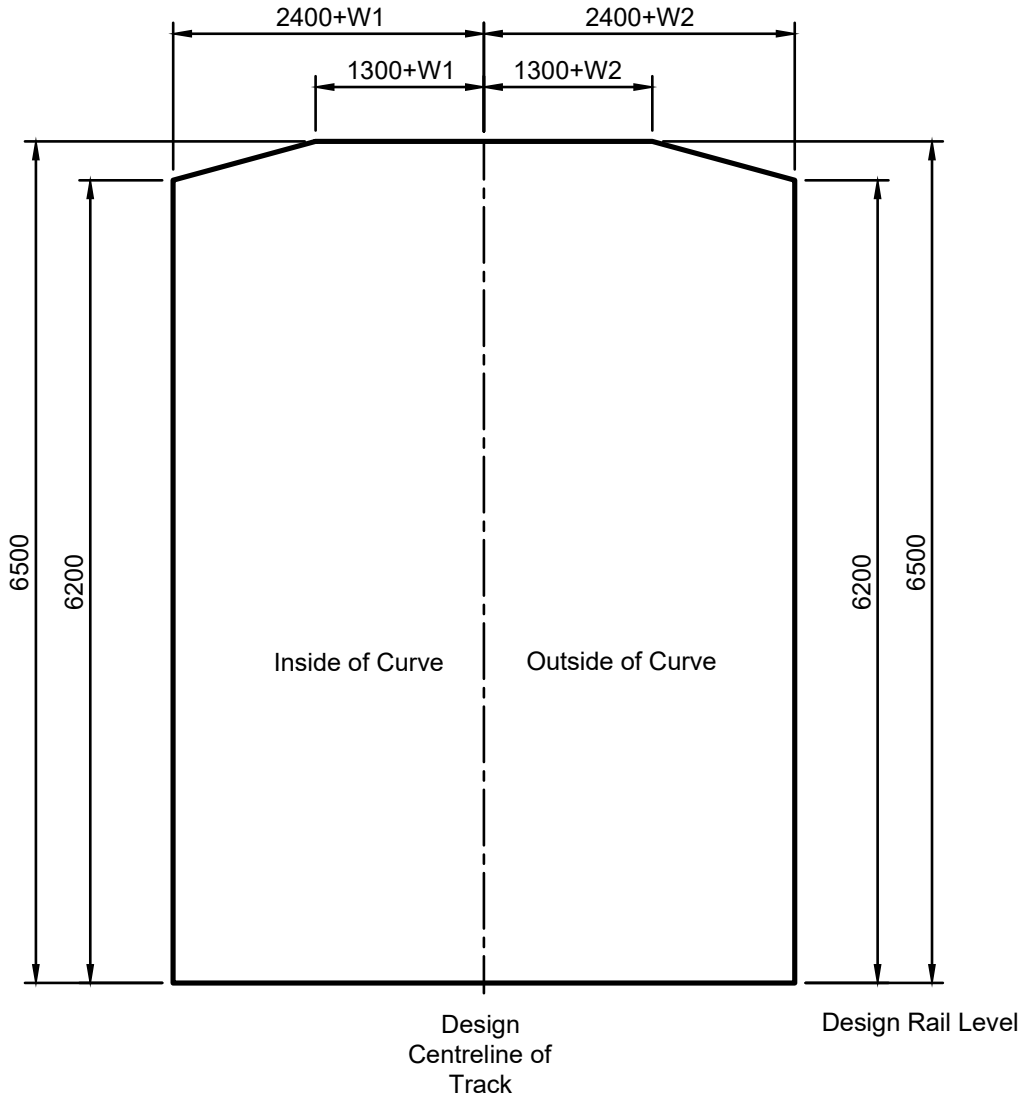
Used for Rolling stock Outline F2 (applicable for Rolling stock Outline D,H,F2 Corridors)



CURVE ALLOWANCE		
RADIUS	**INSIDE OF CURVE W1**	**OUTSIDE OF CURVE W2**
100 to <120	875	275
<140	825	225
<180	800	200
<225	750	150
<300	700	100
<450	675	75
<900	650	50
<1800	600	0
>1800	575	0
Tangent	0	0

B5 Structure Outline E1

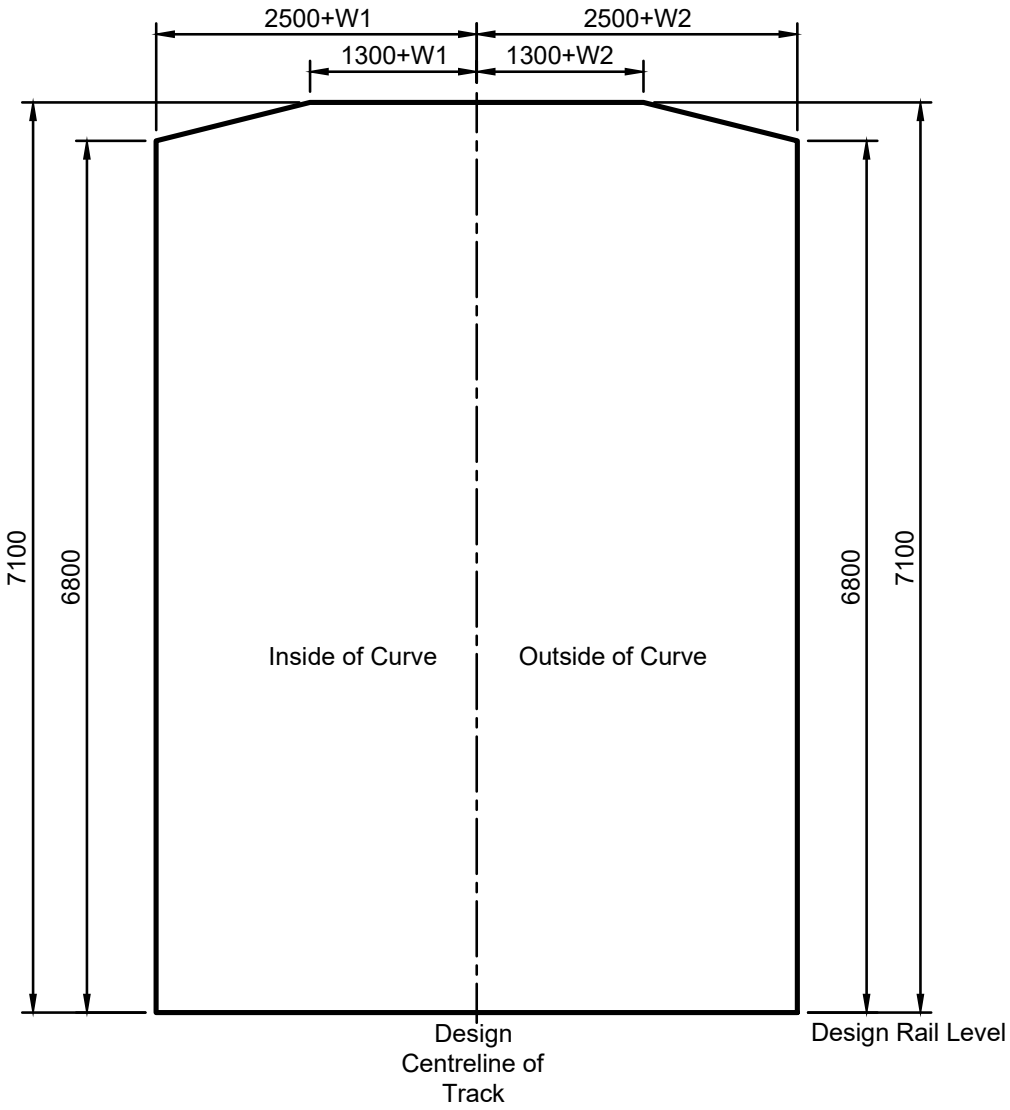
Used for Rolling stock Outline E1



CURVE ALLOWANCE		
RADIUS	**INSIDE OF CURVE**	**OUTSIDE OF CURVE**
	W1	**W2**
100 to <120	925	325
<140	850	250
<180	800	200
<225	750	150
<300	700	100
<450	650	50
<900	600	0
<1800	550	0
>1800	525	0
Tangent	0	0

B6 Structure Outline F

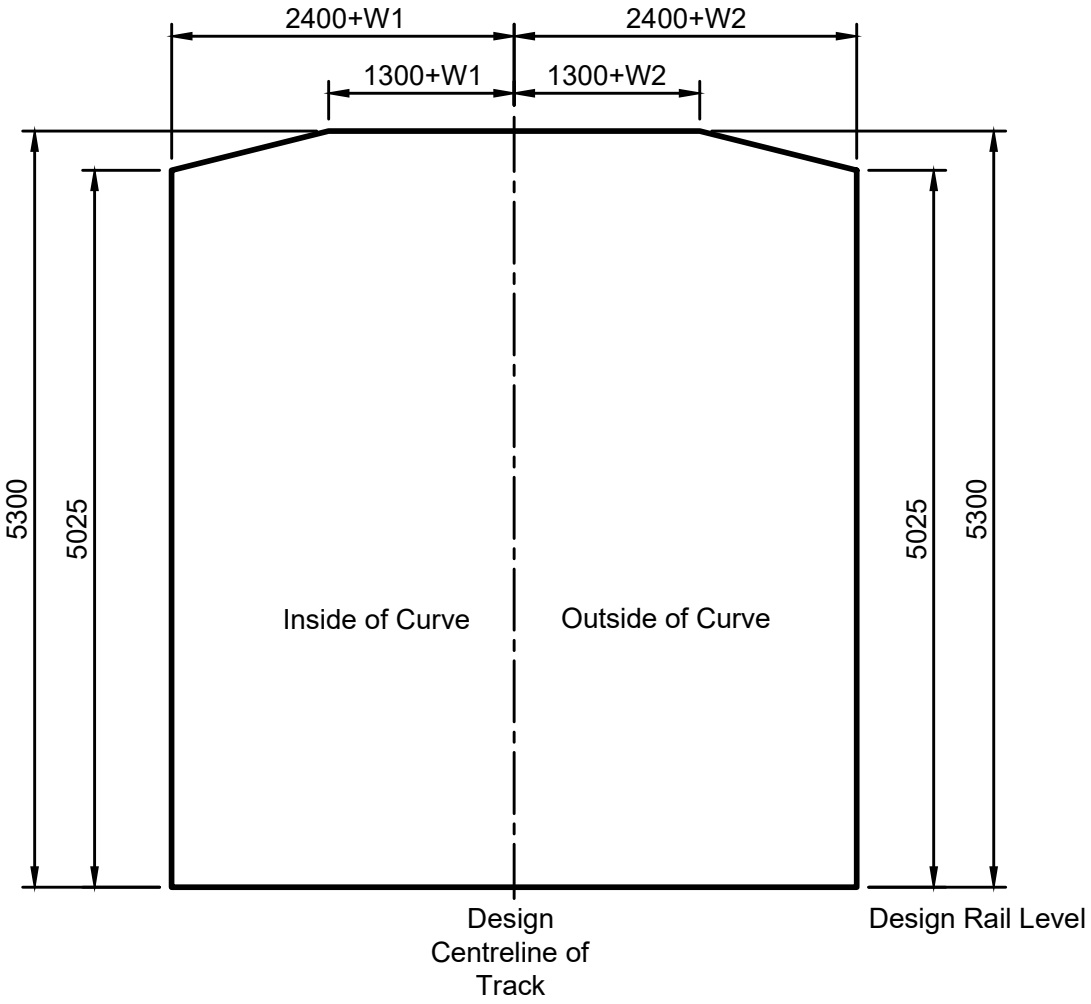
Used for Rolling stock Outline F and F1



CURVE ALLOWANCE		
RADIUS	**INSIDE OF CURVE**	**OUTSIDE OF CURVE**
	W1	**W2**
100 to <120	1050	375
<140	975	300
<180	925	250
<225	850	175
<300	800	125
<450	775	100
<900	725	50
<1800	675	0
>1800	650	0
Tangent	0	0

B7 Structure Outline G

Used for Rolling stock Outline G



CURVE ALLOWANCE		
RADIUS	**INSIDE OF CURVE W1**	**OUTSIDE OF CURVE W2**
100 to <120	750	375
<140	675	300
<180	625	250
<225	550	175
<300	500	125
<450	450	75
<900	425	50
<1800	375	0
>1800	350	0
Tangent	0	0

B8 Simplified KE+200 Diagram for D, H and F2

Used for Rolling stock Outline F2 (applicable for Rolling stock Outline D,H,F2 Corridors)

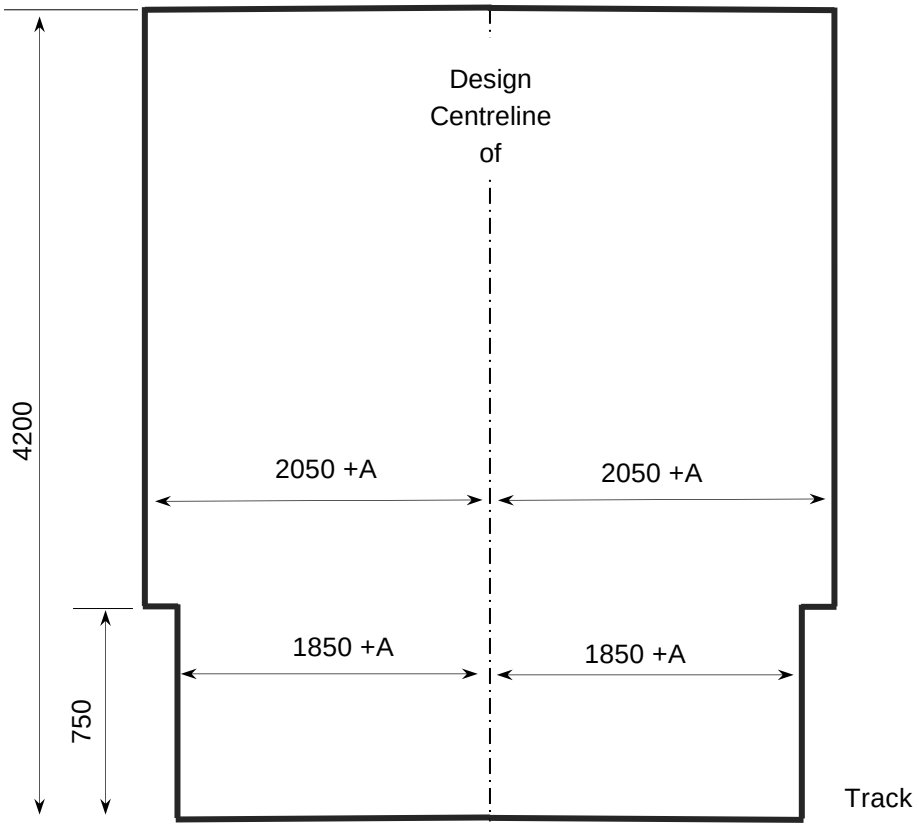
This diagram be used a simple indication of acceptable clearances for relocation or re-alignment of track or trackside requirement (e.g. signals) It will produce a more conservative result than calculating clearance in detail.

This diagram shall only be used for lateral offsets of objects less than 4200mm above top of rail.

Structures outside of the diagram below and below 4200mm from top of rail may be considered as not infringing KE+200. The requirements based on clearance are covered in 7.3.4

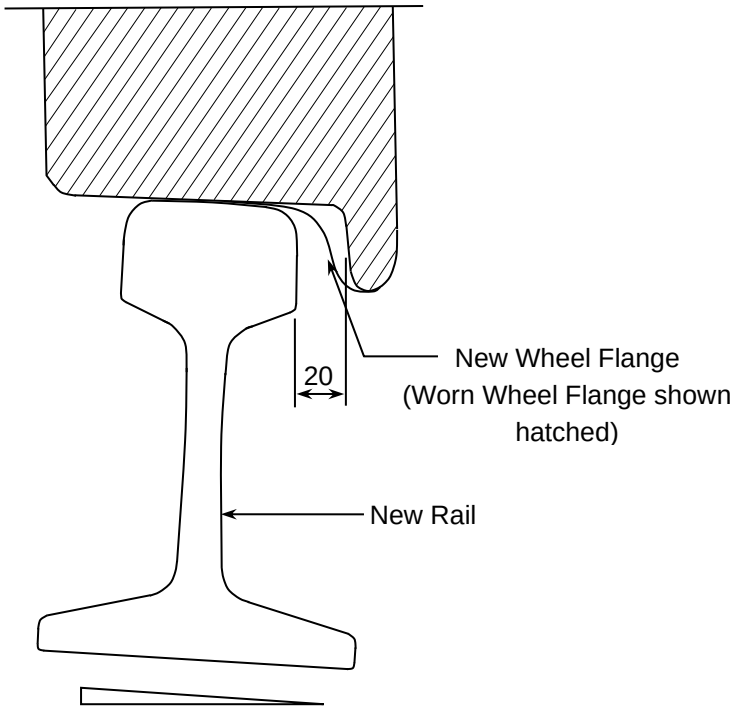
This diagram is aligned with track plane (e.g. the alignment of both rails)

Note: It is preferable that all structures, include signs be outside of the structure outline F2.

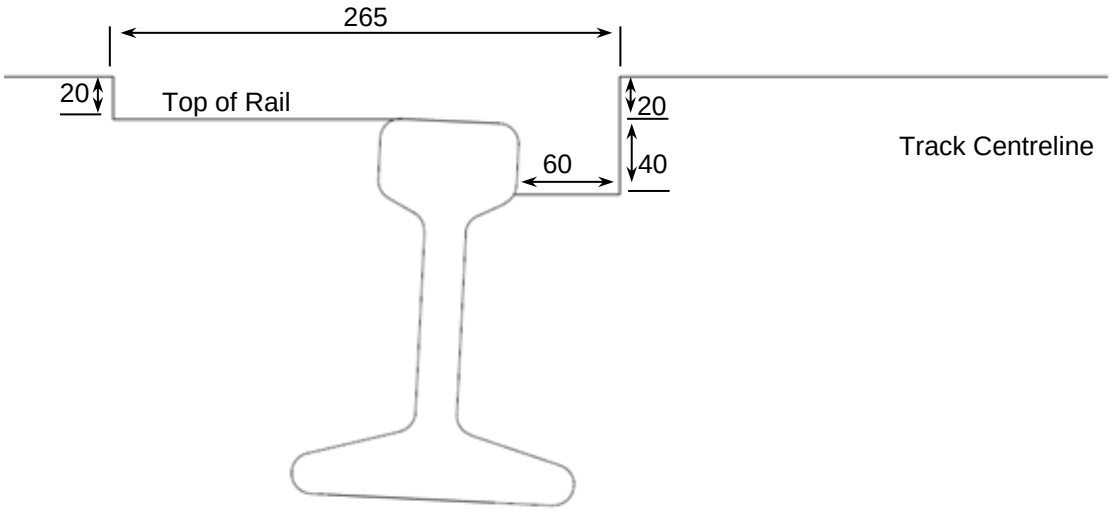


CURVE ALLOWANCE			
RADIUS	**A**	**RADIUS**	**A**
<120	300	<400	100
<140	250	<500	75
<160	200	<800	50
<180	175	<5000	25
<250	150	>5000 & Tangent	0
<300	125		

B9 Wheel Clearance (Worn Wheel to New Rail)



B10 Rail / Sleeper Mounted Equipment Clearances



Appendix C – Clearance Limits

The kinematic, standard contingency and absolute contingency values in this appendix refer to the values furthest from centreline, this is typically toward the top of the rolling stock envelope. Lesser values may be required at heights closer to top of rail.

These values are calculated using full track tolerances for straight track.

Refer to ARTC RAS for list of rolling stock profiles on each corridor.

C1 Horizontal Clearance Limits Measured from Track Centreline

These values apply to straight track only, additional allowances are required for curves.

Refer to 7.4.2 for required actions

PROFILE	KINEMATIC	ABSOLUTE	STANDARD	STRUCTURE GAUGE	TRACK CENTRES
A	1796	1896	1996	2200	3792
B	1834	1934	2034	2200	3868
C	1796	1896	1996	2200	3792
D	1836	1936	2036	2200	3872
E1	2092	2192	2292	2400	4384
F1	2030	2130	2230	2500	4260
F2	1781	1881	1981	2200	3762
H	1852	1952	2052	2200	3904
CZ	1796	1896	1996	2200	3792

C2 Horizontal Clearance Limits Measured from Rail Gauge Point

These values apply to straight track only, additional allowances are required for curves.

These values are measured from the gauge face of the closest rail.

Refer to Section 7.4.2 for required actions.

PROFILE	KINEMATIC	ABSOLUTE	STANDARD	STRUCTURE GAUGE	TRACK CENTRES
A	1079	1179	1279	1483	2357
B	1117	1217	1317	1483	2433
C	1079	1179	1279	1483	2357
D	1119	1219	1319	1483	2437
E1	1375	1475	1575	1683	2949
F1	1313	1413	1513	1783	2825
F2	1064	1164	1264	1483	2327
H	1135	1235	1335	1483	2469
CZ	1079	1179	1279	1483	2357

C3 Vertical Clearance Limits Measured from Top of Rail

Kinematic outline values are measured in the plane of the track (e.g. aligned to the rails).

Structure gauge is measured vertical.

Refer to Section 7.4.2 for required actions.

PROFILE	KINEMATIC	ABSOLUTE	STANDARD	STRUCTURE GAUGE
A	4459	4559	4659	4800
B	4459	4559	4659	4800
C	4459	4559	4659	4800
D	4459	4559	4659	4800
E1	6154	6254	6354	6500
F1	6753	6853	6953	7100
F2	6737	6837	6937	7100
H	5785	5885	5985	7100
CZ	4482	4582	4682	4800