

S1156 A11

Gauging and Clearances

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1 Purpose

- 1.1 The purpose of this standard is to define the required Clearances and limiting dimensions of infrastructure and trains and their management.

2 Scope

- 2.1 This standard applies to all London Underground (LU) track including running lines depot track and sidings and to the vehicles that are approved to operate on this track.
- 2.2 It applies to all platforms and to all structures and equipment both permanent and temporary which form the immediate boundary with the space provided for the passage of the rail vehicles using the Track.
- 2.3 It includes requirements for Clearances between vehicles and structures, between vehicles on adjacent tracks and the dimensions required for places of safety.
- 2.4 It includes requirements for:
- a) approval of Clearances prior to the commencement of works
 - b) checking of Clearances following work
 - c) routine inspection and maintenance of Clearances
 - d) assessment of Clearances for tunnel construction or rebuilds
 - e) the management of non-compliant Clearance.

3 Requirements

3.1 General

- 3.1.1 This standard defines the limiting dimensions for the system comprising the track, the infrastructure adjacent to the track and rail vehicles based on the requirement to ensure that minimum defined Clearances are achieved between trains and structures and between trains on adjacent lines under all permitted operating conditions and all permitted configurations and degradation of the components forming the system.
- 3.1.2 The running edge and crown of the nearest running rail must be used as the datum for all measurements of the adjacent Structure Gauge. The wheel tread and flange must be used as the datum for all measurements of Vehicle Profile.
- 3.1.3 In all cases where heights and offsets are used to measure the Structure Gauge in the true horizontal and vertical planes they must be adjusted to allow for any cant present on the track at the location of measurement. For platforms see 5.3.1.3.
- 3.1.4 A Concession shall be sought for clearance non-compliance unless managed by TfL Permanent Way Engineering using the approved methods detailed within this standard, i.e. if permitted as part of the Clearance Approval process (see 3.2) or Track Engineers adherence to PR0038 using Dynamic Gauging (see 3.5 & 3.6).

3.2 Clearance approvals

- 3.2.1 Any temporary or permanent asset, structure, or equipment to be installed, modified or adjusted that is located less than 5m above or within 3m laterally of LU track shall receive Clearance approval in advance of the works.
- 3.2.2 In the first instance an application for Clearance assessment shall be made using Stage 1 of the application form for approval of Clearances shown in Attachment 1 or an equivalent form. The applicant must provide all information requested on the form including details of the equipment and procedure that is to be used for checking that the Clearances provided by the completed works are fully compliant with those agreed through the Clearance Approval process.
- 3.2.3 After assessment by a Clearance Approval Engineer, if Clearances are non-compliant with section 5.2, but are deemed acceptable due to specific circumstances, a concession shall be sought (by the applicant) except as explained in clause 3.2.4 below. Applications for Concessions in respect of sub-standard Clearances will not be considered unless the Clearance Approval procedure has been followed and the Assessor has indicated their support for a concession to be granted.
- 3.2.4 Where the proposed change relates to the approval of the installation or repositioning of equipment that will infringe the permitted Structure Gauge/profile but will not make an existing situation worse a concession need not be sought provided that the change is authorised through the Clearance Approval process (by an authorised competent engineer) and has established that:
- a) the work is necessary
 - b) the work will not cause any reduction to existing Clearances where these are equal to or less than those specified in this standard
 - c) the infringement is unavoidable on the basis of technical feasibility and/or cost
 - d) the proposed design represents “Good Practice” and provides the best affordable solution
 - e) the work is formally recorded in the Restriction Management System Database (RMSD).
- 3.2.5 If a concession has been granted the application shall be re-submitted for Clearance Approval before work commences.
- 3.2.6 No physical work shall take place until Stage 2 of the Clearance application form, (as shown in Attachment 1, or the equivalent form), has been completed and signed as Approved by the Clearance Approval Assessor and evidence of this approval, together with any approved Concession, is available to the Site Person in Charge of the work.
- 3.2.7 A T002/T003 Safety Critical Licensed Person shall be used to confirm adequate Clearances at hand back to operations. Stage 3 of the Clearance Application Form, (as shown in Attachment 1, or the equivalent form), shall be completed and returned to [REDACTED] [@tfl.gov.uk](mailto:[REDACTED]@tfl.gov.uk). Physical works are subject to random or discretionary surveillance checks to confirm compliance. The as-built data including amended drawings and dimensions shall be recorded and submitted for inclusion in the Mandatory Asset Information Deliverable for each Clearance Approval.

3.2.8 A central database (RMSD - Restriction Management System Database) of Clearance infringements shall be kept and maintained on behalf of the standards owner.

3.3 Clearance assessment

3.3.1 The Structure Gauge Diagrams show requirements. They must not be interpreted as depicting actual Clearances available, which may be less than shown at any given location.

3.3.2 When carrying out Clearance assessment, the minimum acceptable Clearances (adjusted for curvature and cant) defined on the Structure Gauge Diagrams in Section 5.6 shall be used.

3.3.3 All gauges and profiles described in section 5.6 are defined on straight and level track. On curves vehicle bodies are displaced relative to the track centre line due to the effects of curvature and cant. An appropriate method shall be used to calculate the effects of curvature and cant. Where horizontal curvature drops below 400m, the more accurate formula in attachment 3 should be used.

3.4 Gauges and verification of Clearances

3.4.1 All Tunnel Gauges and processes, including software, shall be of an approved type and appropriate for the required work. Reference shall be made to Structure Gauge Diagram A2 in section 5.6 to determine the correct type of Tunnel Gauge for use at a particular location.

3.4.2 The gauges shall be requested from an approved Supplier and returned to them on completion of the works.

3.4.3 The Supplier shall be responsible for maintenance and calibration to an approved schedule.

3.4.4 Personnel using gauges or software shall be trained and competent to do so.

3.4.5 Use of a Tunnel Gauge may not fully replicate a specific Structure Profile as depicted on the Structure Gauge Diagrams. This particularly applies to those Structure Profiles which are authorised variations to the general issue. In such cases additional measurements shall be made in order to fully replicate the Structure Profile.

3.5 Dynamic Gauging

3.5.1 Dynamic Gauging shall be implemented and managed to detect and measure any infringements of the Structure Profile.

3.5.2 Dynamic Gauging shall be performed to a risk-based cyclical programme to:

- a) Ensure compliance with Structure Profile requirements
- b) Provide up-to-date Clearance data for specific projects, e.g. the introduction of new rolling stock and raising of line speeds
- c) Provide information for the appropriate asset databases
- d) Provide records of infringements and programmed action.

Dynamic Gauging shall additionally be carried out to inspect for compliance with the required Structure Profile prior to the opening of new or reconstructed lines.

- 3.5.3 Dynamic Gauging shall survey Clearances to detect infringements of the Structure Profile whilst combining the dynamic effects of a vehicle in terms of body throw and loading of the track.
- 3.5.4 Computer simulated Dynamic Gauging can be undertaken by using a vehicle model that is compared with laser gauged profiles to establish accurate Clearance between the Swept Envelope and the infrastructure. Track geometry data, (e.g. TRV data or a set of track irregularity files named 'track for Gauging files' – reference RSSB document RIS-2773-RST) shall be used in this process to account for the dynamic effect of vehicle loading on track.
- 3.5.4.1 Computerised clearance software products shall consider the survey accuracy used to measure the structure. All software used for computer simulation must be approved by TfL.
- 3.5.4.2 Additional track positional tolerances shall be considered for: (a) Track Fixity and (b) side wear. The practical application of Track Fixity for use on LU is detailed in Procedure PR0038 which relates to the management of Clearance infringements. Further Track Fixity applicability shall be considered on a case-by-case basis where reference can be made to TfL document 20877-RPT-TRK-TF-001 for guidance.

Note: Computer simulation shall not be used to allow infringements of the Structure Profile without authorised TfL Permanent Way Engineering personnel's adherence to Procedure [PR0038](#) in association with approved processes (see 3.6.1.1).

- 3.5.5 Each Dynamic Gauging assessment shall generate a report of infringements of the Structure Profile, including their location, extent and value in sufficient detail to allow them to be easily located during subsequent site visits. As a minimum the following reports shall be provided:
- a) On-line reports (real time). Where possible, on-line reports shall be generated in real time, or immediately after a Dynamic Gauging
 - b) Off-line reports (post analysis). Data recorded during Dynamic Gauging shall be stored into a database for off-line report generation and further analysis, if required.
- 3.5.6 Dynamic Gauging data stored in a database shall be archived before over-writing so that a statistical history of structural Clearances can be maintained. Statistical data for each line recorded shall be backed up and retained for a minimum five-year period or until superseded by later Dynamic Gauging data.

3.6 TfL Permanent Way Engineering

- 3.6.1 Track Engineers shall consider the requirements of section 5 in all track designs.
- 3.6.1.1 Track Engineers (authorised as competent) may utilise Dynamic Gauging methods by adherence to Procedure [PR0038](#) "Management of Clearance Infringements" along with approved processes including the required level of checking and approval.

- 3.6.2 An appropriate clearance assessment shall be carried out before moving any track on site. The nature of the clearance assessment shall be determined on the estimated level of risk-taking account of relevant factors including:
- a) existing clearances to structures and to vehicles on adjacent tracks;
 - b) availability of track position datums
 - c) the nature of the proposed works.
- 3.6.3 Where the proposed clearances infringe the permitted Structure Gauge (see Structure Gauge Diagram C1 or E1) but maintains the relevant Structure Profile then a concession need not be sought provided that for each infringement it can be shown that:
- a) the work is part of an agreed package of work
 - b) the infringement is reasonably tolerable on the basis of technical feasibility
 - c) the proposed design represents “Good Practice” and provides the best affordable solution
 - d) the infringement is accepted by a suitably accredited engineer and formally recorded in the GNCR form
 - e) Consideration is given to any reduction of places of safety (See 5.5) via liaison with the relevant Track Manager(s).
- 3.6.4 Work which will move the track from its position shall be controlled so that adequate clearance to the Structure Profile and associated Kinematic Limit is maintained wherever practicable by reference to the principles set out in the Clearances section (see 5.2.) Where the Structure Profile is unavoidably infringed, clearance assessments shall be carried out in accordance with Procedure PR0038 using the Swept Envelopes of relevant passenger rolling stock (see Permitted Running Routes for Passenger Rolling Stock). The concluding clearance assessments shall be accepted by a suitably accredited engineer, via the Generic Non-Compliance Report (GNCR), and formally recorded in the RMSD database. The RMSD shall be updated with final as-built data.
- 3.6.5 Where it is necessary to carry out clearance assessments using the Swept Envelope(s) of passenger rolling stock, a clearance assessment shall also be carried out using the appropriate Load Gauge for engineering trains permitted to run at the location (see Permitted Running Routes for Engineers Trains and Heritage Trains) in accordance with Procedure PR0038. The concluding clearance assessments shall be accepted by a suitably accredited engineer and formally recorded in the GNCR form.
- 3.6.6 For platform clearance non-compliance, a concession shall be sought. Procedure PR0038 may be used in support of a concession for ‘tight’ clearance in cases where it is not practical to adjust the platform edge. Approved non-compliance shall be formally recorded in the RMSD. The RMSD shall be updated with final as-built data.
- 3.7 Rolling stock engineering**
- 3.7.1 The introduction or transfer of rolling stock shall comply with the following.

- 3.7.1.1 The new works or maintenance Structure Gauge Diagram shall be selected, from Section 5.6, according to the route.
- 3.7.1.2 A full Clearance assessment shall be carried out before any introduction of rolling stock to a new route.
- 3.7.1.3 On existing routes where Clearances are equal to or less than those specified in this standard, the new rolling stock must have a Swept Envelope equal to or smaller than the Swept Envelope of the existing rolling stock unless actions are taken to increase the available space by modifying the infrastructure.
- 3.7.1.4 If it can be demonstrated that sufficient Clearance exists between the new rolling stock, other vehicles or structures or both after allowance has been made for displacements of the vehicles on curves, Route Availability can be granted.
- 3.7.1.5 Where new rolling stock is to be operated, or when existing stock is required to run over lines for which no permission has been granted, no vehicle shall exceed the current Kinematic Limit for the line under any operating condition or state of adjustment or wear.

4 Responsibilities

- 4.1 **The Head of Profession - Permanent Way (TfL)** shall be responsible for creating and maintaining this standard and auditing Suppliers thereby ensuring compliance, whilst identifying opportunities for improvement.
- 4.2 **Any person managing** any temporary or permanent asset, structure, or equipment to be installed, modified or adjusted that is located less than 5m above or within 3m laterally of LU track shall receive Clearance approval in advance of the works.
- 4.3 **The T002/T003** shall be responsible for confirming safe Clearances on completion of the works.
- 4.4 **The Supplier of Gauges** shall be responsible for the maintenance and calibration of the gauges to an approved schedule.
- 4.5 **Head of Profession - Permanent Way (TfL)** shall be responsible for defining the controls for maintaining track position and infrastructure in accordance with this standard. This includes defining the controls for maintaining the defined safety margins between Kinematic Limit and Structure Profile.

5 Supporting information

5.1 Safety considerations

- 5.1.1 Failure to conform to the requirements of this standard will prejudice the safety of train operations and may result in:
 - a) trains striking other trains or striking fixed assets such as tunnels, platforms or bridges
 - b) injury to passengers either through train impacts, or through falling or being trapped due to excessive steps or gaps or both between trains and platforms

- c) injury to railway personnel through the inadequate provision of Clearances and places of safety.

5.1.2 If the track is moved from its controlled position in the course of maintenance or renewals activities, there is a risk of reducing the Clearance to the Swept Envelope, leading to collision between trains and the tunnel walls, damage to trains and tunnel infrastructure, injuries to passengers or railway personnel or both and the disruption of train services.

5.2 Clearances

- 5.2.1 For new, modified or temporary track alignments or the introduction of new or modified rolling stock the Clearance to be provided to adjacent infrastructure or passing trains shall be:
- a. the maximum achievable under an ALARP regime that takes account of the following principles:
 - i. existing acceptable Clearances shall not be worsened so that they become substandard
 - ii. existing substandard Clearances shall not be worsened
 - iii. existing substandard Clearances shall be improved where possible
 - iv. the number of substandard Clearances shall not be increased.
 - b. as a minimum, that indicated on the appropriate new works or maintenance Structure Gauge Diagram, see section 5.6
 - c. such that it takes account of the effects of cant and curvature on rolling stock.

Note: Special arrangements exist for the Central line between White City and Liverpool Street, these are set out in Attachment 2.
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- 5.2.2 The new works or maintenance Structure Gauge Diagram shall be selected, from section 5.6, according to the type of work defined below:
- a) **New construction and extension of infrastructure works.** The minimum requirement shall conform to the appropriate sub-surface or tube new works Structure Gauge Diagram.
 - b) **Track works only.** Renewals or maintenance work shall be in conformity with sub-surface or tube maintenance Structure Gauge Diagrams.
 - c) **Unplanned infrastructure works.** When carrying out unplanned maintenance of existing structures, equipment or track. The work shall conform to the sub-surface or tube maintenance Structure Gauge Diagrams, except where compliance is not possible, and a specific route variation Structure Gauge Diagram exists. In this case the specific site circumstances shall be reported, and appropriate action taken.
 - d) **All infrastructure works (boundaries of executed work).** Where items outside the work scope are affected as a consequence of the work, resultant Clearances shall conform to the appropriate sub-surface or tube maintenance Structure Gauge Diagram, except where compliance is not possible, and a specific route variation Structure Gauge Diagram exists. In this case the specific site circumstances shall be reported.

- e) **Structural works.** Structural works include either the construction or reconstruction of structures alongside, over or under the railway, or the installation of new equipment alongside the railway. The work shall conform to the requirements of the appropriate sub-surface or tube new works Structure Gauge Diagram where reasonably practicable.
- f) **Temporary infrastructure works.** Works alongside, over or under the railway which require either the use of temporary supports or physical separation from the railway shall meet the Clearance requirements laid down on the appropriate sub-surface or tube maintenance Structure Gauge Diagram where reasonably practicable.

5.2.3 The structure and passing Clearances, as recommended by Office of the Rail Regulator (ORR), shall be used where possible.

5.2.4 Control of engineering trains

5.2.4.1 Engineers' vehicles or their loads shall not be permitted to travel on LU track fouling the Load Gauge of the route unless a detailed survey is taken of the proposed route which demonstrates that there is adequate Clearance.

5.2.4.2 Loading of Engineers' vehicles requires sign-off by a Safety Critical licensed person.

5.2.5 Structure Gauges and Structure Profiles

5.2.5.1 The application of the following elements of Section 5.6 is mandatory:

- a) the Structure Gauges and Structure Profiles, which apply to lines where LU is the infrastructure owner
- b) the Structure Gauge Diagrams defining the minimum acceptable dimensions of both Structure Gauges and Structure Profiles and the maximum permitted Kinematic Limits associated with each
- c) the separate Structure Gauge Diagrams for the Structure Gauge and Structure Profile required for:
 - i. new works, both on new and existing lines
 - ii. the maintenance of existing structures and equipment.
- d) the map showing the application area of each variant of Structure Gauge and Structure Profile.

Figure 1 below shows a simplified Structure Gauge Diagram, depicting the relationship between Structure Gauge, Structure Profile and kinematic limit.

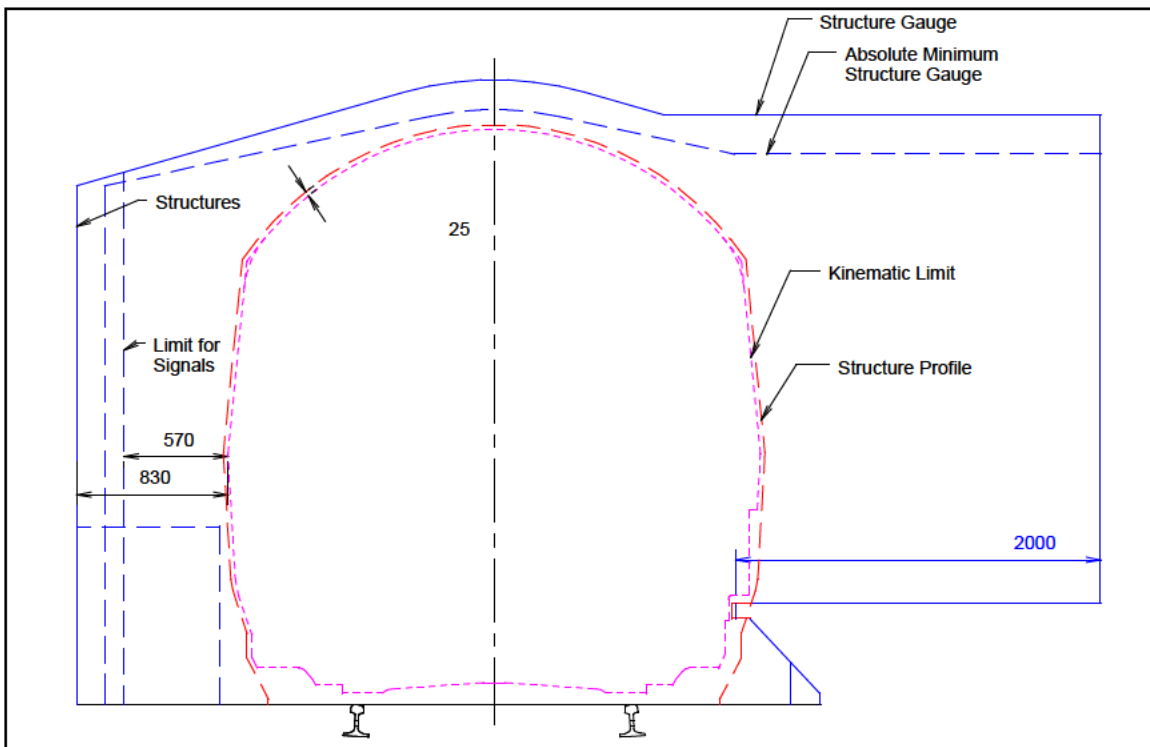


Figure 1 - Simplified maximum kinematic limit and minimum maintenance Structure Profile and Structure Gauge for tube lines - dimensions in mm.

Note: This diagram is for illustrative purposes only. Do not use - see 5.6.

5.2.6 Electrical cables

- 5.2.6.1 Where overhead electrical cables and conductors, telephone, telegraph and stay wires cross the railway in the open they shall be at least 10m above the highest running rail level after allowing for sag, temperature and wind effects.
- 5.2.6.2 Where electrical cables and conductors cross under the track they shall be located to ensure that any electrical Clearance required is maintained under all conditions of operation or maintenance, including movement of rails under the weight of a train. The absolute minimum Clearance achieved between the electrical cable and the foot of the running rail shall always be greater than 25mm.
- 5.2.6.3 Cable routes at the lineside.
- 5.2.6.3.1 Standard Cable Posts should be installed at 2500mm centres from the running edge of the nearest rail to comply with the requirement for the minimum distance to the face of a cable post of 2440mm.
- 5.2.6.3.2 Minimum Clearances for Maintenance and Renewal of cable routes and stiles should be no worse than for the existing installation and ideally should be:

Table 1: Maintenance Clearances (mm) for cable routes (main line only)

<u>Clearances in order of priority</u>	<u>Tube Stock Only</u>				<u>Everywhere Else</u>			
	<u>Straight</u>	<u>R\geq200</u>	<u>$\frac{200 > R}{\geq 100}$</u>	<u>R < 100</u>	<u>Straight</u>	<u>R\geq200</u>	<u>$\frac{200 > R}{\geq 100}$</u>	<u>R < 100</u>
1 With space for a walking route (Preferred)	1900	2000	2100	2150	2000	2100	2200	2250
2 With Place of Safety only	1600	1700	1800	1850	1700	1800	1900	1950
3 Absolute Minimum for Short Lengths	1420	1520	1620	1670	1550	1650	1750	1800
Centre line for new Cable Posts	2500	2600	2700	2750	2500	2600	2700	2750

Notes:

1. R \geq 200m usually indicated by having **no check rail** installed;
2. R < 200m usually indicated by having a **check rail** installed. This dimension also applies to P&C;
3. In 5.3 Short Lengths defined as <2m and Limited Clearance signs will be required;
4. All radii are shown in metres.

5.2.7 Clearances to other railways

- 5.2.7.1 New railway works alongside an existing LU railway or new LU works alongside an existing railway shall be separated by a security fence. The minimum distances from the nearest LU running edge to the nearest part of the fence shall be:
- a) where a cable run exists 4.5m
 - b) where no cable run is present 3.2m.
- 5.2.7.2 Where LU and other railways already operate alongside each other, the requirement for a fence segregating the two systems shall be made on a case-by-case basis in consultation with ORR in cases where either system requires to introduce a 'change of use' in terms of traction, rolling stock or other operating principle.
- 5.2.7.3 Where no fence is provided, the dimensions apply to the operational boundary.
- 5.2.7.4 If the other railway is at a different level to the LU track, any earthwork slopes, retaining walls or other structures shall be outside the dimensions given above.

Note: These distances apply only on the LU side of the fence or boundary. On the other side of the fence or boundary, the requirements of the other rail system apply.

5.2.8 Passing Clearances

Note: The ORR specify that the Clearance between the Swept Envelopes of vehicles passing on adjacent tracks should be:

Normal	380mm
Minimum on new lines	200mm
Minimum on existing lines	100mm

5.2.8.1 In addition to ORR requirements the minimum track centres shall be 3.4m for new lines, which on 1435mm gauge is equivalent to a minimum distance of 1965mm between the running faces of the nearest running rails.

Note: The above dimensions need to be adjusted on curved track for overhang and cant effect.

5.2.8.2 Over the range of operating speeds the vehicles' Swept Envelopes shall not infringe the Kinematic Limit inclusive of the effects of track curvature and cant, as defined in the Structure Gauge Diagrams.

5.2.9 Sub-standard Clearance

5.2.9.1 Where the Structure Profile or minimum six-foot is infringed, a Concession or Generic Non-Compliance Report is required. A speed restriction shall be applied as defined in tables 2,3 & 4 below (unless there is a statement in a Concession or Generic Non-Compliance Report that adherence to Procedure PR0038 has been met using Dynamic Gauging in the design process).

Table 2: Infringements to Structure Profile: Tube tunnels only

<u>Infringement (mm)</u>	<u>Above Platform Level</u>	<u>Platform Level or Below</u>
0 – 34	No Speed Restriction	
35 – 49	20 mph	10 mph
50 – 74	10 mph	STOP
≥75	STOP	

Table 3: Infringements to Structure Profile: Sub-Surface tunnels

<u>Infringement (mm)</u>	<u>Above Platform Level</u>	<u>Platform Level or Below</u>
0 – 34	No Speed Restriction	
35 – 49	35 mph	
50 – 74	20 mph	10 mph
>75-124	10 mph	STOP
≥125	STOP	

5.2.9.2 Where the minimum passing Clearance of 100mm between Kinematic Limits is infringed a speed restriction shall be applied as defined below:

Table 4: Infringements to passing Clearances

Infringement (mm)	Passing Clearance (mm)	Speed restriction
≤ 84	≥ 16	No Speed Restriction
85 – 99	15 – 1	35 mph
100 – 124	0 to minus 24	20 mph
125 – 175	Minus 25 to minus 75	10 mph
>175	Less (worse) than minus 75	STOP
Note;	These restrictions are based on considering the Kinematic Limit on the adjacent track to be the equivalent to fixed equipment.	

5.2.9.3 In order to maximise the control of track position, particularly where Clearances are sub-standard, consideration shall be given to increasing track fixity by means including strutting, gluing of ballast, and slab track. In addition, see clause 5.4.2 regarding the provision of Datum Markers.

5.2.10 Fouling Points

5.2.10.1 Converging tracks shall be marked to show the position at which there is a minimum Clearance between Kinematic Limits of 100 mm, after making the appropriate allowance for any cant effect and vehicular end or centre throw. Where both tube and sub-surface vehicles are able to access the tracks then the larger Kinematic Limits shall be used on both tracks. In practice the Fouling Point may be marked at the position at which the distance between the running edges of two converging tracks diminishes to 2 metres. This distance may actually be more or less than 2 metres, subject to site constraints, provided a minimum of 100mm is achieved between Kinematic Limits.

5.2.11 Non-Operational Assets

5.2.11.1 Non-operational or redundant assets shall preferably be removed. They may remain within the Structure Gauge provided that a risk assessment is carried out to confirm that in the event of structural failure they will not infringe the Structure Profile.

5.2.11.2 Non-operational assets which remain within the Structure Gauge shall have a designated Asset Steward who is accountable to carry out inspections to confirm the ongoing integrity of the asset, and to carry out any repairs or corrective actions which are identified from these inspections. A risk assessment shall be carried out to determine the scope and frequency of such inspections, which shall be part of an inspection and maintenance regime to control the risk of structural failure of the asset and infringement of the Structure Profile.

5.2.11.3 Non-operational assets which infringe the Structure Profile shall be removed or repositioned to eliminate the infringement as soon as it is practical to do so. The requirements of 5.2.9 shall apply.

5.3 Platforms

5.3.1 Heights, offsets and widths

5.3.1.1 LU's policy is to provide customers with the best possible interface between platforms and trains in terms of steps and gaps, and where possible to provide level access as described in 5.3.2 below. The size of the vertical steps and horizontal gaps between platforms and trains is determined by a number of factors including the height and offset of the platform edge and of the train door sill relative to the running rails, the curvature of the track and platform and the axle configuration of individual train types.

5.3.1.2 To encourage standardisation LU has defined a range of standard dimensions and tolerances for platform heights and offsets. These standard platform heights and offsets are given in Attachment 3. However, owing to variations in design of different rolling stock fleets compliance with the standard platform heights and offsets will not necessarily provide the best possible interface. In order of preference platform heights and offsets should therefore be designed to provide:

- a) level access to trains as described in 5.3.2 below
- b) minimum practical vertical and horizontal stepping distances
- c) the standard platform heights and offsets given in Attachment 3
- d) vertical and horizontal stepping distances less than 250mm with the resultant diagonal less than 275mm.

The preferred configuration may therefore only be possible by the use of non-standard platform heights and offsets. Where this is the case a concession must be obtained to formally authorise the use of non-standard dimensions and to provide evidence of approval required to permit the introduction of the assets into service.

5.3.1.3 Platform heights and offsets shall be measured relative to the plane of the running rails, the offset along the plane and the height perpendicular to the plane. The offset shall be measured from the running edge of the rail.

5.3.1.4 The vertical steps and horizontal gaps from vehicle door sill plate to platform nosing shall be determined for all passenger rolling stock using each platform.

5.3.1.5 The Structure Gauge Diagrams show a refuge formed below the platform edge. This refuge shall have a minimum width of 300mm, minimum height of 495mm measured from sleeper level and shall be kept clear of cables and other obstructions.

5.3.1.6 Where the distance between the platform edge and train door sill/floor exceeds 250mm horizontally or 300mm diagonally, hatched markings shall be used as per TfL Standard [S1131](#) Premises – station platforms.

5.3.1.7 TfL Built Environment Engineering are a major stakeholder at platforms so reference must be made to TfL/LU Standard S1131 Premises – station platforms, when planning alterations of the platform edge.

5.3.2 Level Access

5.3.2.1 Full-length level access for the RVAR nominated doorways shall be provided in compliance with RVAR as follows:

- a) Maximum Gap = 75mm
- b) Maximum Step = 50mm
- c) This equates to 90mm on the diagonal.

Where it is reasonably practicable to do so, level access shall be provided at the remaining passenger doorways with consideration of the following:

- i. If the combination of track radius and door positions enable a horizontal gap that is reasonable, e.g. below 150mm to avoid 'Mind the Gap' signage being required.
- ii. If calculated horizontal gaps are above 150mm to the relevant passenger rolling stock, then an oversail solution (increased vertical steps; decreased horizontal gaps) shall be considered to limit large horizontal gaps, rather than pursue a level access Platform/Train Interface.

5.3.2.2 S Stock has floors at 980mm above rail level, thus satisfying the RVAR maximum step requirement at existing 950mm-height platforms.

5.3.2.3 Where reasonably practicable, Level Access shall be achieved by either change to Rolling Stock floor heights or adjustment to station platform heights, as far as platform construction and track renewal permit.

5.3.2.4 At many existing platforms on curves or in tunnels, full-length level access cannot be provided at all platforms. Section 4 of G347 "Platform Accessibility Humps" identifies the designated 'wheelchair accessible' car or doors for each line.

5.3.2.5 On each platform where full-length Level Access cannot be provided, a Level Access Boarding Point (LABP) shall be created by one or more of the following:

- a) Localised platform humps or dips
- b) Control of track position to minimise the offset (gap).

For further guidance please refer to Section 4 of G347 "Platform Accessibility Humps".

5.3.2.6 At existing Tube stations in tunnels platform humps shall be provided at the LABP.

5.3.2.7 In determining a suitable platform offset for the LABP the following primary factors shall be considered:

- a) The Rolling Stock Swept Envelope based on fastest train speed along the platform
- b) Rolling Stock sill plate heights (when at rest) based on tare and crush laden characteristics
- c) Track curvature and cant
- d) Existing alignment.

- 5.3.2.8 The length of the LABP shall be calculated as being a minimum of the distance between the RVAR designated doors plus an allowance for the stopping position tolerance of the train. The train stopping position and tolerance shall be established early in the design process as it significantly influences the size and slope of the access ramps either side of the LABP.
- 5.3.2.9 The height of the LABP is dictated by the height of the existing platform relative to the known floor height of the train. The height of the LABP shall be set to accommodate the full extent of suspension travel from crush to tare load, and the step shall be up into the train for as much of the suspension range as possible. Permitted limits on the wear of the rail and the effect of maintenance processes, e.g. tamping, shall also be considered in determining the height of the LABP.
- 5.3.2.10 The LABP offset from the running edge of the rail adjacent to the platform shall be calculated to provide a gap of 75mm or less to the edge of the sill plate of the car, whilst retaining Clearance to the Swept Envelope of the car. Where track is curved allowance shall be made for the end and centre throw of the car and cant effect as appropriate. The LABP offset shall also apply to any slopes from the current platform height.
- 5.3.2.11 Where the LABP is provided by a hump the design alignment is dependent on the alignment of the adjacent track and, when the track is new or has a significant residual life, the hump shall be aligned parallel to the running edge of the nearest rail. However, if the track is likely to be replaced in the foreseeable future then the hump should be aligned to an approved design alignment of the new (future) track. The hump shall not infringe the Kinematic Limit so as not to need modifications in the future or compromise forthcoming track works.
- 5.3.2.12 The formula used for calculating car body throws in platforms areas is found in attachment 4.
- 5.3.2.13 With Level Access the gaps will have to be controlled. Consideration shall be given to methods of increasing track fixity, e.g. strutting, ballast glueing and slab track.
- 5.3.2.14 The minimum width of unobstructed platform shall be:
- a) 3m for new build
 - b) 2m for existing platforms.

5.3.3 Platform furniture

- 5.3.3.1 Structures, furniture and equipment less than 2m (measured horizontally) from the edge of the platform and lower than the headroom requirements given in sub paragraph 5.3.3.3 below shall not be permitted in the public area of the platform.
- 5.3.3.2 The Clearance to the rigid end of platform barriers from the edge of platforms shall be 1m. The barrier can be extended to within 160mm of the platform edge by providing a swinging gate such that the free edge of the gate near to the platform edge shall not infringe the maintenance Structure Profile, see Figure 2.

- 5.3.3.3 In passenger and public areas on platforms the headroom shall be as follows:
- a) 3m desirably to ceilings
 - b) 2.5m minimum to ceilings
 - c) 2.5m desirably to bottom of signs
 - d) 2.3m to the bottom of signs in cases of extreme difficulty.
- 5.3.3.4 Where it is reasonable to do so, platform monitors for OPO, signalling equipment and associated signage shall comply with the Clearances shown in Figure 2. In all cases, platform monitors for OPO, signalling equipment and associated signage shall be clear of the relevant Structure Profile enlarged for track curvature and cant.
- 5.3.3.5 Dot Matrix Indicators and station information signs are required to comply with the requirements set out in this standard and those in LU category 1 standard no. 1-356 – ‘Sightlines, visual clutter and visual space planning’. The latter standard contains diagrams in Section 5 which illustrate the positional requirements for Dot Matrix Indicators and station signs. These requirements are reflected in Figure 2.

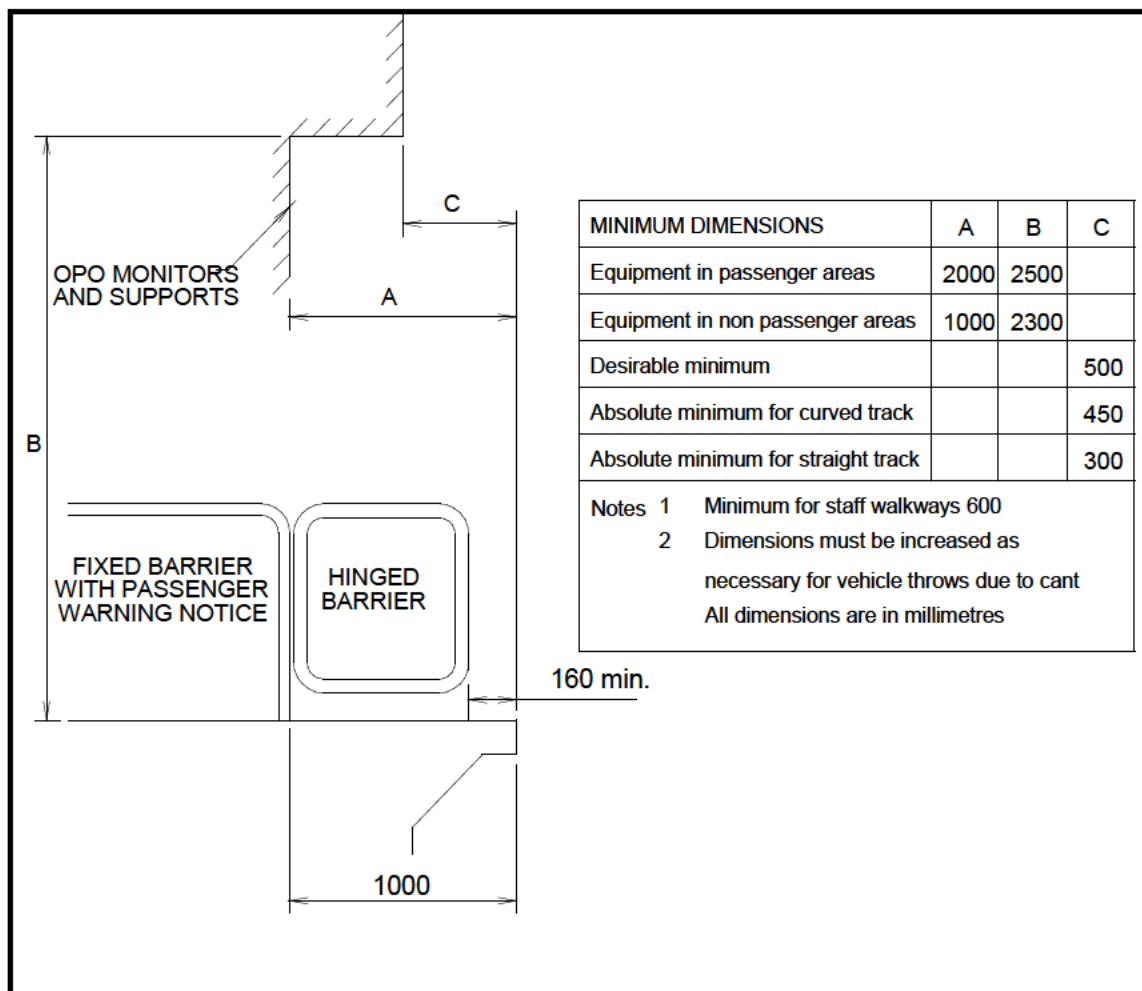


Figure 2 - Minimum Clearances to monitors and barriers

- 5.3.3.6 Where temporary obstructions are located on platforms in designated non-passenger areas, special horizontal Clearances shall be restricted to those shown in Figure 3.

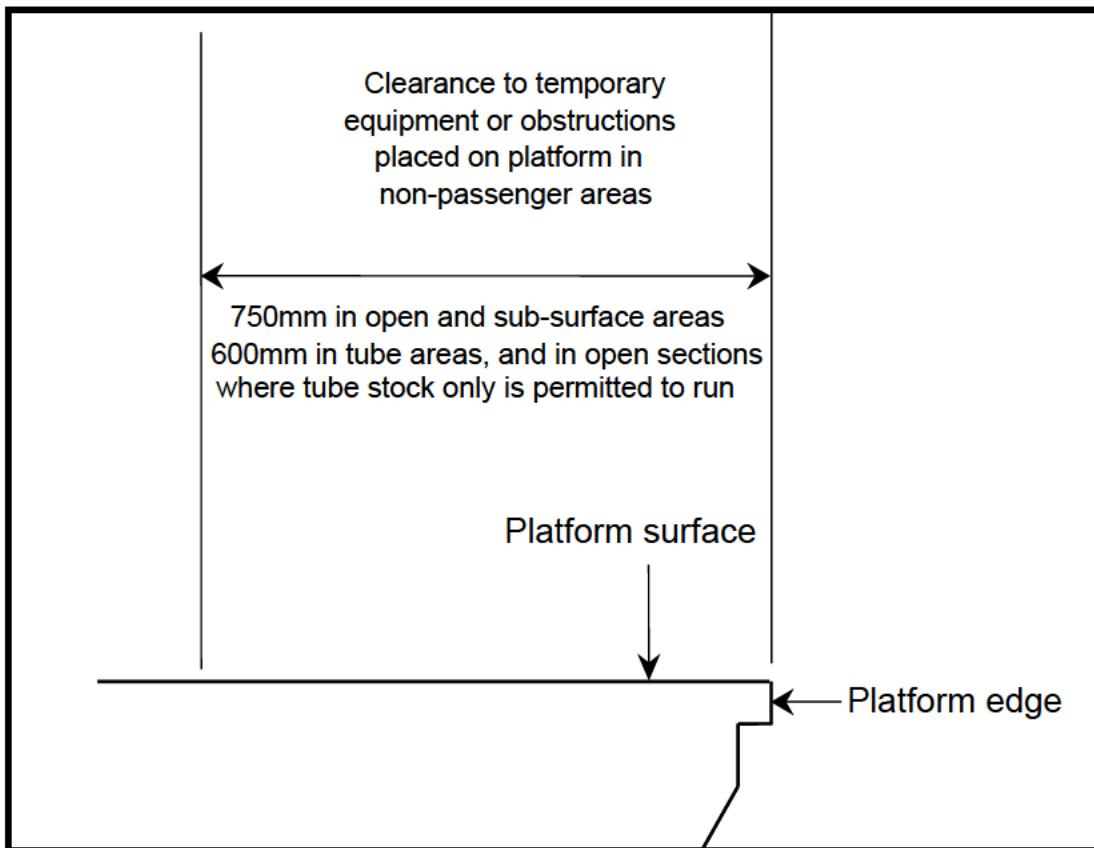


Figure 3 - Clearances to temporary structures or equipment above platform level

5.3.4 Clearances to depot, workshop maintenance and driver access platforms

5.3.4.1 The following applies to depot and workshop passenger rolling stock maintenance platforms and driver access platforms that are used with either surface stock or tube stock:

- a) Maintenance platforms and driver access platforms shall be within +10/- 0mm of the level of the rolling stock door sill plate under tare conditions
- b) Horizontal offsets from the running edge (of running rail) to maintenance platforms and driver access platforms shall maintain 22-45mm clearance to the Swept Envelope appropriate to the location of the depot or workshop. The gap to the rolling stock shall be minimised in order to facilitate ease of access for maintenance equipment
- c) Where it is possible to do so, maintenance platforms and driver access platforms shall be positioned on straight track. Where the track is curved, the offset to the platform shall be increased by the throw of all stocks using the maintenance platform and driver access platforms.

5.3.5 Inspection and minimum corrective action

- 5.3.5.1 Clearances to all platforms and underline bridge girders on ballasted track shall be checked annually. In cases where Clearances have been reduced such that at least 50% of the permitted tolerance has been used, remedial action to restore the Clearances shall be completed within 6 months.

5.3.6 Records

- 5.3.6.1 Records shall be maintained for each platform Datum Marker showing its location, the data upon it, the dates when this data is scheduled for checking, the results of each check, any action recommended and when this action was taken.
- 5.3.6.2 At platforms where Datum Markers do not currently exist, records shall be maintained of heights and offsets for each platform at defined intervals.

5.4 Tunnels

5.4.1 General

- 5.4.1.1 To eliminate infringements of the Structure Gauge or Structure Profile, the track alignment shall where reasonably practicable be modified provided that the new alignment conforms to the curvature and alignment criteria. The survey data shall then be re-assessed to confirm that the Structure Gauge or Structure Profile is not infringed in areas affected by the realignment.

5.4.2 Monitoring and maintenance of Clearances

- 5.4.2.1 Datum Markers, indicating rail level, alignment and cant, shall be installed in order that the position of the track can be controlled for Clearance purposes.
- 5.4.2.2 At locations where structures are close to infringing Clearances, lifting and lining of the track shall be restricted and the degree of restriction indicated, e.g. by installation of warning plates and/or Datum Markers.
- 5.4.2.3 Datum Markers shall be inspected periodically such that adequate warning can be given of any relative movement of track and structure which could lead to the creation of unacceptable Clearances. In areas of particularly tight Clearances, the use of lateral restraint plates or ballast glueing shall be considered.
- 5.4.2.4 Datum Markers shall be securely installed to provide permanent track geometry design datum points.
- 5.4.2.5 Regardless of the type of works, all work following monument establishment shall be checked against datum on completion to ensure the tolerances in S1159 and Section 5 are not exceeded.
- 5.4.2.6 In tube and sub surface tunnel sections, track movement shall be avoided if possible. Where track is moved, movements shall be controlled and monitored. Defined track positional tolerances exist for the Central Line and these shall be achieved. These tolerances are shown in Attachment 2.
- 5.4.2.7 Control of track position with respect to maintaining the required Clearance between the Structure Profile and the Kinematic Limit when carrying out any works in the tunnel sections shall conform with approved methods.

Note: The 11'-8" diameter tube section between White City and Liverpool Street on the Central line is among the smallest on LU giving rise to the tightest Clearances and the construction standard achieved between White City and Oxford Circus makes this length the most critical. On all parts of the LU Network renewal and maintenance work must be controlled to ensure that Clearances to the Kinematic Limit are not reduced, and this is particularly relevant to the section described above. The reports produced by the Central line Project Team on tunnel gauging and on monument plate installation give the background to the Central line Clearance survey and details of the monument plates (since amended to suit the use of standard offset gauges). These reports are based on a survey of tunnel and track carried out during 1991/92. A computer simulated run of a standard kinematic profile was superimposed on the survey information. The Central line Project Team and Track Manager Central line subsequently agreed the positional tolerances contained in attachment 2. The tunnels were subsequently monumented to ensure that future control of track position can be achieved. The Central line Management Team are the custodians of that information and any queries shall be addressed to them.

5.4.3 Assessment of tunnel wriggle

- 5.4.3.1 New or rebuilt tunnels shall be surveyed and assessed to confirm that the optimum track alignment can be achieved without infringement of the relevant Structure Profile either by the tunnel structure or by the fixed equipment within it.
- 5.4.3.2 Survey information shall be sufficient to adequately describe the tunnel shape for the appropriate design of tunnel and shall include the minimum requirements shown in table 5.

Table 5: Survey information for tunnel wriggle

Type of Tunnel	Minimum survey details to be supplied
Running tunnels	7 evenly spaced points around each surveyed ring plus roll of lining
Station tunnels	10 evenly spaced points around each surveyed ring
Sprayed Concrete Lining (SCL) tunnels	13 evenly spaced points around the intrados of the tunnel
Cut and cover tunnels	Survey points at 1.5m intervals around the intrados of the tunnel

- 5.4.3.3 For the survey data shown in table 5 the dimensions shall be perpendicular to the design track centreline, at the leading edge of the ring for segmentally lined tunnels. Where the survey data is taken at discrete intervals these shall be no greater than 10m apart on curved track, including transitions, and 20m apart on straight track.
- 5.4.3.4 In segmentally lined tunnels the roll of the lining shall be measured at the soffit of the tunnel. The roll shall be quoted as being to the left or right of the normal position in the intended direction of running. Each ring shall be numbered sequentially, and the ring number quoted for each position of recorded dimensions.

- 5.4.3.5 Wherever there is a change in the tunnel construction, segment type or principal dimensions, a survey shall be made adjacent to and on either side of the change.
- 5.4.3.6 For existing tunnel rebuilds the survey information shall include the location of the running rails to establish the track alignment relative to the tunnel.
- 5.4.3.7 The raw survey data shall be downloaded and checked for gross errors prior to analysis. The analysis of data for the assessment of tunnel wriggle shall be by means of approved software. The analysis shall:
- a) Establish the as-built tunnel alignment and tolerances
 - b) Identify locations where the Structure Profile may be infringed using the proposed track alignment
- 5.4.3.8 If the Tunnel Drive is not complete and the alignment is not within the required tolerance of the design alignment then a revised tunnel alignment shall be designed to bring the Tunnel Drive back to the design alignment whilst conforming to the track curvature and alignment criteria in S1157.
- 5.4.3.9 To eliminate Structure Profile infringements, the track alignment may be modified provided that the new alignment conforms to the curvature and alignment criteria in S1157. If Clearance to the Structure Profile cannot be achieved in this way then the offending tunnel linings shall be identified for rectification to provide the necessary Clearances. For existing tunnels, a Concession may be requested to accept the Structure Profile infringements without rectification of the tunnels. Where applicable, Dynamic Gauging may be utilised by adherence to Procedure PR0038 (see 3.5 & 3.6).
- 5.4.3.10 Following rectification of tunnel linings they shall be re-surveyed, and the analysis repeated to confirm that the Structure Profile is not infringed.
- 5.4.3.11 Following assessment the final track alignment data shall be established on site by use of Datum Markers which shall be fixed to the tunnel walls or lineside structures and shall be marked to identify dimensions for the horizontal and vertical positioning of the track in order that the installation, and subsequent maintenance may be undertaken to conform with the optimum alignment design.

5.5 Places of safety

5.5.1 Places of safety shall comply with the requirements of Table 6.

Table 6: Minimum dimensions (mm) including places of safety

<u>Type of Stock</u>	<u>Location</u>	<u>Straight track</u>	<u>Curved track of Radius</u>		
			<u>R\geq200m</u>	<u>R<200m</u>	<u>R<100m</u>
			<i>Usually with no check rail</i>	<i>Usually with a check rail</i>	
Tube only	Cess (measured to back of Place of Safety)	1600	1700	1800	1850
	Between tracks (running edges)	3300	3500	3700	3800
All others	Cess (measured to back of Place of Safety)	1700	1800	1900	1950
	Between tracks (running edges)	3500	3700	3900	4000
Ten-foot way between LU and Network Rail (NR) lines, where there is no physical barrier to segregate the two railways.		4200	4300	4400	4500
<p><u>Notes:</u></p> <ol style="list-style-type: none"> The dimensions in this table provide for Railway Safety Principles and Guidance (RSPG) requirements for the width of a Place of Safety, i.e. <ul style="list-style-type: none"> 430mm for the minimum Clearance from the Kinematic Limit to a Place of Safety or walking route; 400mm for the minimum width of a Place of Safety alongside track (standing); 700mm for the minimum width of a walking route; 900mm for the minimum width of a Place of Safety between tracks. Adequate Clearances do not, in isolation, determine the suitability of a location as a Place of Safety. Other requirements such as easy access, good underfoot conditions and good visibility shall also be met (refer to S1168 3.3). If the Place of Safety is within 3m of the NR line, then the appropriate NR regulations for work on or near the line must be followed. 					

5.5.2 Areas that do not comply with the dimensions in Table 6 shall be defined by Limited Clearance warning boards as follows:

- a) Limited Clearance warning boards shall be fixed to structures in the Line Safe area when there is less than the required Clearance adjusted for curvature and cant, and the structure for a continuous distance of 2m or more, but less than 2m where a particular hazard exists.
- b) Limited Clearance warning boards shall be fixed at the ends of the area of Limited Clearance and at a maximum of 20m intervals throughout the Limited Clearance;

- c) Where both cesses have Limited Clearance the 20m intervals shall be so arranged on opposite sides that a sign is visible on either the right or left at 10m intervals;
- d) Where the places of safety are intermittent the Limited Clearance warning board shall be surmounted by a supplementary sign containing the words 'Limited Clearance with places of safety';

5.6 Structure Gauge Diagrams

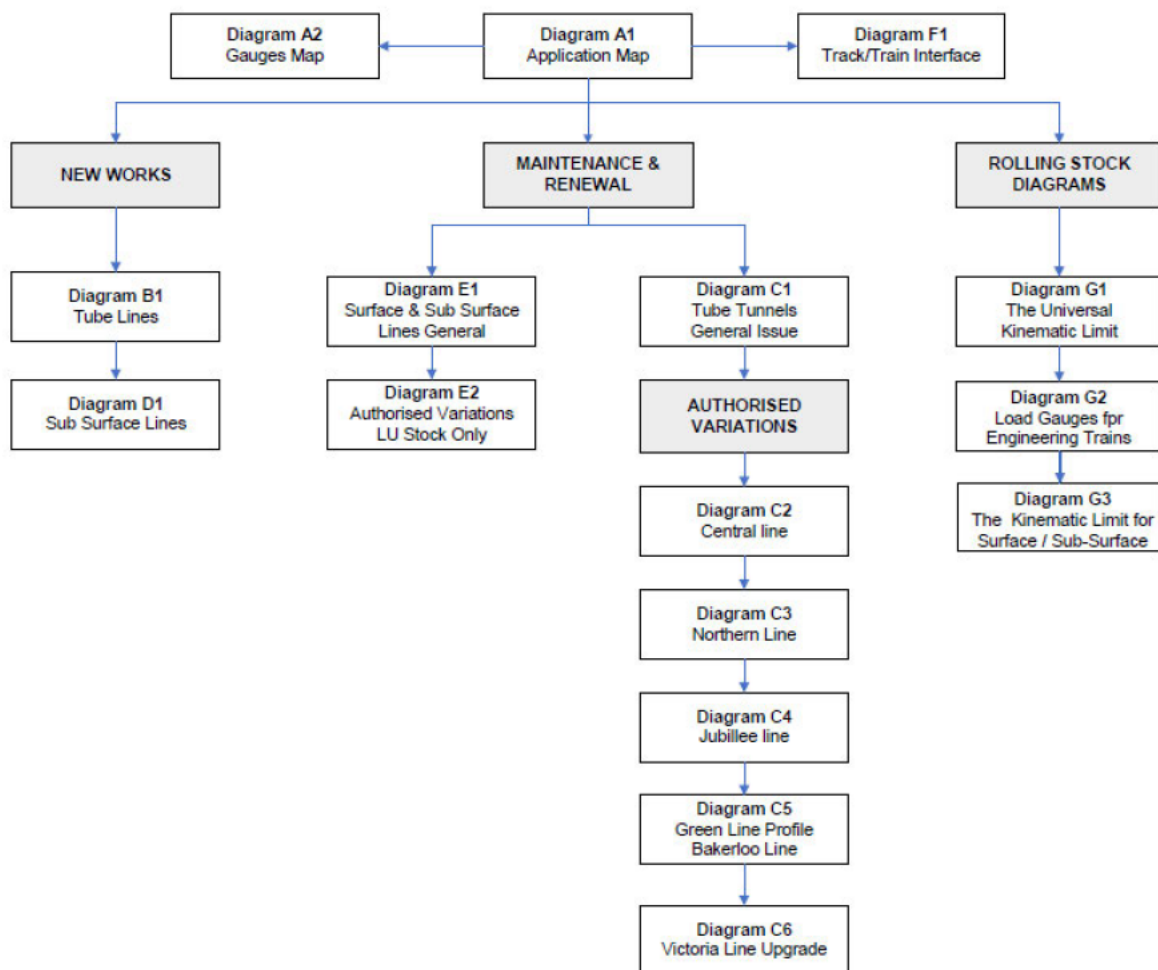
5.6.1 Development and organisation

- 5.6.1.1 ORR recommends desirable structural and passing Clearances associated with new work which permits the operation of rolling stock currently in use anywhere in the UK. The resulting 'Standard Structure Gauge' is an ideal which should be pursued wherever practicable in the light of proposals for inter-running between LU and Network Rail, the possible use of trains of common design and the contracting-out of maintenance activities. However, this ideal gauge cannot be achieved through much of LU's infrastructure due to its age and history which results in restricted Clearances at existing structures which cannot be improved, and these Clearances determine the size of vehicles permitted to travel over a route. This being the case, LU has developed individual gauges for both sub-surface and tube lines. The nature of the lines and the rolling stock permitted to use them are described in the following sections.
- 5.6.1.2 The Structure Gauge Diagrams (SGDs) were derived from their predecessors, the Load & Structure Gauge drawings, in the latter part of the 1990's when LU wanted to move from specifying static Load Gauges for its rolling stock to kinematic/Dynamic Gauging. The SGDs were initiated as a series of 'envelopes' or 'profiles' which would define the spatial requirements for trains and for infrastructure.
- 5.6.1.3 In order to quickly develop this new series of envelopes the Structure Gauges as shown on the Load & Structure Gauge drawings were taken as a 'known', even though it was recognised that there were existing infringements in many locations. For tube sections a line was drawn 25mm, (1"), inside and parallel to the Structure Gauge to produce the profile which would apply to rolling stock. This profile was subsequently termed the Kinematic Limit. This was the gestation of the C1 SGD. A similar exercise was carried out for the sub-surface railway, but with a line drawn 50mm inside the Structure Gauge to provide additional clearance, due to the reduced fixity of ballasted track. This was the gestation of the E2 SGD. This work was done on the basis that, subsequently, a comprehensive clearance survey would be carried out across the LU network to 'prove', and in many locations 'disprove', the actual space in the tunnels compared to the new SGD's. The intention was that the SGDs would be refined based on the clearance survey data. Due to business priorities funding was not available to carry out these clearance surveys.
- 5.6.1.4 Since the introduction of the SGDs, there have been a number of Line upgrades and associated introduction of new rolling stock. Almost all of these projects have carried out clearance surveys and found that the C1 Structure Profile has significant infringements in many locations. This has obviously required the Structure Profiles and Kinematic Limits for each of these lines to be modified to

cater for the reduced clearances which actually exist, as evidenced by Structure Gauge Diagrams C2, C3, C4 and C6, (C5 was introduced due to strengthening works in tunnels under the Thames). This essential need, to carry out clearance surveys prior to the design of a new rolling stock fleet, was recognised in the development of S Stock, and the survey data generated provided the basis for the modifications to the roof line of the E2 SGD.

5.6.1.5 The drawings are grouped as follows:

- a) Series A Maps defining areas of application of Structure Gauge Diagrams and Tunnel Gauges;
- b) Series B New Works for Tube Lines;
- c) Series C Maintenance for Tube Lines;
- d) Series D New Works for Sub-surface Lines;
- e) Series E Maintenance for Sub-surface Lines;
- f) Series F Track/train interface diagram (common to all lines);
- g) Series G Diagrams for engineer's vehicles.



5.6.2 Selecting the correct Structure Gauge Diagram: particular location

- 5.6.2.1 All existing lines are shown on the application map, (Diagram A1), thereby enabling the user readily to identify the Structure Gauge Diagram to be used, by:
- a) Referring to the application map and identifying the colour code applicable to the location in question;
 - b) Referring to the key table where the colour code directly identifies the maintenance Structure Gauge Diagram, plus any permitted variation (if required) and whether the Structure Gauge or Structure Profile is applicable. The key table also lists the new works Structure Gauge Diagram and the engineer's vehicle Load Gauge for each colour code. The train/track interface is common to all areas and must be used together with the appropriate tube or sub-surface Structure Gauge Diagrams for all works in the lower part of the gauge;
 - c) Selecting the maintenance or new works Structure Gauge Diagram dependent on the type of work.

5.6.3 Selecting the correct Structure Gauge Diagram: type of rolling stock

- 5.6.3.1 Three categories of passenger rolling stock operate over LU tracks: tube stock, LU surface/sub-surface stock and Train Operating Company (TOC) rolling stock normally operating on Network Rail infrastructure. An individual LU track may be used by one type of stock only or by any combination of all three. In addition to scheduled services, consideration must also be given to passenger stock transfer movements and to non-passenger train operations, including engineer's trains.
- 5.6.3.2 For existing lines, the Structure Gauge Diagram is defined by location. For new lines it is necessary to select the Structure Gauge Diagram appropriate for the rolling stock which will be using the line, whether on a regular basis or on non-scheduled operations.
- 5.6.3.3 The map and diagrams must not be taken as defining permitted Route Availability.

5.6.4 Selecting the correct Tunnel Gauge: particular location

- 5.6.4.1 All existing lines are shown on the application map, (Diagram A2), thereby enabling the user readily to identify the Tunnel Gauge to be used, by:
- a) Referring to the application map and identifying the colour code applicable to the location in question;
 - b) Referring to the Tunnel Gauge identification drawing table where the colour code directly identifies the correct Tunnel Gauge for the location by drawing number. The table also identifies where Structure Gauges are applicable, and therefore the use of a Tunnel Gauge is not required.

5.6.5 Description of each diagram

- 5.6.5.1 **Diagram A1** Map of areas of application of Structure Gauges, Structure Profiles and Load Gauges. The information is presented as a system-wide map showing all running lines and principal sidings. The map is colour-coded to identify the maintenance Structure Gauges and Structure Profiles, with any authorised variations, appropriate to each line and area. The map also shows the boundaries between Structure Gauge and Structure Profile areas. A key table

identifies the Structure Gauges, Structure Profiles and engineer's Load Gauges relevant to each line and area. The application of Structure Gauges to routes has the objective of satisfying the ORR requirements which state: "On existing railways, at places where Clearances are equal to or less than those specified in these requirements, the present Clearances must not be reduced, nor must the extent or number of such places be increased by new or altered works, by track alterations affecting line or level, or by the introduction of different rolling stock, without the agreement of the Inspectorate". With such an old railway system, no route complies throughout with the ORR requirements for new construction. Therefore, the maintenance gauges are applied with the objective of preserving existing Clearances rather than reducing them to the minimum.

- 5.6.5.2 **Diagram A2** is a Beck style map showing which Tunnel Gauge applies to each LCS code.
- 5.6.5.3 **Diagram F1: Track/Train Interface.** The diagram shows the Kinematic Limit under the train and the exclusion zone which ensures that adequate physical and electrical separation is maintained. The exclusion zone extends to 63mm below rail level in order to provide a minimum of 76mm Clearance to free hanging shoes at traction voltage. The width is obtained by extending the exclusion zone around the shoe areas thus making it possible to have equipment in the 4 foot and alongside the track. No equipment is permitted to be located within the exclusion zone without Clearance approval with the exception of equipment itemised on the diagram. This diagram covers both new works and maintenance requirements.
- 5.6.6 New Works Diagrams**
- 5.6.6.1 **Diagram D1: General issue, Surface and sub surface lines, new works.** The Structure Gauge is developed from the ORR recommendations adjusted to suit the dimensions of the LU sub-surface lines Kinematic Limit. The ORR recommendations include provision for 25kV AC electrification which may affect LU due to inter-running. The Kinematic Limit is large enough for all LU and TOC multiple units and, in addition, allows space for national freight and locomotive-hauled operations if required. All new works, including cut and cover tunnels, should comply with this Structure Gauge wherever possible. A variety of platform heights and offsets exist, appropriate to the rolling stock using the lines.
- 5.6.6.2 **Diagram B1: General issue Tube lines, new works.** The Structure Gauge is developed from the ORR recommendations adjusted to suit the dimensions of the Kinematic Limit derived in C1 and the reduced platform height. The minimum headroom is determined by the higher of Kinematic Limit plus 250mm Clearance or platform level plus passenger headroom.
- 5.6.6.2.1 In this case the latter gives the limiting headroom of $520 + 2500 = 3020\text{m}$. The Structure Profile is developed by adding the following Safety Clearances around the Kinematic Limit:
- above platform level and below platform level: 150mm;
 - to platforms: 16mm.
- 5.6.6.2.2 In tube tunnels additional space may be required for evacuation purposes dependent upon current requirements of ORR.

5.6.6.2.3 ORR requires a minimum headroom of 2.5m to be provided from the edge of the platform for a minimum width of 2m back from the edge. For tube stocks this also applies above the rolling stock door openings. LU station design guidelines recommend a minimum of 3m for both width and height and the latter figures have been adopted for new works. Under the face of the platform a recess is provided as an emergency refuge of 300mm depth. Behind the refuge is a 160mm depth for cabling and services. The Structure Gauge and Structure Profiles are dimensioned from the running rail plane and adjacent running edge. The Kinematic Limit is dimensioned from the track centre line at the running rail plane. This convention is followed for all diagrams in this series. The general issue diagram applies to all surface lines built to tube dimensions and used only by tube stock. The authorised variations apply only to tunnel sections

5.6.7 Surface Lines Maintenance Diagrams

5.6.7.1 **Diagram E1: General issue, Surface and sub surface lines, maintenance.**

The same Kinematic Limit is used as for the surface new works diagram. This provides adequate space for LU and TOC stock to operate. The Structure Gauge is defined by adding the ORR recommended and minimum Safety Clearances around the Kinematic Limit. Platform widths and head rooms are the ORR minimum.

5.6.7.2 **Diagram E2: Authorised variations to general issue, LU stock only.** This variation is the minimum acceptable Clearance for the operation of LU sub-surface stock. The Kinematic Limit is the same as on Diagram E1 up to a height of 2968mm above new rail datum. Above this height it is derived from comprehensive clearance survey work which was carried out in order to inform the development of 'S' stock. This work showed that in many locations within the sub-surface tunnels the tunnel arches significantly infringed the Structure Profile and the Kinematic Limit in the cant rail area. In order to address this problem, the Kinematic Limit profile for 'S' stock was modified by basically introducing a larger radius curve at the cant rail. This modified Kinematic Limit was married to the 'C' stock roof profile and height, which already had full Route Availability through all sub-surface tunnels. The overall height of the modified Kinematic Limit has been further adjusted in height to:

- a) Reconcile it with the existing LG2 Load Gauge, and;
- b) Acknowledge the now understood worst-case overhead structural clearance existing on the sub-surface lines, which has increased the height by 33mm when compared with the 'S' stock Kinematic Limit.

The Kinematic Limit has been further amended by the removal of the Enhanced Kinematic Limit, which was previously shown indicated as a hatched area above the roof centre line. This was developed to permit operation of dual voltage rolling stock with lowered pantographs in anticipation of Crossrail trains running through LU sub-surface tunnels. However, this proposal was not adopted and with the completion of the Crossrail Project this is no longer a requirement. Any new Route Clearance Approval for E2/LG2 areas will need to consider an allowance for kinematic movement at the roof line in order to ensure compliance with the Kinematic Limit.

5.6.8 Tube Tunnels Maintenance Diagrams

5.6.8.1 **Diagram C1: General issue, Tube lines.** The Structure Gauge has reduced headroom compared to the new works gauge (B1). The lateral Clearance table also permits some tighter Clearances to operational equipment than for new works. The Kinematic Limit is developed from the Structure Profile by introduction of the following Safety Clearances:

- a) Above platform level and below platform level: 25mm;
- b) To platforms: 16mm.

5.6.8.1.1 In comparison with the new works diagram, the maintenance diagram permits reduced Clearances to the Kinematic Limit, minimal headroom, and reduced track spacing. The Clearances near rail level are of particular concern as the existing Clearances in older tunnels are less than desirable and are further reduced in some locations by the presence of operational equipment. This area is shown as a larger scale scrap view indicating the desirable Structure Profile for installations within the tunnels together with the minimum acceptable Structure Profile for Gauging existing installations. The authorised variations apply only to tube tunnel sections.

5.6.8.2 **Diagram C2 Authorised variations to general issue, Central Line, White City to Liverpool Street.** The original tunnels on the Central Line between Liverpool Street and White City are poorly aligned, resulting in reduced Clearances both below floor level and above the cant rail. Only those areas and dimensions which differ from the general issue are shown. This convention is followed for all variation diagrams. The Kinematic Limit is developed from the Structure Profile by introduction of the following Safety Clearances:

- a) Above platform level and below platform level to 75mm above rail level = 25mm;
- b) Absolute minimum at low level = 16mm.

5.6.8.3 **Diagram C3 Authorised variations to general issue, Northern Line.** The Northern Line has significant restrictions in space below floor level. This variation diagram identifies the reductions acceptable in these areas. Of particular note is the need to apply differing curving calculation rules for the area below 619mm above new rail datum. See 'curvature enlargement limit line'.

5.6.8.4 **Diagram C4 Authorised variations to general issue, Jubilee Line, Finchley Road to Charing Cross.** This variation shows small but significant restrictions in Clearance at sill plate level which are acceptable in the Jubilee Line tunnels between Finchley Road and Charing Cross.

5.6.8.5 **Diagram C5 Authorised variations to general issue, Green Line Structure Profile.** This reduced Structure Profile was introduced due to strengthening works in tunnels under the Thames. It was developed from the Green Line Structure Gauge, and its name arises because it was originally drawn in green ink on a standard diagram. This Structure Profile is applicable only in the Bakerloo Line tunnels between Embankment and Waterloo and must not be used elsewhere without the authority of the LU Head of Permanent Way Engineering. The Structure Profile was developed from the Green Line Structure Gauge. The Kinematic Limit is developed from the Structure Profile by introduction of the

following Safety Clearance: From 657mm above rail level to roof centre-line
25mm.

- 5.6.8.6 **Diagram C6 Authorised variations to general issue, Victoria Line.** The revision is restricted to the region from 187.5mm to 667mm above rail level and is relevant to platform offsites and away from platforms only. The revision from 535mm to 667mm above rail level is broadly similar to the limits adopted for diagrams C2, C3 and C4. The revision from 187.5mm to 535mm above rail revises the vertical boundary of the Structure Profile inwards towards the running edge datum by 20mm to eliminate the existing anomaly of the noise reduction screens and the platform offside ledges infringing the C1 Structure Profile laterally by 20mm. The Kinematic Limit is also moved inwards to maintain the 25mm Safety Clearance.

Note: A more detailed history behind the derivation of each gauge can be found in [TE-HBS-007](#) (G156) 'Gauging and Clearances Handbook'.

5.6.9 Rolling Stock Diagrams

- 5.6.9.1 **Diagram G1 Universal Kinematic Limit.** This diagram illustrates the maximum Kinematic Limit for engineer's vehicles which require Route Availability throughout the LU system. The Kinematic Limit is generated from the most restrictive combination of dimensions from the Central, Northern and Jubilee Line Kinematic Limit. At platforms the width is reduced to clear Jubilee Line platform edge doors. For vehicles of greater lengths than those shown, the vehicle envelope must be sized such that the Kinematic Limit is not exceeded on the minimum radii shown in the notes.
- 5.6.9.2 **Diagram G2 Maximum Load Gauges.** The three Load Gauges shown are for the loading of engineer's vehicles only. LG1 has universal Route Availability, LG2 is prohibited from tube tunnel sections and LG3 is permitted only on lines cleared for operation of rolling stock normally working on Network Rail. In case of doubt about the suitability of a load or a vehicle, a Clearance assessment and, if necessary, a concession must be obtained from the LU Track Engineer.
- 5.6.9.3 **Diagram G3 Universal Kinematic Limit.** This diagram illustrates the maximum Kinematic Limit for engineer's vehicles which require Route Availability throughout the LU 'sub-surface' lines, as shown on Structure Gauge Diagram A1. The G3 Kinematic Limit is generated from that shown on Structure Gauge Diagram E2, with a common roof line but a car-body half-width at the narrower dimension (i.e. where the Structure Profile = 921mm-25mm). The differences between G3 the E2 Kinematic Limit are at low level, with the G3 low-level half-width accommodating tube oversail platforms.

6 Person accountable for the document

Name	Job title
Andrew Brice	Head of Profession - Permanent Way (TfL)

7 Definitions

The following topic specific definitions are either:-

- contained within the TfL Management System Jargon Buster, [REDACTED], or;
- from stated sources, or;
- created as part of this document

Term	Definition	Source
Clearance	The minimum calculated distance between the Swept Envelope of a vehicle and fixed infrastructure, or between Swept Envelopes of two vehicles on adjacent tracks.	Jargon Buster
Datum Marker	A plate or sigot fixed to structures indicating the design geometry of the track including either the design or the maximum rail level (sometimes referred to as a monument plate).	Jargon Buster
Dynamic Gauging	The process of measuring Clearances to detect infringements of the Structure Profile whilst combining the dynamic effects of a vehicle in terms of body throw, displacement of the vehicle and dynamic movement of the track due to vehicle loading. This can be either through use of a vehicle – based measurement system or a computer simulation using a vehicle model through laser gauged profiles incorporating loaded track geometry data, (e.g. TRV data), to account for the dynamic effect of vehicle loading on track.	Jargon Buster
Fouling Point	The point at which the Clearance between Kinematic Limits on two converging tracks diminishes to 100 mm, after making the appropriate allowance for any cant effect and vehicular end or centre throw. In practice this is generally conservatively interpreted as the point at which the distance between the running edges of two converging tracks diminishes to 2 metres. This distance may actually be more or less than 2 metres, subject to site constraints, provided a minimum of 100mm is achieved between Kinematic Limits.	Jargon Buster
Gauging	The process of measuring the distance of tunnels, structures or fittings from the running rails (structure gauging) or the measurement of the car body profile from the running rail datums (load gauging).	Jargon Buster
Gauging Car	A vehicle fitted for the gauging of tunnels, structures and their fittings.	Jargon Buster

Term	Definition	Source
Generic Non-Compliance Report (GNCR)	<p>By adherence to Procedure PR0038 (<i>Management of Clearance Infringements</i>), a GNCR may be used in place of a clearance concession.</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> The GNCR shall be approved by the Head of Profession or an accredited engineer. <input checked="" type="checkbox"/> Structure Profile or sixfoot infringement values shall be provided in the GNCR or Concession to ensure T002/T003 track hand-back requirements can be completed in line with normal procedures. 	Jargon Buster
Kinematic Limit	<p>The maximum space available for Swept Envelopes within the Structure Profile determined for the route. The Kinematic Limit is enlarged for track curvature and cant where appropriate.</p> <p>Note: For existing lines, the Kinematic Limit is determined by introducing the Safety Clearance inside the existing Structure Profile.</p> <p>Track tolerances, wear and measurement accuracy of track and infrastructure are the responsibility of the infrastructure manager. Track tolerances to be allowed for are track lateral position (S1159 Clause 2.2.4 SSL3), track vertical position (S1159 Clause 2.1.6 SSL3), track cross level error (S1159 Clause 2.3 SSL3) and track wear tolerance (S1159 Clause 4.1.2 SSL3).</p>	Jargon Buster
Limited Clearance	An area where there is not enough room for a person to stand or walk safely between the trackside infrastructure and a passing train.	Jargon Buster
Load Gauge	The maximum permitted dimensions to which rolling stock with simple, stiff suspensions can be constructed and loaded. Primarily used for controlling the loading of engineer's vehicles.	Jargon Buster
LSG Grid	A transverse Mercator Projection with parameters chosen to minimise grid distortion caused by earth curvature over the LUL area.	Jargon Buster
Place of Safety	A location beside the track where people can walk or stand safely when trains pass.	Jargon Buster
Restriction Management System Database (RMSD)	<p>A data repository for:</p> <ol style="list-style-type: none"> I. constraints in track geometry and infrastructure clearance that limit train performance speeds. II. Infrastructure clearance non-compliance. 	Jargon Buster

Term	Definition	Source
Route Availability	A vehicle is declared as having Route Availability for a route if it has signalling and traction compatibility and conforms to all the requirements of the route in terms of its physical size, dynamic behaviour and axle loading.	Jargon Buster
Safety Clearance	The space between the Kinematic Limit and the Structure Profile.	Jargon Buster
Structure Gauge	The construction limits to be observed when building new railways and infrastructure. The boundary enclosing the Clearances required outside the Kinematic Limit to enable the railway to be operated in safety. This boundary must be enlarged on curved or canted track (or both) to allow for their effects. The Structure Gauge includes provision for staff safety where staff are permitted on the railway whilst trains are running.	Jargon Buster
Structure Profile	The space to be kept totally clear for trains; smaller than the Structure Gauge by the space occupied by signal and electrical installations and other miscellaneous railway equipment.	Jargon Buster
Supplier	Supplier to London Underground, the primary organisation or individual that is selected to deliver a product, service or facility to London Underground and contracting directly to London Underground. This includes Consultants, Contractors and excludes organisations or individuals selected by and contracting directly to them.	Jargon Buster
Swept Envelope	A cross-sectional profile, taken at right angles to the track, enclosing all dynamic movements, static deflections and overthrows of all points along the surface of the vehicle that can reasonably be expected to occur under the appropriate range of operating conditions as it sweeps past a theoretical track location. It takes into account vehicle suspension characteristics, allowances for vehicle tolerances (including build, maintenance, wear and measurement). A family of Swept Envelopes is required to define a vehicle's behaviour on a route. The Swept Envelopes referred to within this document exclude the effects of track tolerances and wear.	Jargon Buster
Total Station Instruments	Surveying instruments which record survey data in electronic form	Jargon Buster
Track Fixity	The definition is derived from RSSB Railway Group Standard GIRT7073 as <i>"The degree to which a track is restrained from movement in any direction. Track fixity can be different laterally and vertically, and can be asymmetric"</i>	Jargon Buster

Term	Definition	Source
Tunnel Drive	The process of excavating a tunnel using a tunnel boring machine	Jargon Buster
Tunnel Gauge	Timber template with fingered projections used to measure tunnel Clearances beyond the Structure Profile	Jargon Buster
Vehicle Profile	The profile formed by the maximum cross-sectional dimensions of a particular type of vehicle in tare condition when at rest on straight and level track. It shall take into account allowances for tolerances in the manufacture of the vehicle.	Jargon Buster
Wriggle Assessment	A method of determining the optimum designed position of the track within an as-built tunnel to obtain the required Clearances to structures and operational equipment and where necessary determining tunnel segment re-alignment to achieve such.	Jargon Buster

8 Abbreviations

Abbreviation	Meaning
ALARP	As Low As Reasonably Practical
GNCR	Generic Non-Compliance Report
JLE	Jubilee Line Extension
LABP	Level Access Boarding Point
OPO	One Person Operation
ORR	Office of the Rail Regulator
RMSD	Restriction Management System Database
RSPG	Railway Safety Principles and Guidance
SCL	Sprayed Concrete Lining
TOC	Train Operating Company

9 References

9.1 Industry codes of practice

Document no.	Title or URL
HS(G) 153/2	Railway Safety Principles and Guidance Part 2
GIRT7073	RSSB Railway Group Standard

9.2 LU company documents

Document no.	Title or URL
S1157	Track – Performance, Design and Configuration
S1159	Track – Dimensions and Tolerances
S1168	Track Asset Walkways
F5714	Clearance Application Form

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G156	Gauging and Clearances Handbook
PR0038	Management of Clearance Infringements
F1185	RMSD Upload Form
S1131	Premises – station platforms
20877-RPT-TRK-TF-001	Application of Track Fixity Guidance

10 Document history

Issue no.	Date	Changes	Author
1-156 A1	October 2007	Standard 2-01302-120 re formatted and re-numbered to 1-156, no technical changes have been made to the content other than changing references to other Standards where their numbers have changed. Authorised for use. Previous authorisation is valid.	
1-156 A2	November 2007	Authorised variation to Victoria line, diagram C6, and explanatory clause added. Previous Written Notice, LU-WN-00647, included. Authorised for use.	
1-156 A3	March 2008	Changes agreed at the Director led Review Meetings – TLL Standards Review - Track. Authorised for use.	
1-156 A4	February 2009	Ref PSC M1-01186. Clauses 3.2.1.4 to 3.2.1.11 inserted. Clause 3.5.2 amended to reflect appropriate reference. Authorised for use.	
1-156 A5	February 2011	Standard updated in accordance with DRACCT Log No 00079. Standard reformatted in accordance with new template. Revised Post Aldgate Incident Section 3 Requirements changed, and old requirements moved to Section 5 'Supporting Information' Tables and Attachments from 2009 review	Mike Barlow / Steve McCallum
S1156 A6	December 2011	Renumbered, minor corrections to text, incorporation of Written Notice and amendments to diagrams.	Mike Barlow
S1156 A7	February 2012	Amendments made to the Platform Tables in Attachment 3 as per DRACCT No. 01234	Mike Barlow

S1156 A8	July 2014	Standard updated in accordance with DRACCT Log No 01187. (Sections 3.5, 5.4.3 added and section 7.2 amended.) Amendments made to the Platform Tables. References updated. Written Notice LU-WN-01228 incorporated.	Mike Barlow
S1156 A9	November 2016	Standard updated in accordance with DRACCT Log No 04721 (Terms and definitions adjusted to make consistent with Standard for Rolling Stock S1180 A6. Clearer definition of responsibilities at the interface. Standard reformatted. Audit actions IA 16710 addressed) Definitions for clearance has been added.	Andrew Brice
S1156 A10	October 2018	Updated following feedback from Track Engineering in order to bring clarity and consistency in the use of S1156. Also, reference to a new procedure PR0038 'Management of clearance infringements' and associated form F1185 'RMSD Upload Form' have been added. Change request No. CR-10092.	Andrew Brice
S1156 A11	August 2021	Various Drawings in Attachment 5 updated with G3 added. Reference linking S1156 to PR0038 and the GNCR added. Platform Tables updated. Change No. CR- 15098.	David Watkinson

11.0 Attachments

<u>Attachment</u>	<u>Description</u>
1	Guidance on completing the Clearance Application Form
2	Control of Track Position on the Central Line
3	Platform Tables
4	Detailed Throw Formula for Plain Curves
5	Drawings
	A1 - All Lines - Application Map for Diagrams
	A2 - All Lines - Application Map for Tunnel Gauges
	B1 - Tube Stock Only – New Works Diagram
	C1 - Tube Stock Only – Maintenance Diagram
	C2 - Central Line White City – Liverpool St – Maintenance Diagram
	C3 - Northern Line – Euston – Stockwell via Bank – Maintenance Diagram
	C4 - Jubilee Line Finchley Road – Charing X – Maintenance Diagram
	C5 - Bakerloo Line Thames Tunnels – Maintenance Diagram
	C6 - Victoria Line – Maintenance Diagram
	D1 - Surface and Sub-Surface Lines – New Works Diagram
	E1 - Surface Lines – Maintenance Diagram
	E2 - Sub-Surface Lines – Maintenance Diagram
	F1 - All Lines - Track/Train Interface
	G1 - Universal Kinematic Limit for engineering trains
	G2 - Load Gauges for engineering trains
	G3 - Kinematic Limit for engineering trains (Surface & Sub-Surface only)
	5602 - Sub-Surface tunnels between Finchley Road and Aldgate Platforms 2 & 3 only. Not for use in any other Sub-Surface tunnels.
	5603 - All Sub-Surface tunnels <u>except</u> both roads between Finchley Road and Aldgate Platforms 2 & 3.
	5604 - Tube tunnels between Waterloo and Embankment on the Bakerloo Line only. Not for use in other Tube tunnels or any Sub-Surface Tunnels
	5605 - All Tube tunnels <u>except</u> between Waterloo and Embankment on the Bakerloo Line. Not for use in any Sub-Surface Tunnels.

11.1 Attachment 1: Guidance on completing the Clearance Application Form (F5714)

Is a Clearance Application Required?

Any structure or fixed equipment (whether operational or not) requires a Clearance assessment provided it is less than 5m above or within 3m laterally of the nearest running edge.

When do you NOT NEED a Clearance Application?

Only locations within direct sight of the track need to be assessed. An application is not required if the location is within a station but away from train operations e.g. a cross passage or escalator.

Allow Time for Granting of Application before Work Commences

Ten working days advance notice of installation should be allowed for approval.

Specify the Location to be assessed

Include one or more of the following to define the location exactly:

- a) Station name or Stations to either side of the site;
- b) Platform number if appropriate;
- c) Track LCS designation e.g. NB, SB, Inner, Outer, WB, EB, BOTH or ALL etc.
- d) Number or Name of structure.

Specify the Track Geometry at the location

Geometry is important for establishing the throws of the vehicle body and hence the additional Clearances required on track that is curved either Horizontally, Vertically or Both. Geometry information required includes:

- a) Curve Radius
- b) Direction or hand of curve in direction of normal running
- c) Cant whether positive or negative for the direction of the curve
- d) If there is no curve or cant at the location then make this clear.

Define the points to be gauged

The nearest locations of the structure or fixed equipment need to be assessed for Clearance to the trains in order that the required Clearances are maintained. The Running Edge is used as the datum point because the track gauge is permitted to be widened on curves and the width of the rail varies with the weight or size of the rail. The real running edge should be used to take into account any rail side wear.

The closest points are defined by measuring the X and Y coordinates from the running edge (inside edge) of the nearest running rail. These points are defined by:

- a) The Height (vertical);
- b) The Offset (horizontal)

Explain how the Clearances will be measured

Provide an explanation of the method which will be used to measure the Clearances, including a clear description of the equipment to be used.

Cost Code

Please include the Project number to which the work can be charged. Without this number the assessment may be delayed while funding is arranged.

11.2 Attachment 2: Control of Track Position on the Central Line

The 11'-8" (3556mm) diameter tube section between White City and Liverpool Street on the Central line is among the smallest on LU giving rise to the tightest Clearances, and the construction standard achieved between White City and Oxford Circus in particular creates critical Clearance conditions between the vehicle cant rail position and roof and below the door sill. It is thus essential that all work which could affect the absolute height and lateral position of each rail is controlled within allowable tolerances using the monument plates established as part of the Central line Clearance survey as a datum. Where alterations exceeding allowable tolerances defined in the tables below are proposed they shall be checked against the Central line Clearance survey details to determine the effect on Clearances before the work is authorised to proceed.

The Central line Clearance survey results are held by the Central Line Management Team, (CLMT), which is also responsible for monument integrity. The Central line Track Manager, is responsible for the storage, use and updating of the data. Where other parties are involved in design or carrying out of works which may affect Clearances the CLMT shall ensure that sufficient updated data is supplied or available for reference to ensure the design and implementation of such works is carried out within the constraints imposed by the Central line Clearance survey.

Where design work involves the optimisation of track alignment within the positional tolerances indicated in the tables in this attachment, such designs shall require to be finally ratified by the CLMT who shall ensure that subsequent track installation is carried out to that design. In the event of such optimisation work being considered by the CLMT to be sufficient to merit altering the tolerances in the tables then such alterations shall be documented, and application made to The Head of Track Engineering to amend and re-issue the tables. The CLMT shall arrange corresponding alterations to the appropriate monument plates and the Central line Clearance survey data. Where improvements are made to Clearances but the CLMT decision is not to apply for an alteration to the tolerances then the CLMT shall keep on record such improvements until they consider it appropriate to make such an application. Until that time the prevailing positional tolerances shall be adhered to.

Monument plates have been established every 20m on straight track and every 10m on curved track. These vary in position as to the side of the track due to Clearance restraints but in general are installed adjacent to the low rail. Each monument plate has a location identifier using LCS codes, direction, and ring number and is inscribed with the horizontal offset to the nearest running edge in metres and the cant in mm. Cant is described as either RH (right hand rail high in direction of travel) or LH (left hand rail high in direction of travel). Monuments relate to the position of the rail at the time the survey was carried out in 1991/92 and do not represent optimum track position.

Vertical height is controlled by the vertical position of the plates relative to the unworn rail head. The method used to establish datum was to measure the height of the rail and calculate the level of the unworn rail head. No measurement was made of the packing or pad depth underneath the chair, which can vary from zero to approximately 30mm. The monument plates were then installed with the datum 300mm above the nearest (unworn) rail level. Rail head wear is thus allowed for and like for like rerailing (BH new for BH worn or FB new for FB worn) will return Clearances to datum providing packings or pads are not altered.

The horizontal offset is to the unworn running edge and excludes sidewear effect.

Measurement of the position of the track relative to the monument plates shall be by means of the standard LUL offset gauge. Measurement of cant shall be by means of a graduated track gauge reading 1mm increments of applied cant.

The tables below list the parameters to be controlled and the tolerances they are to be controlled to for specific sections of tube to ensure the three defined values at each location i.e. height, lateral position and cant, remain within allowable limits. The sections of tube have been categorised into zones based on known available Clearance to avoid the need for specific tolerances at each monument plate.

No work shall be carried out which results in track position outside these tolerances. Should subsequent measurement reveal the tolerances have been exceeded a specific check of Clearances shall be necessary using the Central line Clearance survey base data at that location. The results of this shall determine whether the track shall be repositioned and to what extent. Where such a check indicates a new track position outside the tolerance range is permissible the situation shall be dealt with as described above.

The most likely cause of change of track position in the tube is a change of height and cant due to the insertion of packing. The magnification of cant changes at cant rail level can result in loss of Clearances. Packing of rails shall be strictly controlled during all maintenance and renewal works.

Trackwork carried out in the tube falls into four general categories:

- a) response to faults found by the TRV;
- b) emergency or planned minor maintenance works which under controlled conditions should normally be able to be carried out without exceeding the positional tolerance limits shown in the tables below, i.e. those which do not require any change in lateral or vertical rail position;
- c) maintenance works which are likely to exceed tolerances the positional tolerance limits shown in the tables below;
- d) renewal works which are likely to exceed the positional tolerance limits shown in the tables below, or to require or benefit from repositioning of the track.

Regardless of which category specific works fall within, all work shall be checked against datum on completion to ensure the positional tolerances are not exceeded.

Positional tolerances relating actual rail position to permanent monumented datum on the Central line (all values in millimetres)

Zone 1 Applies to both tunnels between White City and Oxford Circus;

Zone 2 Applies to both tunnels between Oxford Circus and Liverpool Street;

Zone 3 Applies to both tunnels east of Liverpool Street.

Table 7: Zone 1 Critical Areas

Critical areas where the Clearance between tunnel lining and Kinematic Limit is minimal applies to:	White City - Shepherds Bush		EB & WB	(Caxton curves)	
	Notting Hill Gate - Holland Park		WB		
	Marble Arch - Queensway		WB		
	Bond Street - Marble Arch		WB		
a) Vertical position of nearest running surface Maximum permitted vertical deviation from 300mm below datum mark on plate defining unworn rail level.	+ 0	-3	Renewal work which includes rerailing		
	+ 0	-10	Renewal work which excludes rerailing <i>(allows for 8mm max headwear)</i>		
	As required by cross level tolerances in (c) below		Maintenance intervention threshold		
	+5	-25	Safety intervention threshold		
b) Lateral position of nearest running edge Maximum permitted deviation from marked offset on plate defining unworn running edge position	+4	-4	Renewal work which includes rerailing		
	+6	-10	Maintenance intervention threshold		
	+8	-13	Safety intervention threshold		
c) Cross level	<u>Uncanted Track</u>		<u>Canted Track</u>		
	± 2		+0	-4	Renewal
	± 5		+2	-5	Maintenance intervention threshold
	± 6		+3	-6	Safety intervention threshold

Table 8: All other areas in Zone 1

a) Vertical position of nearest running surface Maximum permitted vertical deviation from 300mm below datum mark on plate defining unworn rail level.	0	-3	Renewal work which includes rerailing		
	0	-10	Renewal work which excludes rerailing (<i>allows for 8mm max headwear</i>)		
	As required by cross level tolerances in (c) below		Maintenance intervention threshold		
	+5	-25	Safety intervention threshold		
b) Lateral position of nearest running Maximum permitted deviation from marked offset on plate defining unworn running edge position	+4	-4	Renewal work which includes rerailing		
	+6	-10	Maintenance Intervention threshold		
	+8	-13	Safety intervention threshold		
c) Cross level	<u>Uncanted Track</u>		<u>Canted Track</u>		
	± 2		0	-4	Renewals
	± 6		+3	-6	Maintenance intervention threshold
	± 8		+4	-8	Safety intervention threshold

Table 9: Zone 2 Tunnels between Oxford Circus and Liverpool Street, both EB & WB

a) Vertical position of nearest running surface Maximum permitted vertical deviation from 300mm below datum mark on plate defining unworn rail level.	+2	-5	Renewal work which includes rerailing	
	+2	-13	Renewal work which excludes rerailing (allows for 8mm max headwear)	
	As required by cross level tolerances in (c) below		Maintenance intervention threshold	
	+5	-25	Safety intervention threshold	
b) Lateral position of nearest running edge Maximum permitted deviation from marked offset on plate defining unworn running edge position	+6	-6	Renewal work which includes rerailing	
	+8	-10	Maintenance intervention threshold	
	+10	-13	Safety intervention threshold	
c) Cross level	<u>Uncanted Track</u>		<u>Canted Track</u>	
	± 4	+2	-6	Renewals
	± 6	+4	-8	Maintenance intervention threshold
	± 8	+5	-10	Safety intervention threshold

Table 10: Zone 3: Tunnels east of Liverpool Street, both EB & WB

a) Vertical position of nearest running surface Maximum permitted vertical deviation from 300mm below datum mark on plate defining unworn rail level.	+6	-6	Renewal work which includes rerailing		
	+6	-14	Renewal work which excludes rerailing (allows for 8mm max headwear)		
	As required by cross level tolerances in (c) below		Maintenance intervention threshold		
	+5	-25	Safety intervention threshold		
b) Lateral position of nearest running edge Maximum permitted deviation from marked offset on plate defining unworn running edge position	+6	-6	Renewal work which includes rerailing		
	+10	-10	Maintenance intervention threshold		
	+13	-13	Safety intervention threshold		
c) Cross level	Uncanted Track		Canted Track		
	± 5		+5	-5	Renewals
	± 10		+8	-10	Maintenance intervention threshold
	± 15		+10	-15	Safety intervention threshold

Notes:

1. Exceedences of the maintenance intervention threshold require work to be planned to restore or improve the situation within eight weeks of the discovery of the exceedence.
2. Exceedences of the safety intervention threshold shall be immediately referred to the Central line Track Manager for advice on the appropriate action which might be:
 - a) stop traffic;
 - b) pass traffic under controlled conditions and examine track;
 - c) impose an appropriate speed restriction, refer to Clause 5.2.9,
 but is unlikely to be less than restore the situation within one week of the discovery of the exceedence.

11.3 Attachment 3: Platform Tables

Platform codes

Code	Height	Offset	Height Tolerances		Offset Tolerances	Track	Service or Lines	Stock	Access	Platform Gauge Drawing / Section Reference	
			New	Maintenance							
C840B	840	711					Tube Open (Central; Northern; Jubilee)	LUL	Compromise	Em5095	
#C810B	810	695	-0/+10	-10/+25	-0/+10	Ballasted	# SSL/Tube Open (District; Piccadilly; Metropolitan)	LUL	Compromise		
S915B	915	730					SSL/NR Open	LUL/NR	Oversail	Pm16769	
S950J		711	-0/+10	-25/+10	-0/+10		SSL Open	LUL/NR	Level LUL		
S950B	950	695					Sub Surface/Open	LUL	Level LUL	Em2817	
S950F							Fixed (Concrete)	Westminster and Embankment only	LUL	Level LUL	
S1120B	1120	770					Strutted	Ladbroke Grove EB only	S stock	Undersail	
T520B		610					Ballasted	Tube Open	Tube	Oversail	Pm3871
T520Bw	520	648	-0/+10	-10/+25	-0/+10			Tube/SSL Open	Tube	Oversail	Pm2355
T520F		585					Fixed (Concrete)	Tube Tunnels	Tube	Oversail	P45847
TLAB	725	690					Ballasted	Tube Open	Tube	Level	See Section 5.3
TLAF		680				Fixed (Concrete)	Tube Tunnels	Tube	Level		
TLAVF	651	680				Fixed (Concrete)	Victoria	09	Level		
TLAPB	650	685				Ballasted	Piccadilly	2024	Level		
TLAPF	650	685 [*680]	+/- 5	+/- 10		Fixed (Concrete)	Piccadilly	2024	Level		
T700B	700	711				Ballasted	JLE & Stanmore P3	96	Level		
T700F	700	701				Fixed (Concrete)	JLE & Heathrow T5	Tube	Level		

- In the Platform Codes table above, offsets of both 711mm and 695mm are shown for S950J, S950B and S950F code platforms. Where compliance with the Rail Vehicle Accessibility Regulations at the designated doors is required, the offset should be reduced to 690mm where only LU stocks operate. Where LU/NR stocks jointly operate, first consideration should be to use 690mm offset based on swept envelope assessment of the relevant stock.
- When assessing platform offsets where ballasted track is installed, track fixity must be assessed to ensure a stable track/platform interface.

Abbreviations

C	Compromise: #C810B is introduced to improve 'steps and gaps' for the relevant passenger stocks, i.e. S Stock, 73TS, and 24TS.	V	Victoria
S	Surface/Subsurface	F	Fixed / Concrete track
T	Tube	B	Ballasted track
Term	Terminal	Bw	Wide ballast
TLA	Tube Level Access	J	Joint running - LU & NR
P	Piccadilly [* TLAPF: 680mm offset available subject to 2024TS dynamic gauging assessment]		

Note: Numeric values shown in the Code column relate specifically to the platform height.

The rest of this attachment comprises tabulations of all platforms by Line in the following order:

<ul style="list-style-type: none"> Hammersmith and City Circle District Metropolitan Bakerloo Victoria Central and Waterloo and City Jubilee Northern Piccadilly 	In the tables the following fields are shown:	
	Station	Station Name
	Platform	Platform number and direction of normal travel
	Code	The currently installed platform code
	Type	Current access type e.g. Oversail or Level. Note that this is stock dependent.
	New Platform Code	Optimum platform code for Level Access (or at compromise platforms where two LU stock operate a passenger service).

Hammersmith & City Line		Current		New Platform Code		
Station	Platform	Code	Type			
Hammersmith	1 Term	S950B	Level to S stock	S950B		
	2 Term					
	3 Term					
Goldhawk Road	1 WB					
	2 EB					
Shepherd's Bush Market	1 WB					
	2 EB					
Wood Lane	1 WB					
	2 EB					
Latimer Road	1 WB					
	2 EB					
Ladbroke Grove	1 WB				S1120B Strutted	
	2 EB					
Westbourne Park	1 EB				S950B	Level to S stock
	2 WB					
Royal Oak	1 EB					
	2 WB					
Paddington (Suburban)	15 EB					
	16 WB					
Edgware Road	1 OR					
	2 OR					
	3 IR					
	4 IR					

Circle Line		Current		New Platform Code
Station	Platform	Code	Type	
Baker Street	5 IR	S950B	Level to S stock	S950B
	6 OR			
Great Portland Street	1 IR			
	2 OR			
Euston Square	1 IR			
	2 OR			
King's Cross St. Pancras	1 IR			
	2 OR			
Farringdon	1 OR			
	2 IR			
Barbican	1 OR			
	2 IR			
Moorgate	1 OR			
	2 IR			
	3 Bay			
	4 Bay			
Liverpool Street	1 OR			
	2 IR			
Aldgate	1 OR			
	2 Bay			
	3 Bay			
	4 IR			
Tower Hill	1 WB			
	2 Bay			
	3 EB			
Monument	1 WB			
	2 EB			
Cannon Street	1 WB			
	2 EB			
Mansion House	1 WB			
	2 Bay			
	3 EB			

Circle Line		Current		New Platform Code	
Station	Code	Code	Type		
Blackfriars	1 WB	S950B	Level to S stock	S950B	
	2 EB				
Temple	1 WB				
	2 EB				
Embankment	1 WB				S950F
	2 EB				
Westminster	1 WB				
	2 EB				
St. James's Park	1 WB	S950B	Level to S stock	S950B	
	2 EB				
Victoria	1 WB				
	2 EB				
Sloane Square	1 WB				
	2 EB				
South Kensington	1 WB				
	2 EB				
Gloucester Road	1 WB Dis				
	2 WB Cir				
	3 EB				
High Street Kensington	1 IR				
	2 OR				
	3 Bay				
	4 Bay				
Notting Hill Gate	1 OR				
	2 IR				
Bayswater	1 OR				
	2 IR				
Paddington	1 OR				
	2 IR				

District Line		Current		New Platform Code
Station		Code	Type	
Upminster	3 Term	S950B	Level to S stock	S950B
	4 Term			
	5 Term			
Upminster Bridge	1 WB			
	2 EB			
Hornchurch	1 WB			
	2 EB			
Elm Park	1 WB			
	2 EB			
Dagenham East	1 WB			
	2 EB			
	3 Bay			
Dagenham Heathway	1 WB			
	2 EB			
Becontree	1 WB			
	2 EB			
Upney	1 WB			
	2 EB			
Barking	2 EB			
	3 Bay			
	6 WB			
East Ham	1 WB			
	2 EB			
Upton Park	1 WB			
	2 EB			
Plaistow	1 Bay			
	2 EB			
	3 WB			
West Ham	1 WB			
	2 EB			
Bromley-by-Bow	1 WB			
	2 EB			
Bow Road	1 WB			
	2 EB			

District Line		Current		New Platform Code
Station	Code	Code	Type	
Mile End	2 WB	S950B	Level to S stock	S950B
	3 EB			
Stepney Green	1 WB			
	2 EB			
Whitechapel	1 EB			
	2 EB			
	3 WB			
	4 WB			
	1 WB			
	2 EB			
Earl's Court	1 EB			
	2 EB			
	3 WB			
	4 WB			
West Kensington	1 WB			
	2 EB			
Kensington (Olympia)	1 Term			
	1 EB			
West Brompton	2 WB			
	1 EB			
Fulham Broadway	2 WB			
	1 EB			
Parsons Green	2 WB			
	1 EB			
Putney Bridge	2 Bay			
	3 WB			
	1 EB			
East Putney	2 WB			
	1 EB			
Southfields	2 WB	S915B	NR Oversail	S950J
	1 EB			
Wimbledon Park	2 WB			
	1 Term			
Wimbledon	2 Term			
	3 Term			
	4 Term			

District Line		Current		New Platform Code			
Station	Platform	Code	Type				
Barons Court	1 WB L	S950B	Level to S Stock	S950B			
	4 EB L						
Hammersmith	1 WB L	C840B	Comp.	S950B*			
	4 EB L	S950B**	Level to S Stock	S950B**			
Ravenscourt Park	1 WB L	C840B	Compromise	S950B*			
	4 EB L						
Stamford Brook	1 WB L						
	3 EB L						
Turnham Green	1 WB L						
	4 EB L						
Chiswick Park	1 WB L						
	2 EB L						
Acton Town	1 WB L						
	4 EB L						
Ealing Common	1 WB						
	2 EB						
Ealing Broadway	7 Term				S950B	Level to S Stock	S950B
	8 Term						
	9 Term						
Gunnersbury	1 WB	S915B	NR Owned and maintained	S950B			
	2 EB						
Kew Gardens	1 WB						
	2 EB						
Richmond	3 Term						
	4 Term						
	5 Term						
	6 Term						
	7 Term						

Notes:

S950B*
 a) "Level to S Stock" can only be implemented when 73TS stop calling at these platforms in passenger service (circa 2024-26).

S950B (Hammersmith Platform 4)**
 b) Only suitable for unscheduled use by 73TS in passenger service with station staff assistance. Passenger service 73TS shall not be timetabled to stop.



Metropolitan Line		Current		New Platform Code
Station	Platform	Code	Type	
Baker Street	1 Bay	S950B	Level to S stock	S950B
	2 NB			
	3 SB			
	4 Bay			
Finchley Road	1 NB			
	4 SB			
Willesden Green	1 NB			
	4 SB			
Neasden	1 NB			
	4 SB			
Wembley Park	6 SB F			
	5 SB L			
Wembley Park Preston Road	2 NB L			
	1 NB F			
	1 NB L			
Northwick Park	2 SB L			
	1 NB L			
Northwick Park	2 SB L			
	1 NB L			
Harrow-on-the-Hill	6 SB F			
	5 SB Ux			
	4 NB Ux			
	3 NB F			
	2 SB M			
	1 NB M			

L – Local
 F – Fast
 M – Main
 Ux – Uxbridge

Metropolitan Line		Current		New Platform Code			
Station	Platform	Code	Type				
North Harrow	1 NB L	S950B	Level to S stock	S950B			
	2 SB L						
Pinner	1 NB L						
	2 SB L						
Northwood Hills	1 NB L						
	2 SB L						
Northwood	1 NB L						
	2 SB L						
Moor Park	1 NB F				S915B		
	2 SB F						
	3 NB L						
	4 SB L						
Croxley	1 NB	S950B					
	2 SB						
Watford	1 Terminal	S915B	NR Oversail	S950J			
	2 Terminal						
Rickmansworth	1 NB						
	2 SB						
	3 Bay						
Chorleywood	1 NB						
	2 SB						
Chalfont & Latimer	1 NB						
	2 SB						
	3 Bay						
Amersham	1 NB						
	2 NB						
	3 SB						
Chesham	1 Terminal				S950B	Over sail	S950B

Metropolitan Line		Current		New Platform Code
Station	Platform	Code	Type	
West Harrow	1 WB	S950B	Oversail / Level	S950B
	2 EB			
Rayners Lane	1 WB	C840B	Compromise	C810B
	2 EB			
Eastcote	1 WB			
	2 EB			
Ruislip Manor	1 WB			
	2 EB			
Ruislip	1 WB			
	2 EB			
Ickenham	1 WB			
	2 EB			
Hillingdon	1 WB			
	2 EB			
Uxbridge	1 Terminal			
	2 Terminal			
	3 Terminal			
	4 Terminal			

Bakerloo Line		Current		New Platform Code
Station	Platform	Code	Type	
Elephant & Castle	3 Term	T520F	Oversail	TLAF
	4 Term			
Lambeth North	1 NB			
	2 SB			
Waterloo	3 NB			
	4 SB			
Embankment	5 NB			
	6 SB			
Charing Cross	1 NB			
	2 SB			
Piccadilly Circus	1 NB			
	2 SB			
Oxford Circus	3 SB			
	4 NB			
Regent's Park	1 NB			
	2 SB			
Baker Street	8 SB			
	9 NB			
Marylebone	1 NB			
	2 SB			
Edgware Road	1 NB			
	2 SB			
Paddington	3 NB			
	4 SB			
Warwick Avenue	1 NB			
	2 SB			
Maida Vale	1 NB			
	2 SB			
Kilburn Park	1 NB			
	2 SB			
Queen's Park	2 SB	T520B		TLAB
	3 NB			

Bakerloo Line		Current		New Platform Code
Station	Platform	Code	Type	
Kensal Green	1 SB	S915B	NR Owned and Maintained	S915B
	2 NB			
Willesden Junction	1 SB			
	3 NB			
Harlesden	1 SB			
	2 NB			
Stonebridge Park	1 SB			
	2 NB			
Wembley Central	1 NB			
	2 SB			
North Wembley	1 SB			
	2 NB			
South Kenton	1 SB			
	3 NB			
Kenton	1 SB			
	2 NB			
Harrow & Wealdstone	1 NB			
	2 SB			

Victoria Line		Current		New Platform Code
Station	Platform	Code	Type	
Walthamstow Central	1 Term	T520F	Oversail	TLAVF
	2 Term			
Blackhorse Road	1 NB			
	2 SB			
Tottenham Hale	1 NB			
	2 SB			
Seven Sisters	3 SB			
	4 NB			
	5 NB			
Finsbury Park	2 NB			
	4 SB			
Highbury & Islington	3 NB			
	5 SB			
King's Cross St. Pancras	3 NB			
	4 SB			
Euston	4 NB			
	5 SB			
Warren Street	3 NB			
	4 SB			
Oxford Circus	5 SB			
	6 NB			
Green Park	3 SB			
	4 NB			
Victoria	3 NB			
	4 SB			
Pimlico	1 NB			
	2 SB			
Vauxhall	1 NB			
	2 SB			
Stockwell	1 NB			
	4 SB			
Brixton	1 Term			
	2 Term			

Central Line		Current		New Platform Code
Station	Platform	Code	Type	
Epping	1 Term	C840B	Compromise	TLAB
	2 Term			
Theydon Bois	1 WB			
	2 EB			
Debden	1 WB			
	2 EB			
Loughton	1 WB			
	2 Loop			
	3 Loop			
	4 EB			
Buckhurst Hill	1 WB			
	2 EB			
Woodford	1 Bay			
	2 WB			
	3 EB			
Roding Valley	1 WB			
	2 EB			
Chigwell	1 WB			
	2 EB			
Grange Hill	1 WB			
	2 EB			
Hainault	1 EB			
	2 WB			
	3 Bay			
Fairlop	1 EB			
	2 WB			
Barkingside	1 EB			
	2 WB			
Newbury Park	1 EB			
	2 WB			
Gants Hill	1 WB	T520F	Oversail	TLAF
	2 EB			
Redbridge	1 WB			
	2 EB			
Wanstead	1 WB			
	2 EB			

Waterloo & City Line		Current		New Platform Code
Station	Platform	Code	Type	
Waterloo W&C	25 EB	T520F	Oversail	TLAF
	26 WB			
Bank W&C	7 Term			
	8 Term			

Central Line		Current		New Platform Code			
Station	Platform	Code	Type				
South Woodford	1 WB	C840B	Compromise	TLAB			
	2 EB						
Snaresbrook	1 WB						
	2 EB						
Leytonstone	1 WB						
	2 WB						
	3 EB						
Leyton	1 WB						
	2 EB						
Stratford	3aWB				TLAB	Level	TLAF
	3 WB				T520B	Oversail	
	6 EB						
Mile End	1 WB	T520F	Oversail				
	4 EB						
Bethnal Green	1 WB						
	2 EB						
Liverpool Street	4 EB						
	5 WB						
Bank	5 WB						
	6 EB						
St. Paul's	1 WB						
	2 EB						
Chancery Lane	1 WB						
	2 EB						
Holborn	1 WB						
	2 EB						
Tottenham Court Road	1 WB						
	2 EB						
Oxford Circus	1 WB						
	2 EB						
Bond Street	1 WB						
	2 EB						

Central Line		Current		New Platform Code			
Station	Platform	Code	Type				
Marble Arch	1 WB	T520F	Oversail	TLAF			
	2 EB						
Lancaster Gate	1 WB						
	2 EB						
Queensway	1 WB						
	2 EB						
Notting Hill Gate	3 EB						
	4 WB						
Holland Park	1 WB						
	2 EB						
Shepherd's Bush	1 WB				T520B	Oversail	TLAB
	2 EB						
White City	1 WB						
	2 Loop						
	3 Loop						
	4 EB						
East Acton	1 WB						
	2 EB						
North Acton	1 EB	T520B					
	2 Loop	T520B w					
	3 WB	T520B					
West Acton	1 WB	T520B w	Oversail	TLAB			
	2 EB						
Ealing Broadway	5 Term						
	6 Term						
Hanger Lane	1 WB						
	2 EB						
Perivale	1 WB						
	2 EB						
Greenford	1 WB						
	3 EB						
Northolt	1 WB						
	2 EB						
South Ruislip	1 WB						
	2 EB						
Ruislip Gardens	1 WB						
	2 EB						
West Ruislip	1 Term						
	2 Term						

Jubilee Line		Current		New Platform Code	
Station	Platform	Code	Type		
Stratford	13 Term	T700B	Level Access	TLAB	
	14 Term				
	15 Term				
West Ham	5 WB				
	6 EB				
Canning Town	5 WB				
	6 EB				
North Greenwich	1 WB	T700F		Level Access	TLAF
	2 Loop				
	3 EB				
Canary Wharf	1 WB				
	2 EB				
Canada Water	1 WB				
	2 EB				
Bermondsey	1 WB				
	2 EB				
London Bridge	3 WB				
	4 EB				
Southwark	1 WB				
	2 EB				
Waterloo	5 WB				
	6 EB				
Westminster	3 EB				
	4 WB				
Charing Cross	5 NB		T520F		
	6 NB				
Green Park	5 NB				
	6 SB				
Bond Street	3 SB				
	4 NB				
Baker Street	7 SB				
	10 NB				
St. John's Wood	1 NB				
	2 SB				
Swiss Cottage	1 NB				
	2 SB				

Jubilee Line		Current		New Platform Code
Station	Platform	Code	Type	
Finchley Road	3 SB	T520B	Oversail	TLAB
	2 NB			
West Hampstead	1 NB	C840B	Compromise	
	2 SB			
Kilburn	1 NB			
	2 SB			
Willesden Green	2 NB			
	3 SB			
Dollis Hill	1 NB			
	2 SB			
Neasden	2 NB			
	3 SB			
Wembley Park	3 NB			
	4 SB			
Kingsbury	1 NB			
	2 SB			
Queensbury	1 NB			
	2 SB			
Canons Park	1 NB			
	2 SB			
Stanmore	1 Term	T700B	Level Access	
	2 Term			
	3 Term			

Northern Line		Current		New Platform Code
Station	Platform	Code	Type	
Morden	1 Term	T520F	Oversail	TLAF
	2 Term			
	3 Term			
	4 Term			
	5 Term			
South Wimbledon	1 NB			
	2 SB			
Colliers Wood	1 NB			
	2 SB			
Tooting Broadway	1 NB			
	2 SB			
Tooting Bec	1 NB			
	2 SB			
Balham	1 NB			
	2 SB			
Clapham South	1 NB			
	2 SB			
Clapham Common	1 NB			
	2 SB			
Clapham North	1 NB			
	2 SB			
Stockwell	2 NB			
	3 SB			
Oval	1 NB			
	2 SB			
Kennington	2 NB			
	3 SB			
Elephant & Castle	1 NB			
	2 SB			
Borough	1 NB			
	2 SB			
London Bridge	1 NB			
	2 SB			
Bank	3 SB			
	4 NB			
Moorgate	7 NB			
	8 SB			
Old Street	1 NB			
	2 SB			
Angel	1 NB			
	2 SB			
King's Cross St. Pancras	7 NB			
	8 SB			
Euston (City Branch)	3 NB			
	6 SB			

Northern Line		Current		New Platform Code			
Station	Platform	Code	Type				
Kennington	1 NB	T520F	Oversail	TLAF			
	4 SB						
Waterloo	1 NB						
	2 SB						
Embankment	3 NB						
	4 SB						
Charing Cross	5 NB						
	6 SB						
Leicester Square	3 SB						
	4 NB						
Tottenham Court Road	3 NB						
	4 SB						
Goodge Street	1 NB						
	2 SB						
Warren Street	1 NB						
	2 SB						
Euston (West End Branch)	1 NB						
	2 SB						
Mornington Crescent	1 NB						
	2 SB						
Camden Town	3 NB						
	4 SB						
Kentish Town	1 NB						
	2 SB						
Tufnell Park	1 NB						
	2 SB						
Archway	1 NB						
	2 SB						
Highgate	1 NB						
	2 SB						
East Finchley	1 NB				T520B	Oversail	TLAB
	2 NB						
	3 SB						
	4 SB						
Finchley Central	1 NB						
	2 NB						
	3 SB						
Mill Hill East	1 SB						

Northern Line		Current		New Platform Code			
Station	Platform	Code	Type				
West Finchley	1 NB	C840B	Compromise	TLAB			
	2 SB						
Woodside Park	1 NB						
	2 SB						
Totteridge & Whetstone	1 NB						
	2 SB						
High Barnet	1 Term						
	2 Term						
	3 Term						
Camden Town	1 NB				T520F	Oversail	TLAF
	2 SB						
Chalk Farm	1 NB						
	2 SB						
Belsize Park	1 NB						
	2 SB						
Hampstead	1 NB						
	2 SB						
Golders Green	1 NB	T520B	Oversail	TLAB			
	2 NB						
	3 Loop						
	4 Loop						
	5 SB						
Brent Cross	1 NB						
	2 SB						
Hendon Central	1 NB						
	2 SB						
Colindale	1 NB						
	2 SB						
Burnt Oak	1 NB						
	2 SB						
Edgware	1 Term						
	2 Term						
	3 Term						

Piccadilly Line		Current		New Platform Code
Station	Platform	Code	Type	
Cockfosters	1 Term	T520B	Oversail	TLAPB
	2 Term			
	3 Term			
	4 Term			
Oakwood	1 WB	T520F	Oversail	TLAPF
	2 EB			
Southgate	1 WB	T520B	Oversail	TLAPB
	2 EB			
Arnos Grove	1 EB	T520F	Oversail	TLAPF
	2 Loop			
	3 Loop			
	4 WB			
Bounds Green	1 WB	T520B	Oversail	TLAPB
	2 EB			
Wood Green	1 WB	T520F	Oversail	TLAPF
	2 EB			
Turnpike Lane	1 WB	T520B	Oversail	TLAPB
	2 EB			
Manor House	1 WB	T520F	Oversail	TLAPF
	2 EB			
Finsbury Park	1 EB	T520B	Oversail	TLAPB
	3 WB			
Arsenal	1 WB	T520F	Oversail	TLAPF
	2 EB			
Holloway Road	1 WB	T520B	Oversail	TLAPB
	2 EB			
Caledonian Road	1 WB	T520F	Oversail	TLAPF
	2 EB			
King's Cross St. Pancras	5 WB	T520B	Oversail	TLAPB
	6 EB			
Russell Square	1 EB	T520F	Oversail	TLAPF
	2 WB			
Holborn	3 WB	T520B	Oversail	TLAPB
	4 EB			
	5 Bay			
Covent Garden	1 WB	T520F	Oversail	TLAPF
	2 EB			
Leicester Square	1 WB	T520B	Oversail	TLAPB
	2 EB			
Piccadilly Circus	3 EB	T520F	Oversail	TLAPF
	4 WB			

Piccadilly Line		Current		New Platform Code
Station	Platform	Code	Type	
Green Park	1 WB	T520F	Oversail	TLAPF
	2 EB			
Hyde Park Corner	1 EB	T520B	Oversail	TLAPB
	2 WB			
Knightsbridge	1 EB	T520F	Oversail	TLAPF
	2 WB			
South Kensington	3 WB	T520B	Oversail	TLAPB
	4 EB			
	4 WB			
Gloucester Road	4 WB	T520F	Oversail	TLAPF
	5 EB			
Earl's Court	5 EB	T520B	Oversail	TLAPB
	6 WB			
Barons Court	2 WB F	T520Bw	Oversail	TLAPB
	3 EB F			
Hammersmith	2 WB F	T520F	Compromise	TLAPB
	3 EB F			
Ravenscourt Park	2 WB F	T520B	Compromise	TLAPB
	3 EB F			
Stamford Brook	2 WB F	T520F	Compromise	TLAPB
	2 WB F			
Turnham Green	2 WB F	T520B	Compromise	TLAPB
	3 EB F			
Acton Town	2 WB F	T520F	Compromise	TLAPB
	3 EB F			
South Ealing	1 EB L	T520B	Compromise	TLAPB
	2 EB F			
	3 WB F			
	4 WB L			
Northfields	1 WB L	T520F	Compromise	TLAPB
	2 WB F			
	3 EB F			
	4 EB L			
Boston Manor	1 WB	T520B	Compromise	TLAPB
	2 EB			
Osterley	1 WB	T520F	Compromise	TLAPB
	2 EB			
Hounslow East	1 WB	T520B	Compromise	TLAPB
	2 EB			
Hounslow Central	1 WB	T520F	Compromise	TLAPB
	2 EB			

L - Local
F - Fast

Piccadilly Line		Current		New Platform Code
Station	Platform	Code	Type	
Hounslow West	1 WB	T520F	Oversail	TLAPF
	2 EB			
Hatton Cross	1 WB	T520B	Oversail	TLAPB
	2 EB			
Heathrow Terminal 4	1 EB	T520F	Oversail	TLAPF
	1 WB			
Heathrow Terminals 1, 2, 3	2 EB	T520B	Oversail	TLAPB
	5 WB			
Heathrow Terminal 5	6 EB	T700F	Level	TLAPB
	1 WB			
North Ealing	2 EB	T520F	Oversail	TLAPF
	1 WB			
Park Royal	1 WB	T520B	Oversail	TLAPB
	2 EB			
Alperton	1 WB	T520F	Compromise	TLAPB
	2 EB			
Sudbury Town	1 WB	T520B	Compromise	TLAPB
	2 EB			
Sudbury Hill	1 WB	T520F	Compromise	TLAPB
	2 EB			
South Harrow	1 WB	T520B	Compromise	TLAPB
	2 EB			

11.4 Attachment 4: Detailed Throw Formula for Plain Curves

The following formulae are more complex than the simplified formulae and take account of the effects of wheelset spacing in bogies and the width of the vehicle. The formulae are based on those used in GE/GN8573 issue 3. These formulae can be used to more accurately calculate the throw of specific vehicles on plain circular curves at any longitudinal position along the vehicle (see diagram below).

Inner throw at a longitudinal distance U_i from the centre of the vehicle can be calculated by the formula:

$$Throw_{inner} = R - W_i - \sqrt{U_i^2 + (J - W_i)^2}$$

Outer throw at a longitudinal distance U_o from the centre of the vehicle can be calculated by the formula:

$$Throw_{outer} = \sqrt{U_o^2 + (J + W_o)^2} - R - W_o$$

Where $J = R^2 - ao^2 - BC^2 / 4$

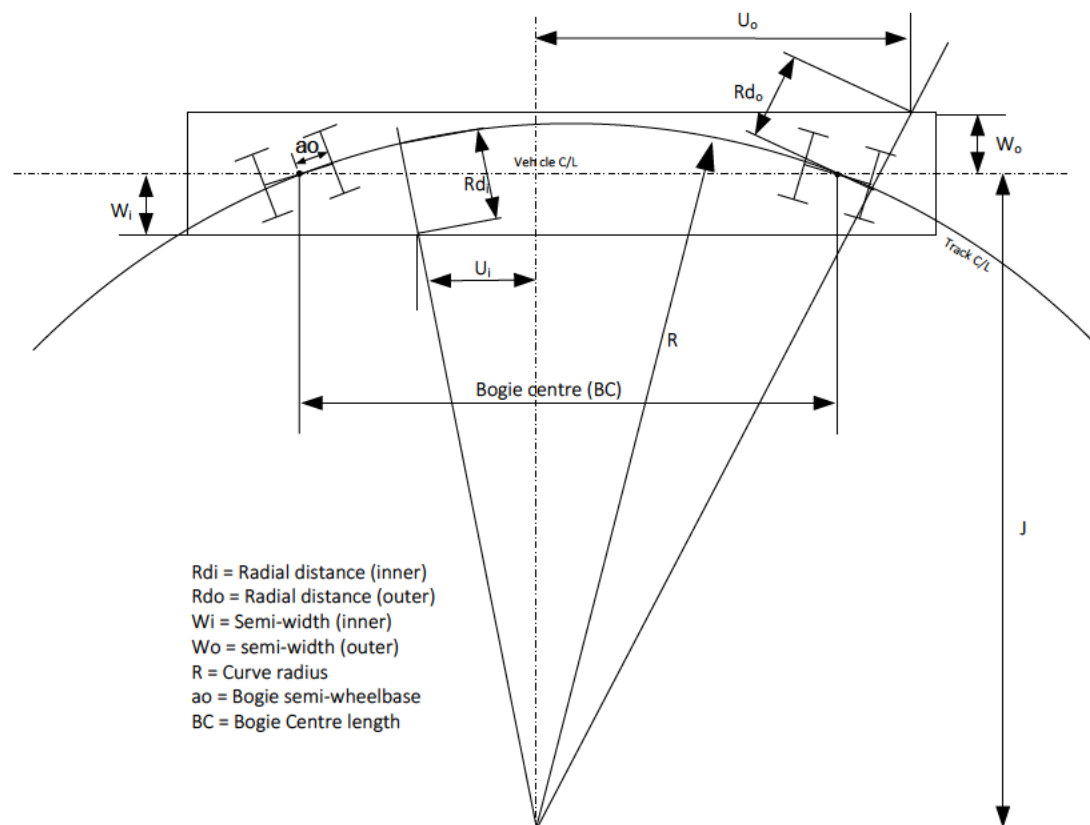


Diagram indicating detailed vehicle body throw

Considering the above diagram, the overthrows at a point on a vehicle body are the differences between the radial distance from the track centreline to the point (Rdo or Rdi), and the lateral distance from the vehicle centreline to the point (Wo or Wi). This is calculated with the vehicle stationary with the wheelsets in the centre of the track.

11.5 Attachment 5: Drawings

<u>Area of Application</u>		<u>New Works Diagrams</u>	<u>Maintenance Diagrams</u>
All Lines	Application Map for Diagrams	A1	
	Application Map for Tunnel Gauges	A2	
	Track/Train Interface	F1	
Surface and Sub-Surface Lines	Open Sections	D1	E1
	Sub-Surface Tunnels		E2
Surface Lines	Tube Stock Only	B1	C1
Tube Tunnels C2 – C6 are authorised variations	General Issue		C1
	Central Line White City – Liverpool St		C2
	Northern Line – Euston – Stockwell via Bank		C3
	Jubilee Line Finchley Road – Charing X		C4
	Bakerloo Line Thames Tunnels		C5
Victoria Line	C6		
Rolling Stock	Universal Kinematic Limit for engineering trains	G1	
	Load Gauges for engineering trains	G2	
	Kinematic Limit for engineering trains (Surface & Sub-Surface only)	G3	
Tunnel Gauges	Sub-Surface tunnels between Finchley Road and Aldgate Platforms 2 & 3 only. Not for use in any other Sub-Surface tunnels.	5602	
	All Sub-Surface tunnels <u>except</u> both roads between Finchley Road and Aldgate Platforms 2 & 3.	5603	
	Tube tunnels between Waterloo and Embankment on the Bakerloo Line only. Not for use in other Tube tunnels or any Sub-Surface Tunnels.	5604	
	All Tube tunnels <u>except</u> between Waterloo and Embankment on the Bakerloo Line. Not for use in Sub-Surface Tunnels.	5605	

THIS COLOURED DRAWING MUST NOT BE TAKEN AS DEFINING PERMITTED ROUTE AVAILABILITY. THIS DIAGRAM SHOWS REQUIREMENTS. IT DOES NOT DEPICT ACTUAL CLEARANCES AVAILABLE, WHICH MAY BE LESS OR GREATER THAN SHOWN AT ANY GIVEN LOCATION.

To aid clarity it is recommended that this coloured drawing is not printed at smaller than A3



- Boundaries**
- Indicates change of applicable Structure Gauge at tunnel mouth
 - Indicates changes of applicable Structure Gauge which are not at junctions or tunnel mouths as follows:
 - Hounslow Central - Hounslow West
For access to Northfields Depot 508m from TOR at Hounslow Central (LCS D226/PWBFA/510)
 - Gunnorsbury - Turnham Green
LUL/NR Boundary
 - Ravenscourt Park
At East End of Platforms
 - North Acton
Platform 2 (EB) E2 to East End
Platforms 1 (Loop) & 3 (WB)
C1 gauge

Key & Colour Reference	Infrastructure				Rolling Stock		
	Structure Profile	Structure Gauge	Maintenance Diagram	New Works Diagram	Kinematic Limits	Loading Gauge Diagram G2	
Application Area					G1	G3	LG1 LG2 LG3
Network Rail Owned Infrastructure	N/A		N/A				
Surface Sections - All Stocks	N/A		E1	D1			
Surface & Sub-surface Sections (LU only)			E2 See Note 8				
Tube Lines - General Issue			C1	B1			
Tube Tunnels - Central Line		N/A	C2				
Tube Tunnels - Northern Line		N/A	C3				
Tube Tunnels - Jubilee Line		N/A	C4				
Tube Tunnels - Bakerloo Line (Thames Tunnels)		N/A	C5				
Tube Tunnels - Victoria Line		N/A	C6				
All Lines - Track / Vehicle Interface				F1			

Notes:

- This map is part of Engineering Standard S1156 and must be used with the standard;
- No minimum clearance shall be employed where a greater clearance can be provided;
- The Structure Gauges & Profiles appropriate to each area are shown on the diagrams referenced in the key table;
- This diagram shows the minimum Structure Gauges & Profiles to which the areas indicated should be maintained;
- For the New Works gauges and Engineer's Loading Gauges appropriate to each area see key table;
- For the schedule of permitted running routes for passenger stocks see LUL Rule Book website;
- For the schedule of permitted running routes for engineer's vehicles see LUL Rule Book website;
- This diagram should not be used to determine platform heights and offsets refer to Attachment 3 of the standard.
Note that in locations where Diagram E2 applies some platforms are set to tube heights and offsets, as stated in Attachment 3 of the standard. Therefore, the E2 KL is not available at low-level through these platforms, and it is not possible for E2 KL-compliant vehicles to operate through them.

Issue	Date	Revision	Drawn By	Checked By	App. By
F	24.10.2011				
E	25.03.2011				
D	25.11.2008				
C	25.07.2005				
B	11.04.2000				

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TRACK ENGINEERING

HEAD OF TRACK ENGINEERING

Title: **ENGINEERING STANDARD S1156**

All Lines
Application Map
New Works & Maintenance
Structure Gauge & Profile Diagrams

Working Type

Project No: **1156**

Scale: **1:1000**

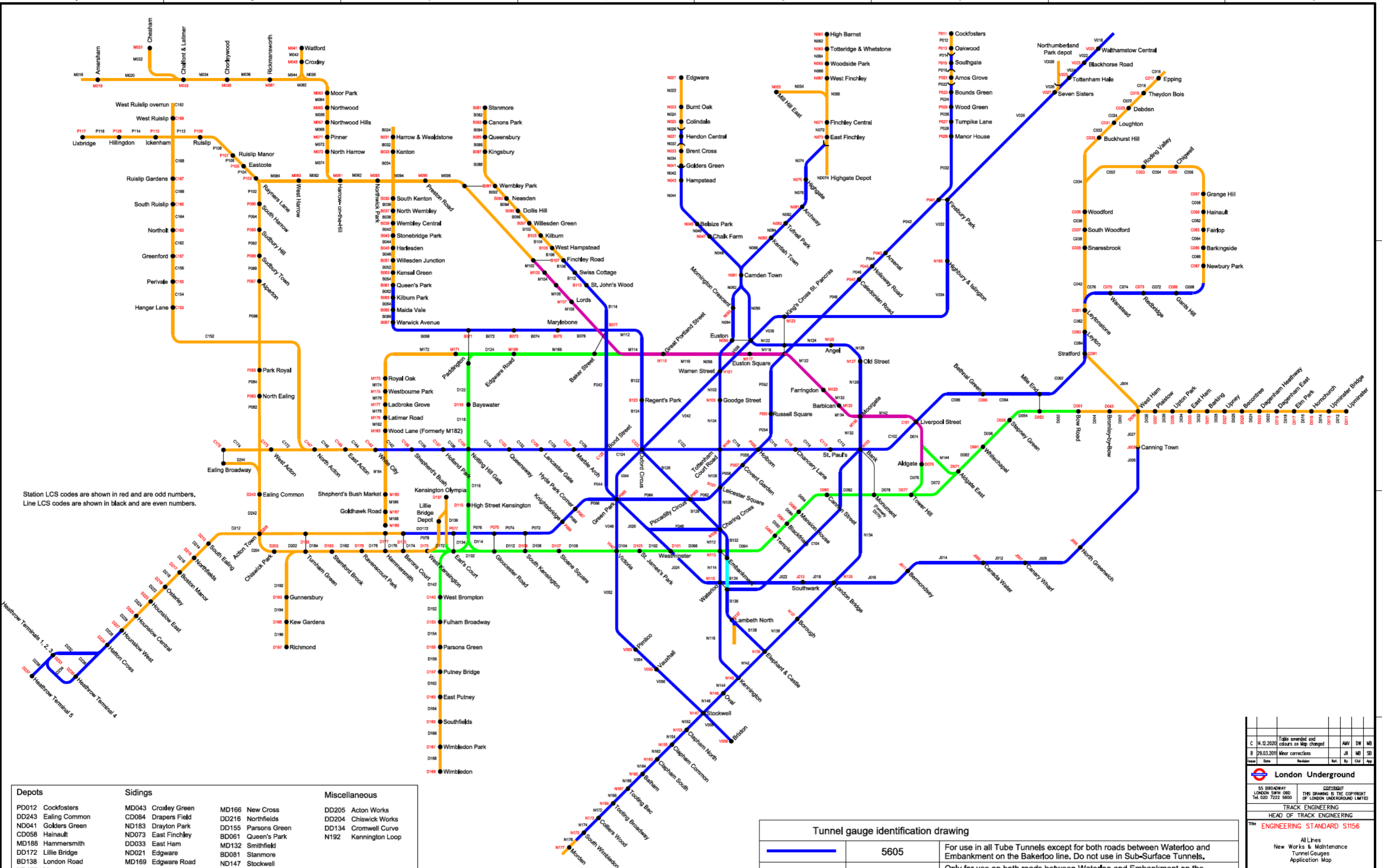
Dimensions in millimetres unless otherwise stated

Drawn: **S. TAILOR** Date: **01/08/07** Checked by: **E.E. Eng** Date: **01/08/07**

Approved: **C.E.G. The Eng** Date: **01/08/07** Approved: **C.E.G. The Eng** Date: **01/08/07**

Contract Number: **T.A. JIPSON** Day No: **J.W. VINT** Issue: **01/08/07**

Sheet: **A1** of **F**



Station LCS codes are shown in red and are odd numbers.
Line LCS codes are shown in black and are even numbers.

Depots	Sidings	Miscellaneous
PD012 Cockfosters	MD043 Croxley Green	MD166 New Cross
DD243 Ealing Common	CD084 Drapers Field	DD216 Northfields
ND041 Golders Green	ND183 Drayton Park	DD204 Chiswick Works
CD058 Hainault	ND073 East Finchley	DD155 Parsons Green
MD188 Hammersmith	DD033 East Ham	BD061 Queen's Park
DD172 Lillie Bridge	ND021 Edgware	MD132 Smithfield
BD138 London Road	MD169 Edgware Road	BD081 Stanmore
ND177 Morden	ND071 Finchley Central	ND147 Stockwell
BD092 Neasden	ND071 Finchley Road	DD237 Terminal 5 Sidings
MD164 New Cross Gate	ND061 High Barnet	PD116 Uxbridge Sidings
DD216 Northfields	ND074 Highgate	BD091 Wembley Park
VD026 Northumberland Park	PD113 Ickenham	CD143 White City
CD168 Ruislip	ND053 Mill Hill East	BD097 Willesden Green
BD043 Stonebridge Park		
JD004 Stratford Market		
DD011 Upminster		
ND115 Waterloo		

Tunnel gauge identification drawing		
	5605	For use in all Tube Tunnels except for both roads between Waterloo and Embankment on the Bakerloo line. Do not use in Sub-Surface Tunnels.
	5604	Only for use on both roads between Waterloo and Embankment on the Bakerloo line. Do not use in other Tube Tunnels or any Sub-Surface Tunnels.
	5603	For use in all Sub-Surface Tunnels except for both roads between Finchley Road and Aldgate platforms 2&3 on the Metropolitan/Circle lines.
	5602	Only for use on both roads between Finchley Road and Aldgate platforms 2&3 on the Metropolitan/Circle lines. Do not use on any other Sub-Surface lines
	Surface Sections Structure Gauges See Diagram A1	

Issue	Date	Revision	Rev.	By	CM	App.
C	14.12.2020	Table amended and colours of Map changed		AW	DW	MB
B	29.03.2019	Minor corrections		JH	MG	SD

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Title: **ENGINEERING STANDARD S1156**

All Lines
New Works & Maintenance
Tunnel Gauges
Application Map

Drawn	Checked	Drawn	Checked
S. TAILOR	S. D. SMITH	S. D. SMITH	S. D. SMITH
Date: 01/08/97	Date: 01/08/97	Date: 01/08/97	Date: 01/08/97
Approved	Approved	Approved	Approved
T.A. JIPSON	J.W. VINT	J.W. VINT	J.W. VINT
Date: 01/08/97	Date: 01/08/97	Date: 01/08/97	Date: 01/08/97

Sheet: **A2** of **C**

THIS DIAGRAM MUST NOT BE TAKEN AS DEFINING PERMITTED ROUTE AVAILABILITY. THIS DIAGRAM SHOWS REQUIREMENTS. IT DOES NOT DEPICT ACTUAL CLEARANCES AVAILABLE, WHICH MAY BE LESS OR GREATER THAN SHOWN AT ANY GIVEN LOCATION.

THE HATCHED AREA MAY NOT BE OCCUPIED BY NEW OR REPLACEMENT STRUCTURES OR EQUIPMENT UNLESS FORMAL CONCESSIONS HAVE BEEN GRANTED BY THE PERMANENT WAY ENGINEER.

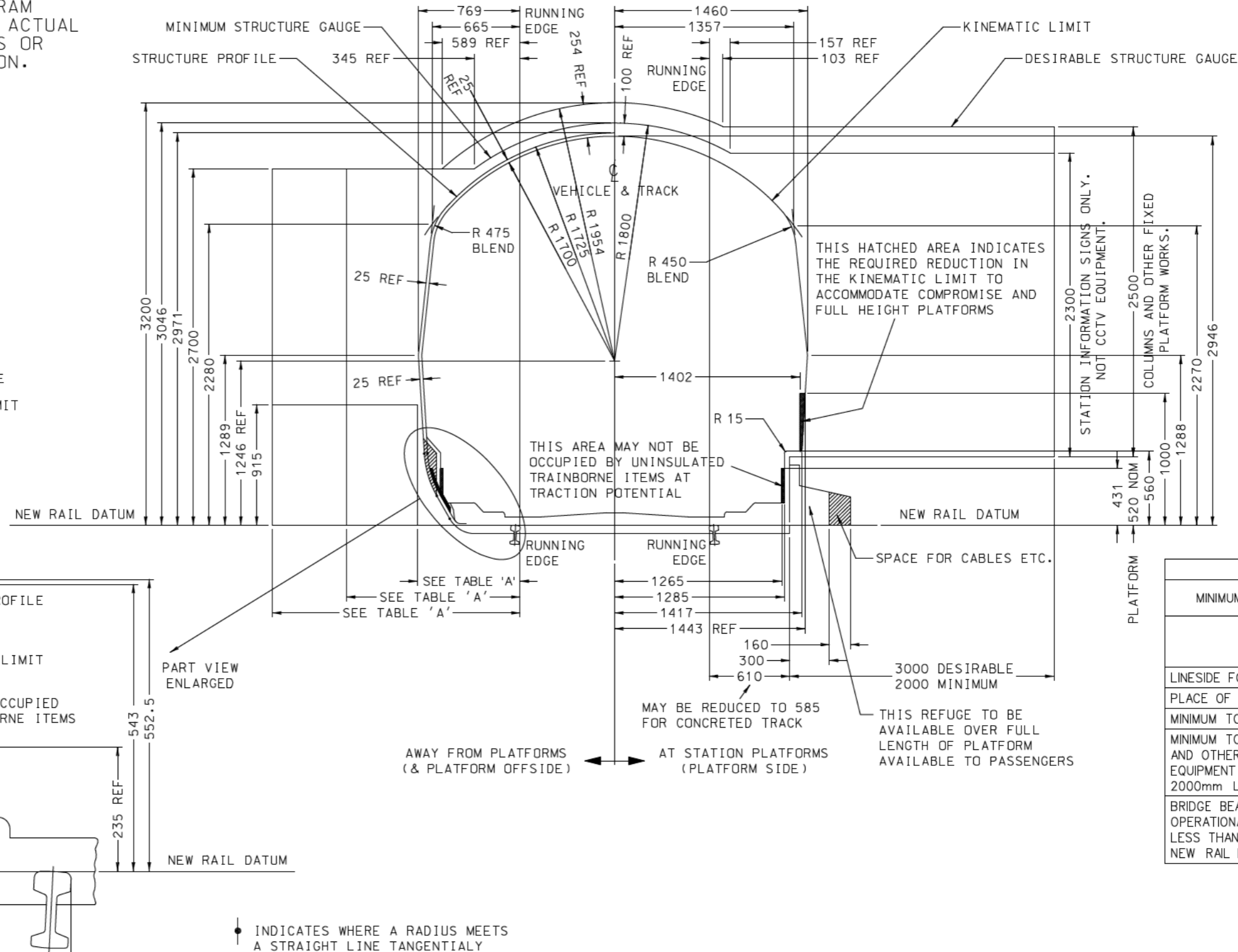
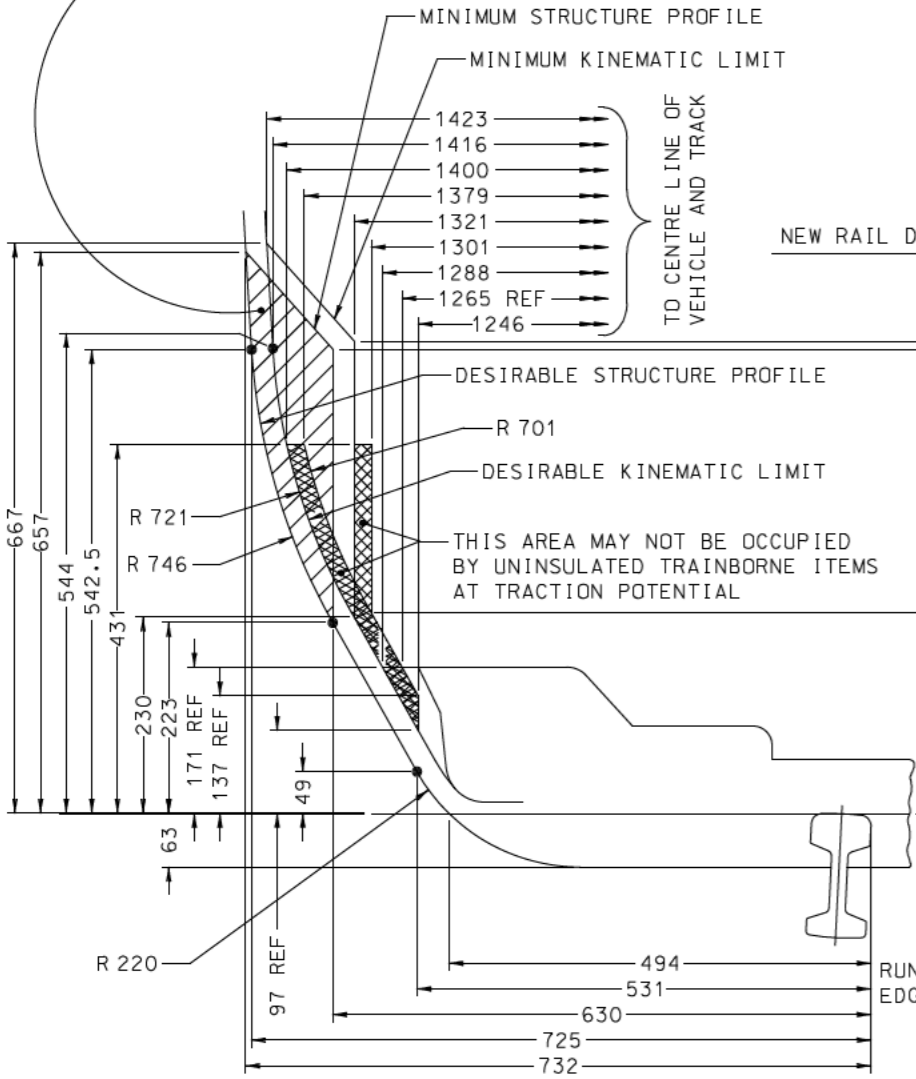


TABLE 'A'	
MINIMUM LATERAL CLEARANCE	
FOR	FROM RUNNING EDGE
LINESIDE FOOTPATH	1900
PLACE OF SAFETY	1600
MINIMUM TO STRUCTURES	1419
MINIMUM TO SIGNALS AND OTHER OPERATIONAL EQUIPMENT LESS THAN 2000mm LONG	1314
BRIDGE BEAMS AND OPERATIONAL EQUIPMENT LESS THAN 915mm ABOVE NEW RAIL DATUM	777

- NOTES:
- NO MINIMUM CLEARANCE SHALL BE EMPLOYED WHERE A GREATER CLEARANCE CAN BE PROVIDED.
 - WHEREVER POSSIBLE ALL MAINTENANCE, REPAIRS AND RENEWALS SHOULD CONFORM TO THE NEW WORKS STANDARD SHOWN ON DIAGRAM "B1".
 - IF IT IS UNFEASIBLE TO ACHIEVE CLEARANCES USING THIS 'C1' DIAGRAM, THE DIAGRAMS NUMBERED 'C2 - C6' (AS APPROPRIATE) CAN BE USED AS A MINIMUM.
 - FOR ROUTES TO WHICH THIS DIAGRAM APPLIES SEE DIAGRAM "A1".
 - FOR TOLERANCES ON PLATFORM HEIGHTS AND OFFSETS SEE ATTACHMENT 3 IN THIS STANDARD (S1156).
 - THE STRUCTURE GAUGES, STRUCTURE PROFILE AND KINEMATIC LIMIT ARE ALWAYS NORMAL TO THE NEW RAIL DATUM.
 - DUE ALLOWANCE FOR RAIL WEAR SHALL BE TAKEN INTO CONSIDERATION WHEN CARRYING OUT GAUGING SURVEYS.

- WHERE TRACKS ARE CIRCULAR CURVES, EITHER HORIZONTALLY OR VERTICALLY, THE KINEMATIC LIMIT, STRUCTURE PROFILE AND STRUCTURE GAUGES AT HEIGHTS GREATER THAN 171mm ABOVE NEW RAIL DATUM SHALL BE ENLARGED FOR END AND CENTRE THROWS AS FOLLOWS:
WHERE
R = RADIUS OF CURVATURE (m)
L = OVERALL BODY LENGTH (m) = 15.240
B = DISTANCE BETWEEN BOGIE CENTRES (m) = 10.060
FORMULAE
INSIDE CURVE = CENTRE THROW (mm) = $B^2 \times 1000/8R$ = 12651/R
OUTSIDE CURVE = END THROW (mm) = $(L^2 - B^2) \times 1000/8R$ = 16382/R

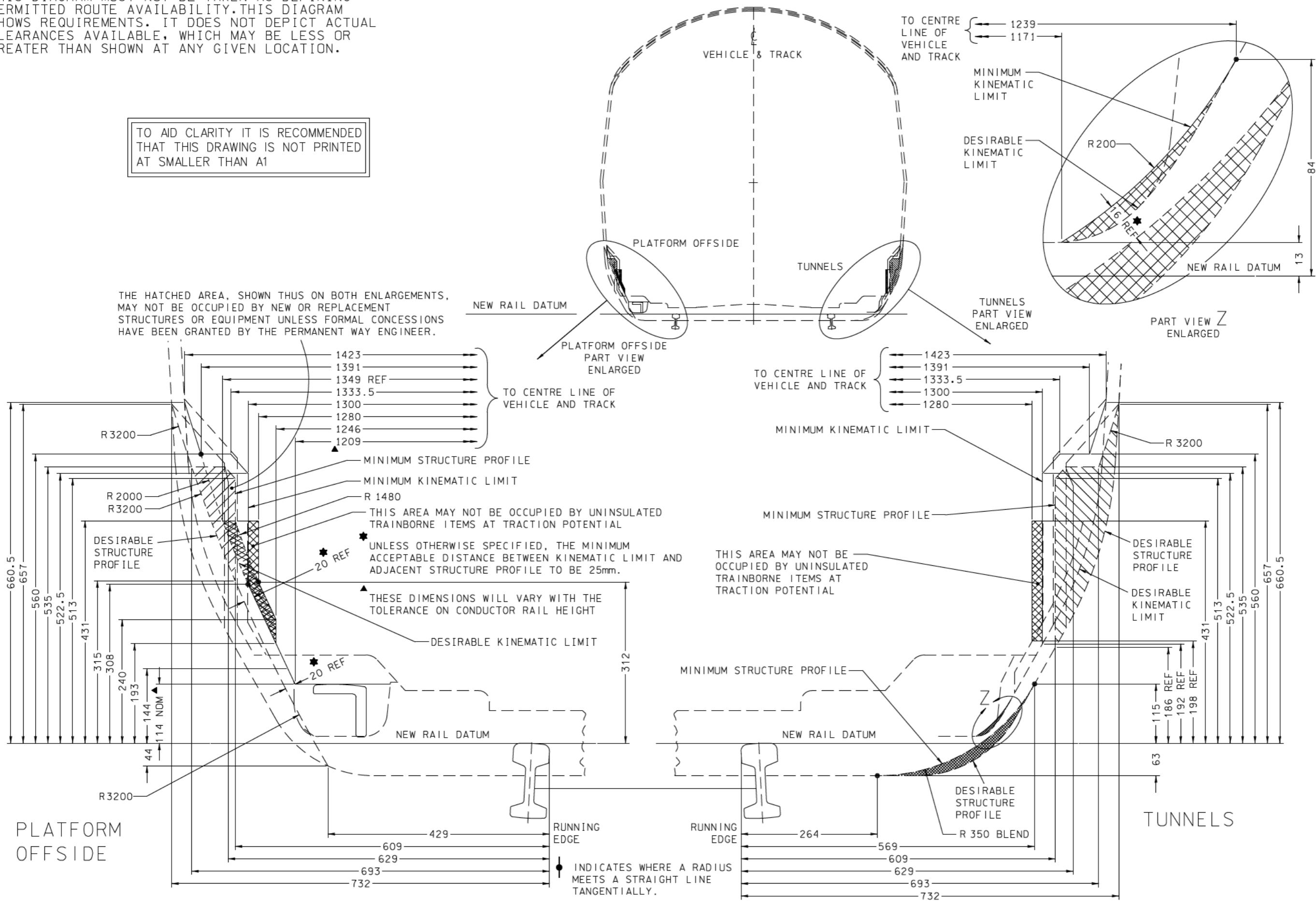
- ANY VARIATION IN ROLLING STOCK DIMENSIONS FROM THOSE GIVEN IN NOTE 8 WILL REQUIRE CORRESPONDING ALTERATIONS IN THE DIMENSIONS OF THE VEHICLE BODY BASED ON A MINIMUM HORIZONTAL RADIUS OF 91m AND A MINIMUM VERTICAL RADIUS OF 402m.
- THE MINIMUM DISTANCE BETWEEN TRACK CENTRES ON STRAIGHT TRACK IS 3400mm DESIRABLE AND 3020mm MINIMUM. ON CURVED TRACKS THIS DIMENSION MUST BE INCREASED BY ADDING CENTRE THROW AND END THROW.
- THIS DIAGRAM IS NOT TO BE USED WITHOUT REFERENCE TO THE TRACK / VEHICLE INTERFACE DIAGRAM "F1" AND THE EXPLANATORY TEXT IN THIS STANDARD (S1156).

TO AID CLARITY IT IS RECOMMENDED THAT THIS DRAWING IS NOT PRINTED AT SMALLER THAN A1

C	14/12/28	Editorial changes	AMJ	DW	ME
B	16/04/08	Editorial changes	JH	EEF	TAL
Issue	Date	Revision	Rev.	By	App.
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TRACK ENGINEERING					
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Title ENGINEERING STANDARD S1156					
TUBE LINES MAINTENANCE GENERAL ISSUE					
Drawing Type DIAGRAM					
Project No. 4000					
Dimensions in MILLIMETRES UNLESS OTHERWISE STATED					
Tolerances					
Drawn Side					
Checked by T&E					
Date					
S. TAILOR					
Date					
01/08/97					
S.D. SMITH					
Date					
01/08/97					
Approved C.E.C. The T&E					
Date					
01/08/97					
Approved C.E.C. The R&S					
Date					
01/08/97					
Contract Number					
J.W. VINT					
Date					
01/08/97					
Sheet					
C1					
of					
C					

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NOTES:

- NO MINIMUM CLEARANCE SHALL BE EMPLOYED WHERE A GREATER CLEARANCE CAN BE PROVIDED.
- THE SPECIAL REDUCED CLEARANCES SHOWN ON THIS DIAGRAM SHOULD ONLY BE USED WHERE IT IS NOT POSSIBLE TO ACHIEVE THE DIMENSIONS SHOWN ON THE NEW WORKS DIAGRAM "B1" OR DIAGRAM "C1", WHICHEVER IS APPROPRIATE.
- THE STRUCTURE PROFILES AND KINEMATIC LIMITS ARE ALWAYS NORMAL TO THE NEW RAIL DATUM.

- DUE ALLOWANCE FOR RAIL WEAR SHALL BE TAKEN INTO CONSIDERATION WHEN CARRYING OUT GAUGING SURVEYS.
- WHERE THE PROFILES ARE NOT SHOWN IN HEAVY LINES OR DIMENSIONED, THE STANDARD DEFINED ON DIAGRAM "C1" SHALL BE USED SHOWN IN CHAIN DOT ON THIS DIAGRAM FOR COMPARISON.
- THESE VARIATIONS MAY ONLY BE USED IN THE AREAS INDICATED BY THE TITLE OF THIS DIAGRAM AND AS SHOWN ON THE APPLICATION MAP, SEE DIAGRAM "A1".

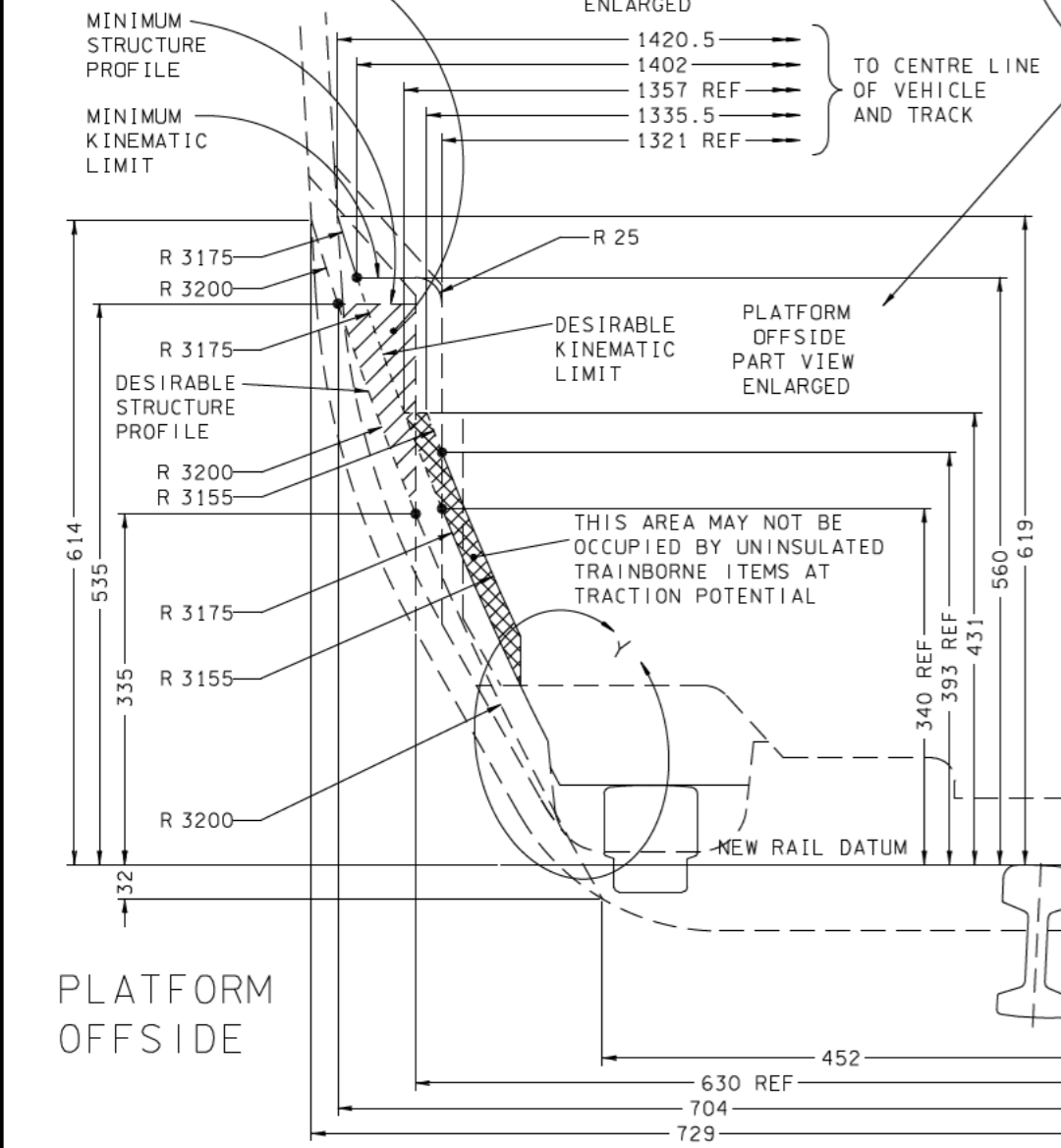
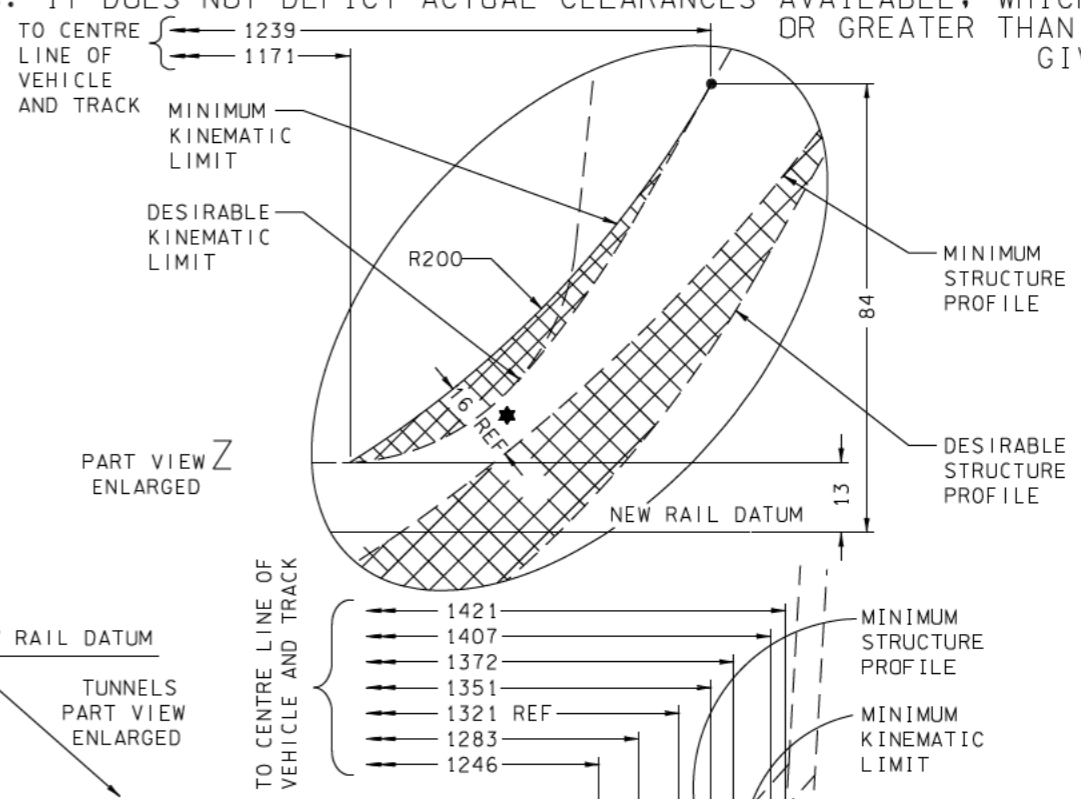
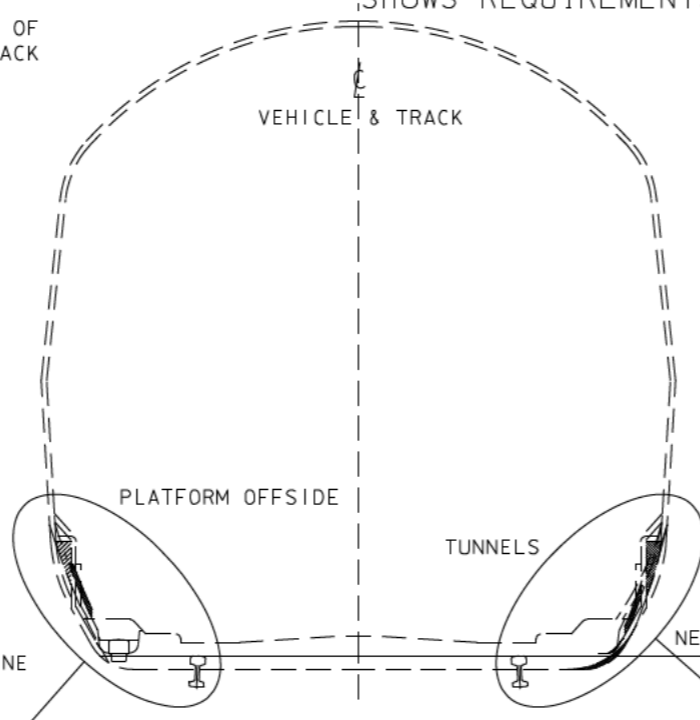
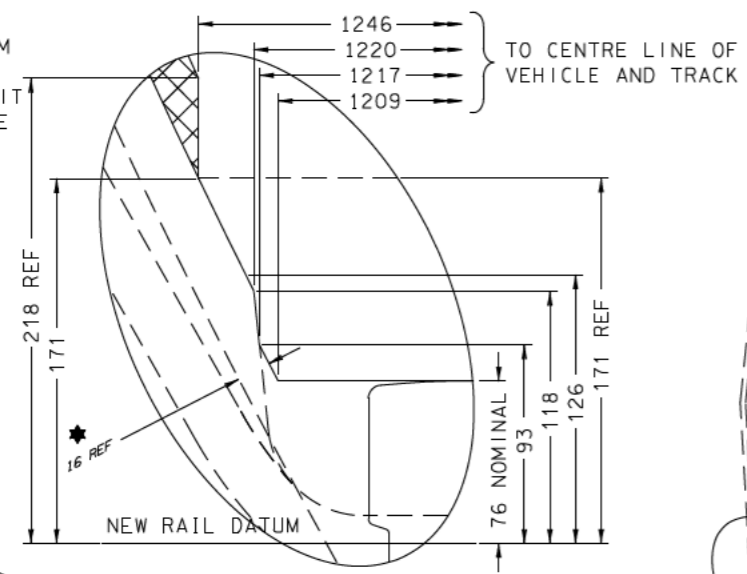
- THIS DIAGRAM IS NOT TO BE USED WITHOUT REFERENCE TO THE TRACK / VEHICLE INTERFACE DIAGRAM "F1" AND THE EXPLANATORY TEXT IN THIS STANDARD (S1156).
- WHERE TRACKS ARE CIRCULAR CURVES, EITHER HORIZONTALLY OR VERTICALLY, THE KINEMATIC LIMIT AND STRUCTURE PROFILE AT HEIGHTS GREATER THAN 171mm ABOVE NEW RAIL DATUM MUST BE ENLARGED. (SEE NOTES 8, 9 AND 10 ON DIAGRAM "C1").

C	14/12/28	Editorial changes	AM	EP	ME
B	16/04/08	Editorial changes	JH	EEF	TAJ
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TRACK ENGINEERING HEAD OF TRACK ENGINEERING					
Title ENGINEERING STANDARD S1156					
TUBE LINES MAINTENANCE AUTHORISED VARIATIONS TO GENERAL ISSUE CENTRAL LINE WHITE CITY TO LIVERPOOL STREET					
Drawing Type: DIAGRAM					
Dimensions in millimetres unless otherwise stated					
Drawn by: S. TAILOR Checked by: E.E.G. Date: 01/08/97 Approved: T.A. JIPSON Date: 01/08/97 Approved: J.W. VINT Date: 01/08/97					
Sheet: C2 of C					

* UNLESS OTHERWISE SPECIFIED, THE MINIMUM ACCEPTABLE DISTANCE BETWEEN KINEMATIC LIMIT AND ADJACENT STRUCTURE PROFILE TO BE 25mm.

THE HATCHED AREA, SHOWN THUS ON BOTH ENLARGEMENTS, MAY NOT BE OCCUPIED BY NEW OR REPLACEMENT STRUCTURES OR EQUIPMENT UNLESS FORMAL CONCESSIONS HAVE BEEN GRANTED BY THE PERMANENT WAY ENGINEER.

THIS DIAGRAM MUST NOT BE TAKEN AS DEFINING PERMITTED ROUTE AVAILABILITY. THIS DIAGRAM SHOWS REQUIREMENTS. IT DOES NOT DEPICT ACTUAL CLEARANCES AVAILABLE, WHICH MAY BE LESS OR GREATER THAN SHOWN AT ANY GIVEN LOCATION.

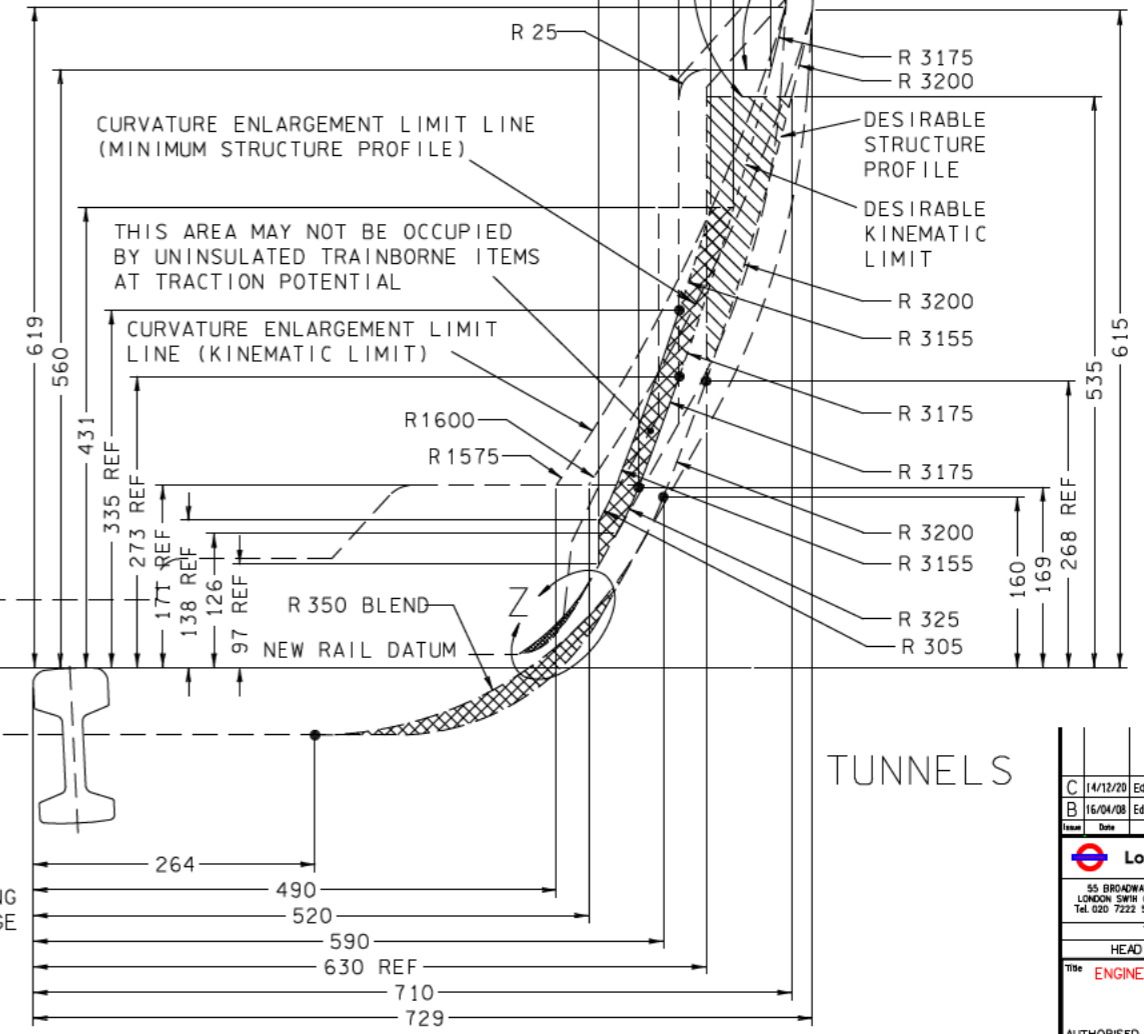


THE CURVATURE ENLARGEMENT LIMIT LINES ARE TO BE USED FOR DEFINING THE EXTENT OF ENLARGEMENT OF ALL OF THE FOLLOWING BOUNDARIES IN TUNNEL AREAS ONLY.

- (a) THE DESIRABLE STRUCTURE PROFILE
- (b) THE MINIMUM STRUCTURE PROFILE
- (c) THE DESIRABLE KINEMATIC LIMIT
- (d) THE MINIMUM KINEMATIC LIMIT

IN THE AREA FROM 171mm TO 619mm ABOVE NEW RAIL DATUM, THE CALCULATED HORIZONTAL AND / OR VERTICAL CURVATURE ENLARGEMENTS (SEE NOTES 6, 7 AND 8 ON DIAGRAM 'C1') ARE TO BE APPLIED TO THESE LINES TO DEVELOP THE ENLARGED PROFILE.

THE CURVATURE ENLARGEMENT LIMIT LINE DOES NOT IMPLY ANY LIMITATION OF STRAIGHT LEVEL TRACK PROFILES SUCH THAT THE DEVELOPED PROFILE MAY BE A COMBINATION OF STRAIGHT TRACK PROFILE AND CURVATURE ENLARGED PROFILE.



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INDICATES TRANSITION POINT BETWEEN RADII

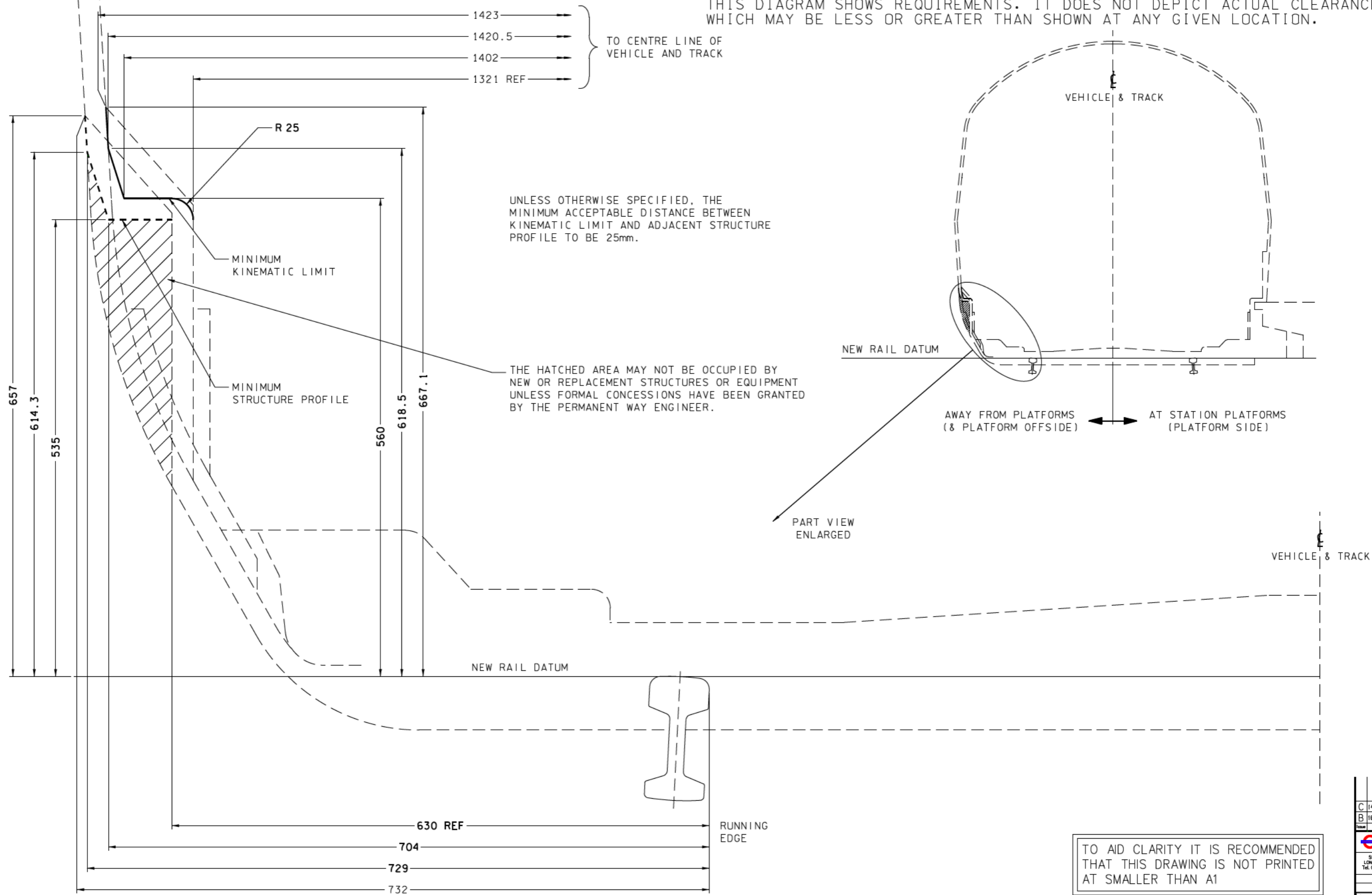
- NOTES:
1. NO MINIMUM CLEARANCE SHALL BE EMPLOYED WHERE A GREATER CLEARANCE CAN BE PROVIDED.
 2. THE SPECIAL REDUCED CLEARANCES SHOWN ON THIS DIAGRAM SHOULD ONLY BE USED WHERE IT IS NOT POSSIBLE TO ACHIEVE THE DIMENSIONS SHOWN ON THE NEW WORKS DIAGRAM 'B1' OR DIAGRAM 'C1', WHICHEVER IS APPROPRIATE.
 3. THE STRUCTURE PROFILES AND KINEMATIC LIMITS ARE ALWAYS NORMAL TO THE NEW RAIL DATUM.

4. DUE ALLOWANCE FOR RAIL WEAR SHALL BE TAKEN INTO CONSIDERATION WHEN CARRYING OUT GAUGING SURVEYS.
5. WHERE THE PROFILES ARE NOT SHOWN IN HEAVY LINES OR DIMENSIONED, THE STANDARD DEFINED ON DIAGRAM 'C1' SHALL BE USED SHOWN IN CHAIN DOT ON THIS DIAGRAM FOR COMPARISON.
6. THESE VARIATIONS MAY ONLY BE USED IN THE AREAS INDICATED BY THE TITLE OF THIS DIAGRAM AND AS SHOWN ON THE APPLICATION MAP, SEE DIAGRAM 'A1'.

7. THIS DIAGRAM IS NOT TO BE USED WITHOUT REFERENCE TO THE TRACK / VEHICLE INTERFACE DIAGRAM 'F1' AND THE EXPLANATORY TEXT IN THIS STANDARD (S1156).
8. WHERE TRACKS ARE CIRCULAR CURVES, EITHER HORIZONTALLY OR VERTICALLY, THE KINEMATIC LIMIT AND STRUCTURE PROFILE AT HEIGHTS GREATER THAN 171mm ABOVE NEW RAIL DATUM MUST BE ENLARGED. (SEE NOTES 8, 9 AND 10 ON DIAGRAM 'C1').

14/12/28	Editorial changes	AM	EP	NE
16/04/08	Editorial changes	JH	EEF	TAJ
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Title: ENGINEERING STANDARD S1156				
TUBE LINES MAINTENANCE				
AUTHORISED VARIATIONS TO GENERAL ISSUE UNDERGROUND AREAS OF NORTHERN LINE				
Drawing Type: DIAGRAM				
Dimensions in millimetres unless otherwise stated				
Drawn to: AS				
Checked by: EE				
Date: 01/08/97				
Drawn by: S. TAILOR				
Date: 01/08/97				
Checked by: S.D. SMITH				
Date: 01/08/97				
Approved by: T.A. JIPSON				
Date: 01/08/97				
Approved by: J.W. VINT				
Date: 01/08/97				
Contract number:				
Drawing number:				
Issue:				
Sheet: C3 of C				

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NOTES:

1. NO MINIMUM CLEARANCE SHALL BE EMPLOYED WHERE A GREATER CLEARANCE CAN BE PROVIDED.
2. THE SPECIAL REDUCED CLEARANCES SHOWN ON THIS DIAGRAM SHOULD ONLY BE USED WHERE IT IS NOT POSSIBLE TO ACHIEVE THE DIMENSIONS SHOWN ON THE NEW WORKS DIAGRAM "B1" OR DIAGRAM "C1", WHICHEVER IS APPROPRIATE.
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7. THIS DIAGRAM IS NOT TO BE USED WITHOUT REFERENCE TO THE TRACK / VEHICLE INTERFACE DIAGRAM "F1" AND THE EXPLANATORY TEXT IN THIS STANDARD (S1156).
8. WHERE TRACKS ARE CIRCULAR CURVES, EITHER HORIZONTALLY OR VERTICALLY, THE KINEMATIC LIMIT AND STRUCTURE PROFILE AT HEIGHTS GREATER THAN 171mm ABOVE NEW RAIL DATUM MUST BE ENLARGED. (SEE NOTES 8.9 AND 10 ON DIAGRAM "C1").

C	14/12/28	Editorial changes	AM	EPH	ME
B	16/04/08	Editorial changes	JH	EEF	TAJ
London Underground 55 BROADWAY LONDON SW1H 0BG TEL: 020 7222 3500 THIS DRAWING IS THE COPYRIGHT OF LONDON UNDERGROUND LIMITED TRACK ENGINEERING HEAD OF TRACK ENGINEERING Title: ENGINEERING STANDARD S1156 TUBE LINES MAINTENANCE AUTHORISED VARIATIONS TO GENERAL ISSUE JUBILEE LINE FINCHLEY ROAD TO CHARING CROSS Drawing Type: DIAGRAM Project: ANGLE Dimensions in millimetres unless otherwise stated Tolerances: DRAWN IN ACCORDANCE WITH BS 518 Drawn: S. TAILOR Date: 01/08/97 Checked for Tidy: C.C. SHARP Date: 01/08/97 Approved C.E.G.-The T.Eng: T.A. JIPSON Date: 01/08/97 Approved C.E.G.-The R.S.Eng: J.W. VINT Date: 01/08/97 Contract Number: _____ Sheet: C4 of C					

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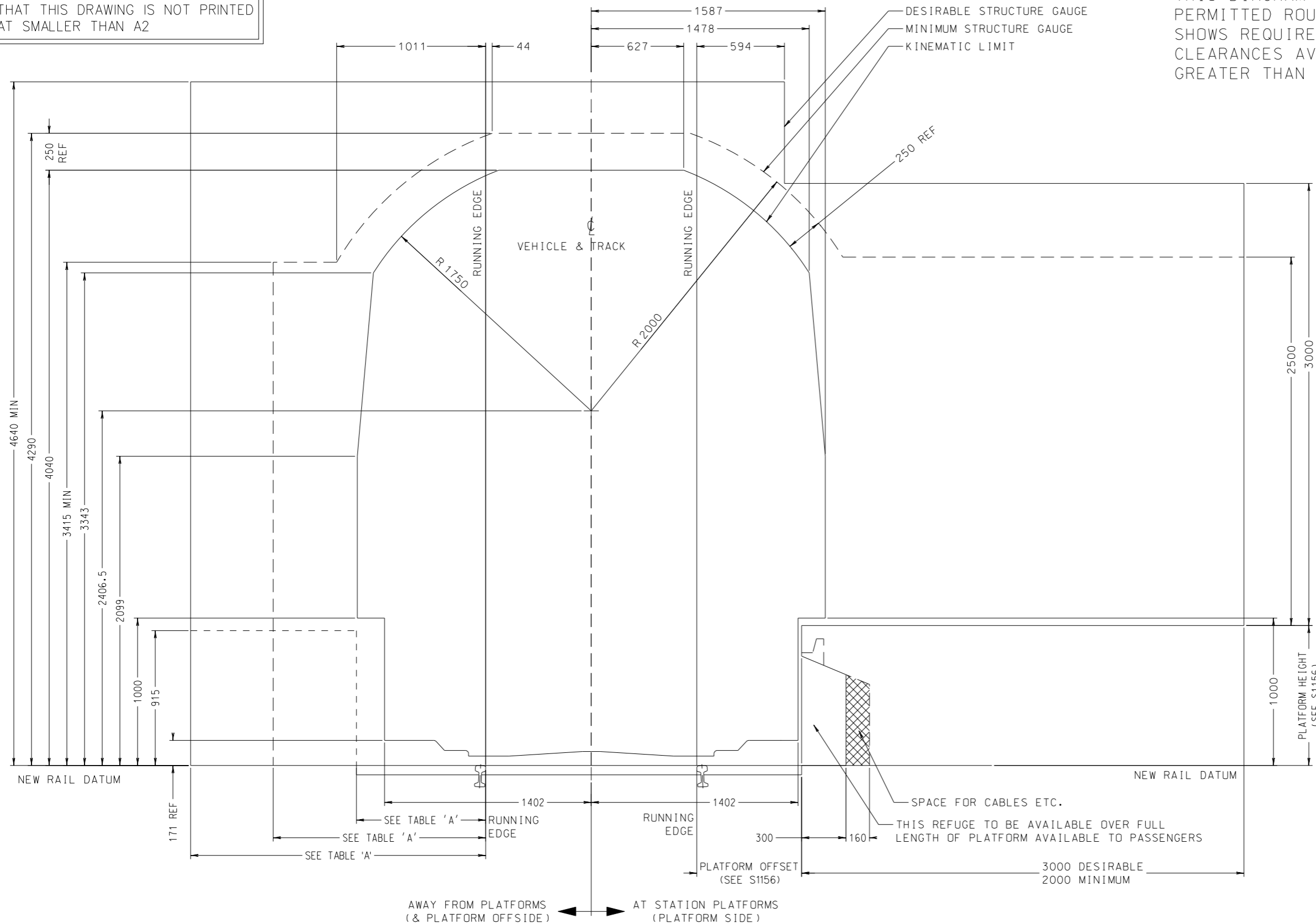


TABLE 'A'	
MINIMUM LATERAL CLEARANCE	
FOR	FROM RUNNING EDGE
LINESIDE FOOTPATH	2000
PLACE OF SAFETY	1700
MINIMUM TO STRUCTURES	1550
MINIMUM TO SIGNALS AND OTHER OPERATIONAL EQUIPMENT LESS THAN 2000mm LONG	1441
BRIDGE BEAMS AND OPERATIONAL EQUIPMENT LESS THAN 915mm ABOVE NEW RAIL DATUM	877

NOTES:

- NO MINIMUM CLEARANCE SHALL BE EMPLOYED WHERE A GREATER CLEARANCE CAN BE PROVIDED.
- FOR ROUTES TO WHICH THIS DIAGRAM APPLIES SEE DIAGRAM "A1".
- FOR DIMENSIONS AND TOLERANCES FOR PLATFORM HEIGHTS AND OFFSETS SEE ATTACHMENT 3 IN THIS STANDARD (S1156).
- THE STRUCTURE GAUGES, STRUCTURE PROFILE AND KINEMATIC LIMIT ARE ALWAYS NORMAL TO THE NEW RAIL DATUM.
- DUE ALLOWANCE FOR RAIL WEAR SHALL BE TAKEN INTO CONSIDERATION WHEN CARRYING OUT GAUGING SURVEYS.

6. WHERE TRACKS ARE CIRCULAR CURVES, EITHER HORIZONTALLY OR VERTICALLY, THE KINEMATIC LIMIT AND STRUCTURE GAUGES SHALL BE ENLARGED FOR END AND CENTRE THROWS AS FOLLOWS:

WHERE	RADIUS > 136m	RADIUS < 136m
R = RADIUS OF CURVATURE (m)		
L = OVERALL BODY LENGTH (m)	= 16.165	19.354
B = DISTANCE BETWEEN BOGIE CENTRES (m)	= 10.827	14.173

FORMULAE

INSIDE CURVE = CENTRE THROW (mm) = $B^2 \times 1000/8R = 14653/R$ [(25110/R)-77]

OUTSIDE CURVE = END THROW (mm) = $(L^2 - B^2) \times 1000/8R = 18011/R$ 21713/R

7. ANY VARIATION IN ROLLING STOCK DIMENSIONS FROM THOSE GIVEN IN NOTE 6 WILL REQUIRE CORRESPONDING ALTERATIONS IN THE DIMENSIONS OF THE VEHICLE BODY BASED ON A MINIMUM HORIZONTAL RADIUS OF 120m AND A MINIMUM VERTICAL RADIUS OF 800m FOR PASSENGER STOCKS AND A MINIMUM HORIZONTAL RADIUS OF 55m AND A MINIMUM VERTICAL RADIUS OF 402m FOR ENGINEERS STOCKS.

8. THE MINIMUM DISTANCE BETWEEN TRACK CENTRES ON STRAIGHT TRACK IS 3400mm. ON CURVED TRACKS THIS DIMENSION MUST BE INCREASED BY ADDING CENTRE THROW AND END THROW.

9. THIS DIAGRAM IS NOT TO BE USED WITHOUT REFERENCE TO THE TRACK / VEHICLE INTERFACE DIAGRAM "F1" AND THE EXPLANATORY TEXT IN THIS STANDARD (S1156).

14/12/20	Editorial changes	AMV	DR	MB
04/08/08	Table B amended	JH	GEF	TAJ
16/04/08	Editorial changes	JH	GEF	TAJ
Issue	Date	Revision	Ref.	By

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Title: ENGINEERING STANDARD S1156

SURFACE & SUB-SURFACE LINES
NEW WORKS

Drawing Type: DIAGRAM

Projection: ANGLE

Tolerances: DRAWN IN ACCORDANCE WITH BS 5368

Drawn Scale: Checked for R.S. Eng C.C. SHARP Date 01/08/97

Drawn: S. TAILOR Date 01/08/97 Checked for T. Eng S.D. SMITH Date 01/08/97

Approved C.E.G.: The T. Eng T.A. JIPSON Date 01/08/97 Approved C.E.G.: The R.S. Eng J.W. VINT Date 01/08/97

Contract Number: Diagram Number: Issue: D1 D

Microfilm reference line

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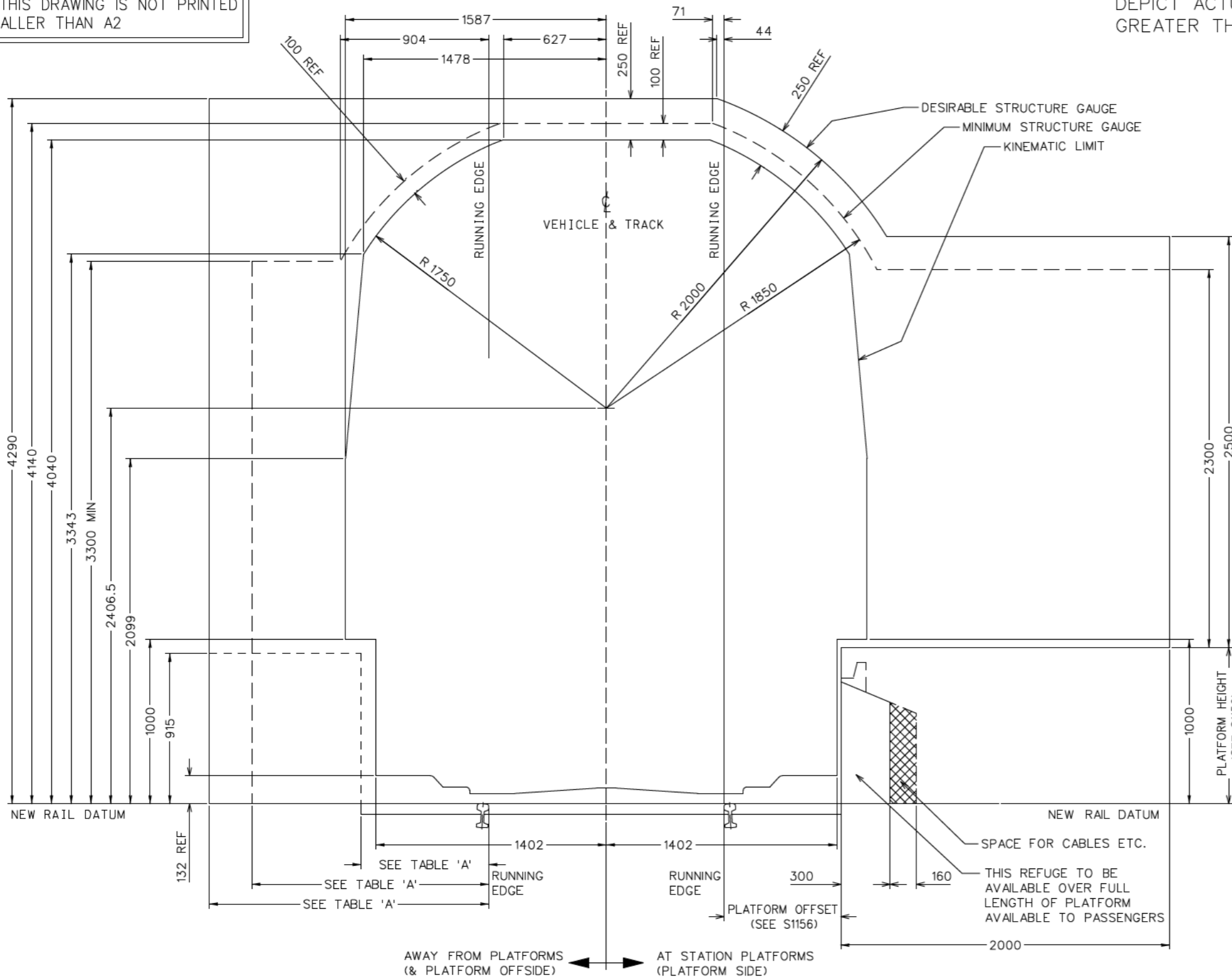


TABLE 'A'	
MINIMUM LATERAL CLEARANCE	
FOR	FROM RUNNING EDGE
LINESIDE FOOTPATH	2000
PLACE OF SAFETY	1700
MINIMUM TO STRUCTURES	1550
MINIMUM TO SIGNALS AND OTHER OPERATIONAL EQUIPMENT LESS THAN 2000mm LONG	1441
BRIDGE BEAMS AND OPERATIONAL EQUIPMENT LESS THAN 915mm ABOVE NEW RAIL DATUM	777

AWAY FROM PLATFORMS (& PLATFORM OFFSIDE) AT STATION PLATFORMS (PLATFORM SIDE)

NOTES:

- NO MINIMUM CLEARANCE SHALL BE EMPLOYED WHERE A GREATER CLEARANCE CAN BE PROVIDED.
- WHEREVER POSSIBLE ALL MAINTENANCE, REPAIRS AND RENEWALS SHOULD CONFORM TO THE NEW WORKS STANDARD SHOWN ON DIAGRAM 'D1'.
- FOR ROUTES TO WHICH THIS DIAGRAM APPLIES SEE DIAGRAM 'A1'.
- FOR DIMENSIONS AND TOLERANCES FOR PLATFORM HEIGHTS AND OFFSETS SEE ATTACHMENT 3 IN THIS STANDARD (S1156).
- THE STRUCTURE GAUGES, STRUCTURE PROFILE AND KINEMATIC LIMIT ARE ALWAYS NORMAL TO THE NEW RAIL DATUM.
- DUE ALLOWANCE FOR RAIL WEAR SHALL BE TAKEN INTO CONSIDERATION WHEN CARRYING OUT GAUGING SURVEYS.

- WHERE TRACKS ARE CIRCULAR CURVES, EITHER HORIZONTALLY OR VERTICALLY, THE KINEMATIC LIMIT, STRUCTURE PROFILE AND STRUCTURE GAUGES SHALL BE ENLARGED FOR END AND CENTRE THROWS AS FOLLOWS:

WHERE	RADIUS > 136m	RADIUS < 136m
R = RADIUS OF CURVATURE (m)	16.165	19.354
L = OVERALL BODY LENGTH (m)	10.827	14.173
B = DISTANCE BETWEEN BOGIE CENTRES (m)		
FORMULAE		
INSIDE CURVE = CENTRE THROW (mm) = $B^2 \times 1000/8R$	= 14653/R	$[(25110/R)-77]$
OUTSIDE CURVE = END THROW (mm) = $(L^2 - B^2) \times 1000/8R$	= 18011/R	21713/R

- ANY VARIATION IN ROLLING STOCK DIMENSIONS FROM THOSE GIVEN IN NOTE 7 WILL REQUIRE CORRESPONDING ALTERATIONS IN THE DIMENSIONS OF THE VEHICLE BODY BASED ON A MINIMUM HORIZONTAL RADIUS OF 120m AND A MINIMUM VERTICAL RADIUS OF 800m FOR PASSENGER STOCKS AND A MINIMUM HORIZONTAL RADIUS OF 55m AND A MINIMUM VERTICAL RADIUS OF 402m FOR ENGINEERS STOCKS.
- THE PERMITTED DISTANCES BETWEEN TRACK CENTRES ON STRAIGHT TRACK ARE 3400mm DESIRABLE AND 3274mm MINIMUM. ON CURVED TRACKS THESE DIMENSIONS MUST BE INCREASED BY ADDING CENTRE THROW AND END THROW.
- THIS DIAGRAM IS NOT TO BE USED WITHOUT REFERENCE TO THE TRACK / VEHICLE INTERFACE DIAGRAM 'F1' AND THE EXPLANATORY TEXT IN THIS STANDARD (S1156).

14/12/20	Editorial changes	AW	DR	MB
04/08/08	Table B amended	JR	GEF	TAL
16/04/08	Editorial changes	JR	GEF	TAL
Issue	Date	Revision	By	Chk

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TRACK ENGINEERING

HEAD OF TRACK ENGINEERING

Title: **ENGINEERING STANDARD S1156**

SURFACE & SUB-SURFACE LINES MAINTENANCE GENERAL ISSUE

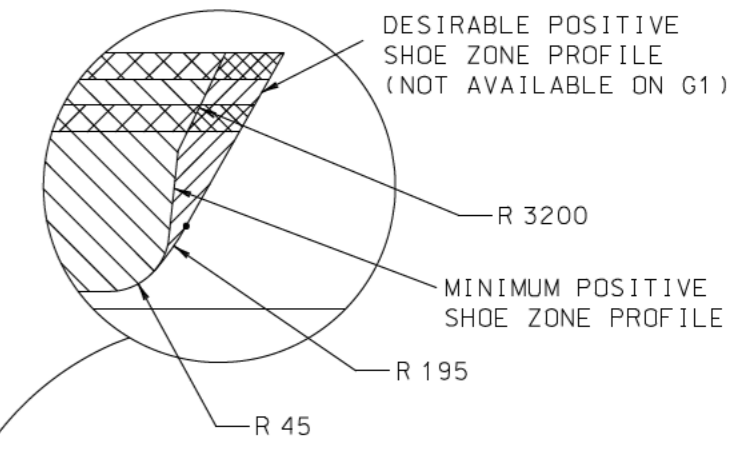
Working Type

Project No	ANGLE	⊕	DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED
Tolerances	DRAWN IN ACCORDANCE WITH BS 5182		
Drawn	S. TAILOR	Checked by E.E.Eng	C.C. SHARP
Drawn Date	01/08/97	Checked by T.E.Eng	S.D. SMITH
Approved	T.A. JIPSON	Approved C.E.S. The R.S.E.Eng	J.W. VINT
Contract Number	Diagram Number		
Sheet	E1		

THIS DRAWING MUST NOT BE TAKEN AS DEFINING PERMITTED ROUTE AVAILABILITY.

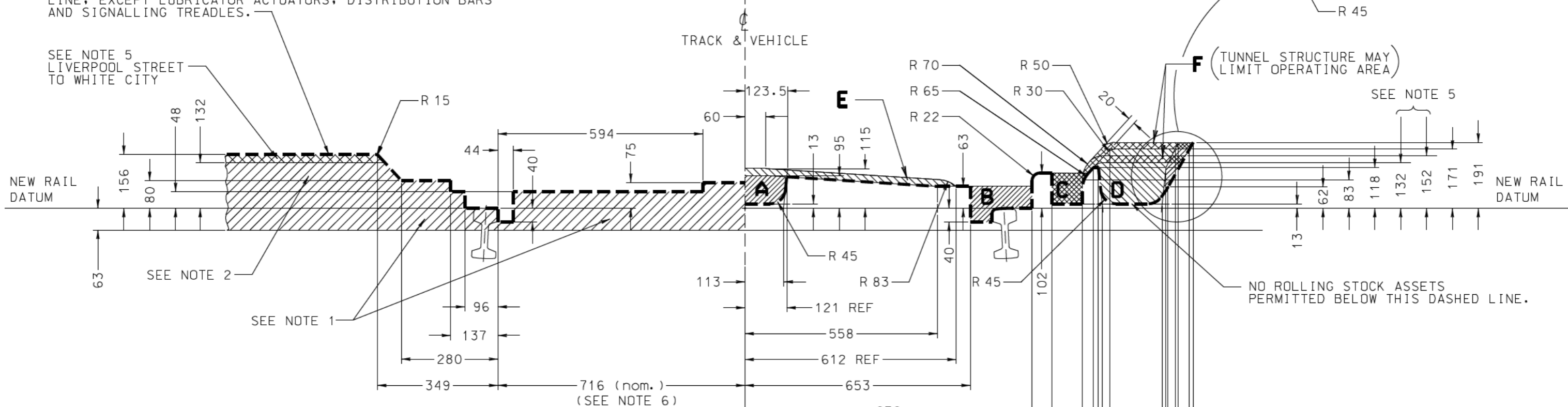
ZONES FOR OCCUPATION BY ROLLING STOCK COMPONENTS
(SEE NOTE 7)

- A - NEGATIVE SHOE & SLEET GEAR
- B - WHEELS & ADHESION MODIFICATION GEAR. (ALSO TRACK MOUNTED LUBRICATOR ACTUATORS, LUBRICATION DISTRIBUTION BARS AND SIGNALLING TREDLES)
- C - TRIP ARM
- D - POSITIVE SHOE & SLEET GEAR
- E - INSULATED COMPONENTS ONLY
- F - INSULATED COMPONENTS ONLY



NO INFRASTRUCTURE ASSETS PERMITTED ABOVE THIS DASHED LINE, EXCEPT LUBRICATOR ACTUATORS, DISTRIBUTION BARS AND SIGNALLING TREADLES.

SEE NOTE 5
LIVERPOOL STREET
TO WHITE CITY



F (TUNNEL STRUCTURE MAY LIMIT OPERATING AREA)

SEE NOTE 5

NO ROLLING STOCK ASSETS PERMITTED BELOW THIS DASHED LINE.

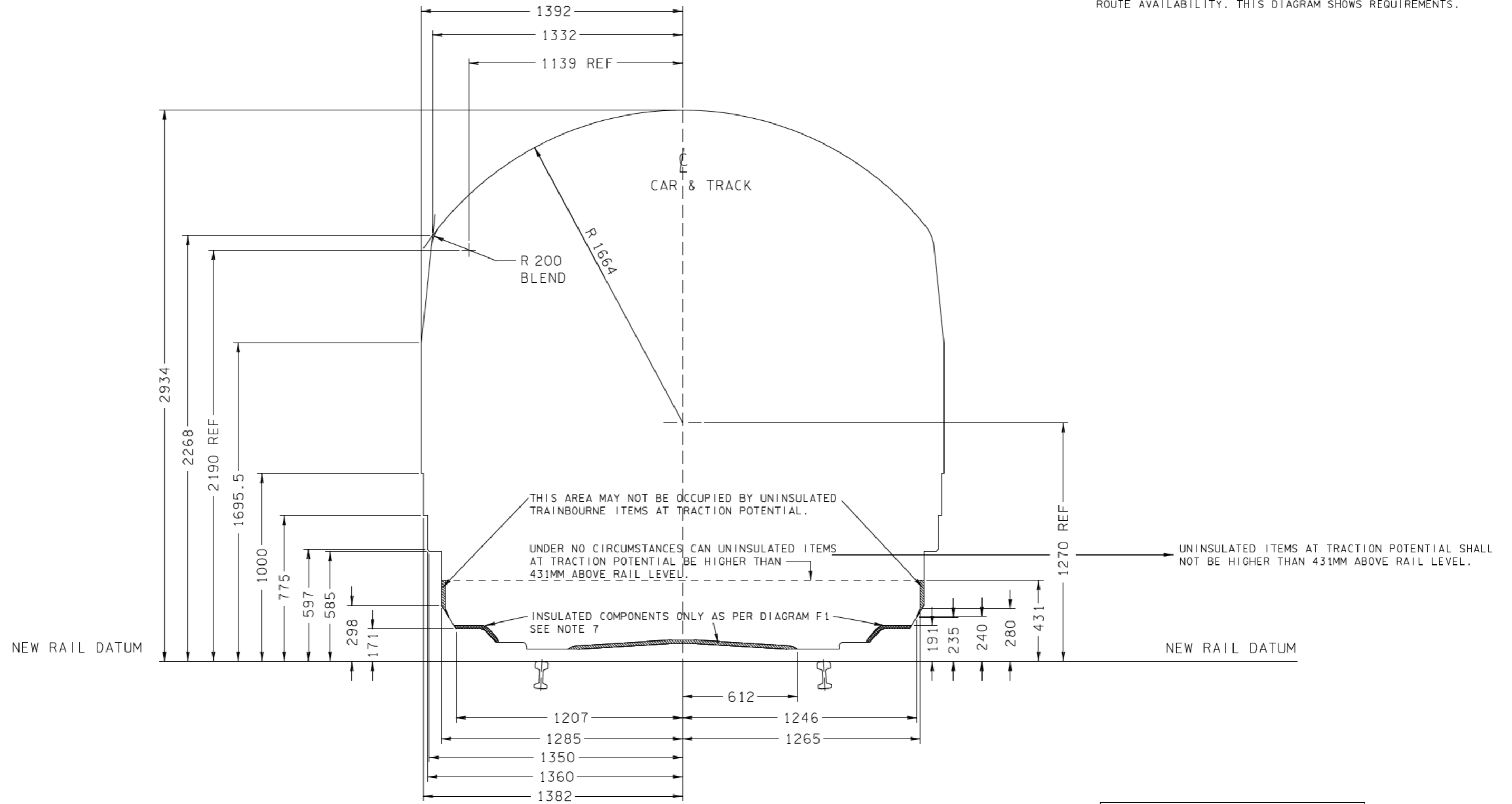
TO AID CLARITY IT IS RECOMMENDED THAT THIS DRAWING IS NOT PRINTED AT SMALLER THAN A1

NOTES:

1. NO EQUIPMENT IS PERMITTED TO BE LOCATED WITHIN THE HATCHED EXCLUSION ZONE WITHOUT CLEARANCE APPROVAL WITH THE EXCEPTION OF RUNNING RAILS, CONDUCTOR RAILS AND RAMPS, TRAINSTOPS, TRIP-TESTERS, CHECK RAILS, LUBRICATORS, PROTECTION PLANKING, POINT AND CROSSING EQUIPMENT AND ANY ITEMS "DIRECTLY" RELATED TO THE POSITIONING OR FUNDAMENTAL OPERATION AND FUNCTIONALITY OF THE ABOVE LISTED ITEMS. TRACK AND VEHICLE OVERLAP BY DESIGN FOR INTERFACING PARTS, E.G. CHECK RAIL AND WHEEL. THESE INTERFACES SHALL BE CONSIDERED FOR ASSETS IN ZONES A-F.
2. FOR PERMITTED WIDTHS OF KINEMATIC LIMITS, STRUCTURE GAUGES AND PROFILES SEE DIAGRAM NUMBERS:- B1, C1-C6, D1, E1-E2, G1 AND G3 AS APPROPRIATE.
3. DUE ALLOWANCE FOR RAIL WEAR SHALL BE TAKEN INTO CONSIDERATION WHEN CARRYING OUT GAUGING SURVEYS.
4. THE REQUIREMENTS OF THIS DRAWING APPLY TO "NEW WORKS" AND "MAINTENANCE".
5. ZONE F IS RAISED FROM 132MM AND 152MM ARL TO 171MM AND 191MM ARL FOR TUBE TUNNELS WITH RESTRICTED CLEARANCES AROUND THE POSITIVE RAIL E.G. LIVERPOOL STREET TO WHITE CITY AND FOR UNIVERSAL ACCESS WITH DIAGRAMS G1 AND LG1.
6. TRACK AND INFRASTRUCTURE ASSETS ARE GAUGED TO THE NEAREST RUNNING RAIL. VEHICLE GAUGING DOES NOT REQUIRE ADDITIONAL ALLOWANCES FOR DESIGNED TRACK GAUGE WIDENING OR TRACK TOLERANCES, E.G. RAIL WEAR, LATERAL, VERTICAL, CROSS-LEVEL OR TRACK GAUGE VARIATION.
7. THE ZONES LIMITS SHOWN FOR OCCUPATION BY ROLLING STOCK COMPONENTS ARE KINEMATIC LIMITS. THE KINEMATIC LIMIT IS ALWAYS NORMAL TO THE NEW RAIL DATUM. SEE EXPLANATORY TEXT IN THIS STANDARD (S1156).
8. THIS DIAGRAM IS NOT TO BE USED WITHOUT REFERENCE TO THE APPROPRIATE STRUCTURE GAUGE DIAGRAM, AND THE EXPLANATORY TEXT IN THIS STANDARD.
9. TO AID CLARITY, ONLY HALF PROFILES ARE SHOWN ABOVE FOR TRACK AND VEHICLE. BOTH TRACK AND VEHICLE PROFILES ARE SYMMETRICAL ABOUT THE CENTRELINE. POSITIVE CONDUCTOR RAILS AND SHOE GEAR OCCUR ON BOTH SIDES.

C	14/12/20	Replacement of diagram	AM	EP	MB
B	16/04/08	Editorial changes	JR	EEF	TAJ
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COPYRIGHT THIS DRAWING IS THE COPYRIGHT OF LONDON UNDERGROUND LIMITED					
TRACK ENGINEERING HEAD OF TRACK ENGINEERING					
Title: ENGINEERING STANDARD S1156					
TRACK / VEHICLE INTERFACE ALL LINES GENERAL ISSUE					
Working Type: DIAGRAM					
Project: ANGLE			DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED		
Tolerances: DRAWN IN ACCORDANCE WITH BS 518					
Drawn Scale:			Checked by: E.E.Eng C.C. SHARP		
Drawn: S. TAILOR		Date: 01/08/97		Date: 01/08/97	
Approved C.E.G.-The Eng: T.A. JIPSON		Date: 01/08/97		Approved C.E.G.-The Eng: J.W. VINT	
Contract Number:		Diagram Number:		Issue:	
Sheet:		of:		F1 C	

THIS DIAGRAM MUST NOT BE TAKEN AS DEFINING PERMITTED ROUTE AVAILABILITY. THIS DIAGRAM SHOWS REQUIREMENTS.



TO AID CLARITY IT IS RECOMMENDED THAT THIS DRAWING IS NOT PRINTED AT SMALLER THAN A2

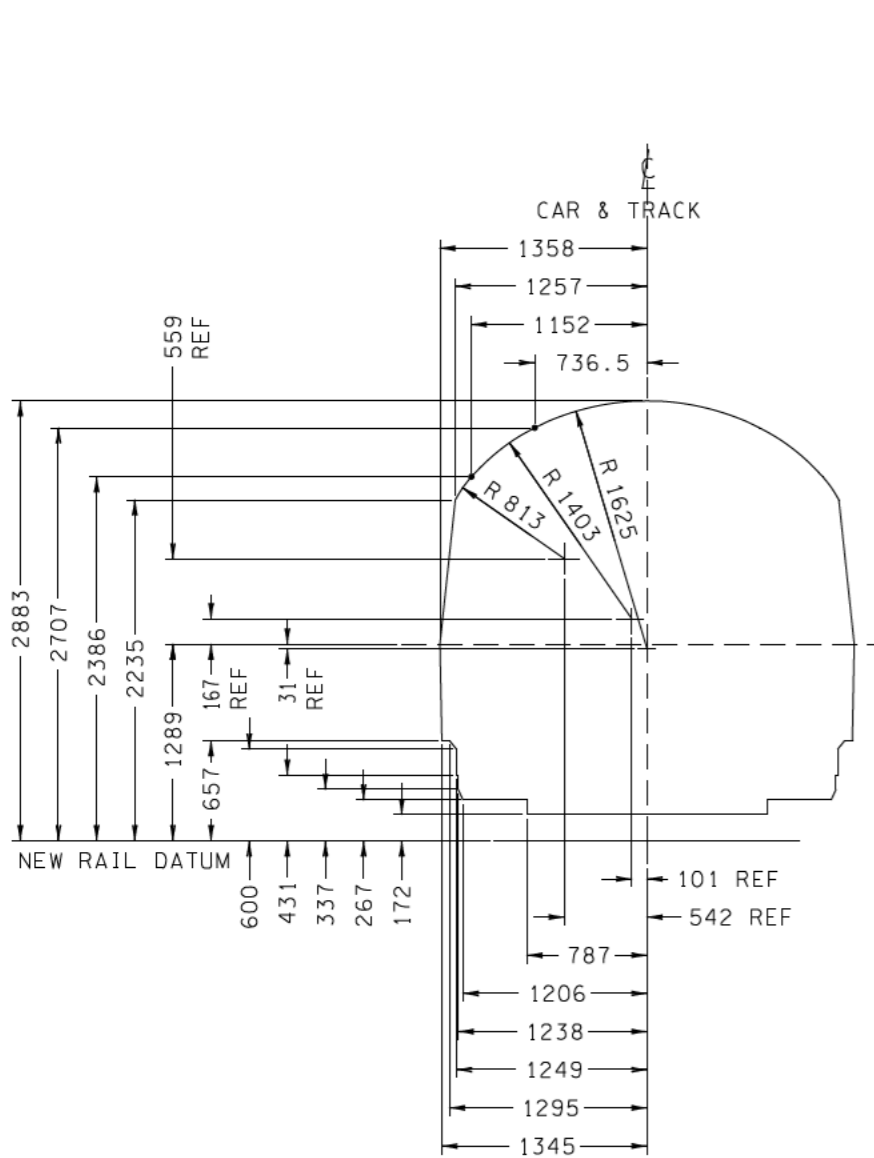
- NOTES:
1. NO MINIMUM CLEARANCE SHALL BE EMPLOYED WHERE A GREATER CLEARANCE CAN BE PROVIDED.
 2. THE KINEMATIC LIMIT SHOWN REPRESENTS THE MAXIMUM PERMISSIBLE DIMENSIONS FOR THE KINEMATIC LIMIT OF ENGINEER'S ROLLING STOCK HAVING ROUTE AVAILABILITY OVER ALL LUL LINES (INCLUDING THE JUBILEE LINE EXTENSION).
 3. LARGER VEHICLES MUST COMPLY WITH THE MAINTENANCE KINEMATIC LIMIT APPROPRIATE TO THEIR AREAS OF OPERATION.
 4. THE KINEMATIC LIMIT IS ALWAYS NORMAL TO THE NEW RAIL DATUM.

5. WHERE TRACKS ARE CIRCULAR CURVES, EITHER HORIZONTALLY OR VERTICALLY, THE KINEMATIC LIMIT SHALL BE ENLARGED FOR END AND CENTRE THROWS AS FOLLOWS:
 WHERE
 R = RADIUS OF CURVATURE (m) = 15.240
 L = OVERALL BODY LENGTH (m) = 10.060
 B = DISTANCE BETWEEN BOGIE CENTRES (m)
 FORMULAE
 INSIDE CURVE = CENTRE THROW (mm) = $B^2 \times 1000/8R = 12651/R$
 OUTSIDE CURVE = END THROW (mm) = $(L^2 - B^2) \times 1000/8R = 16382/R$

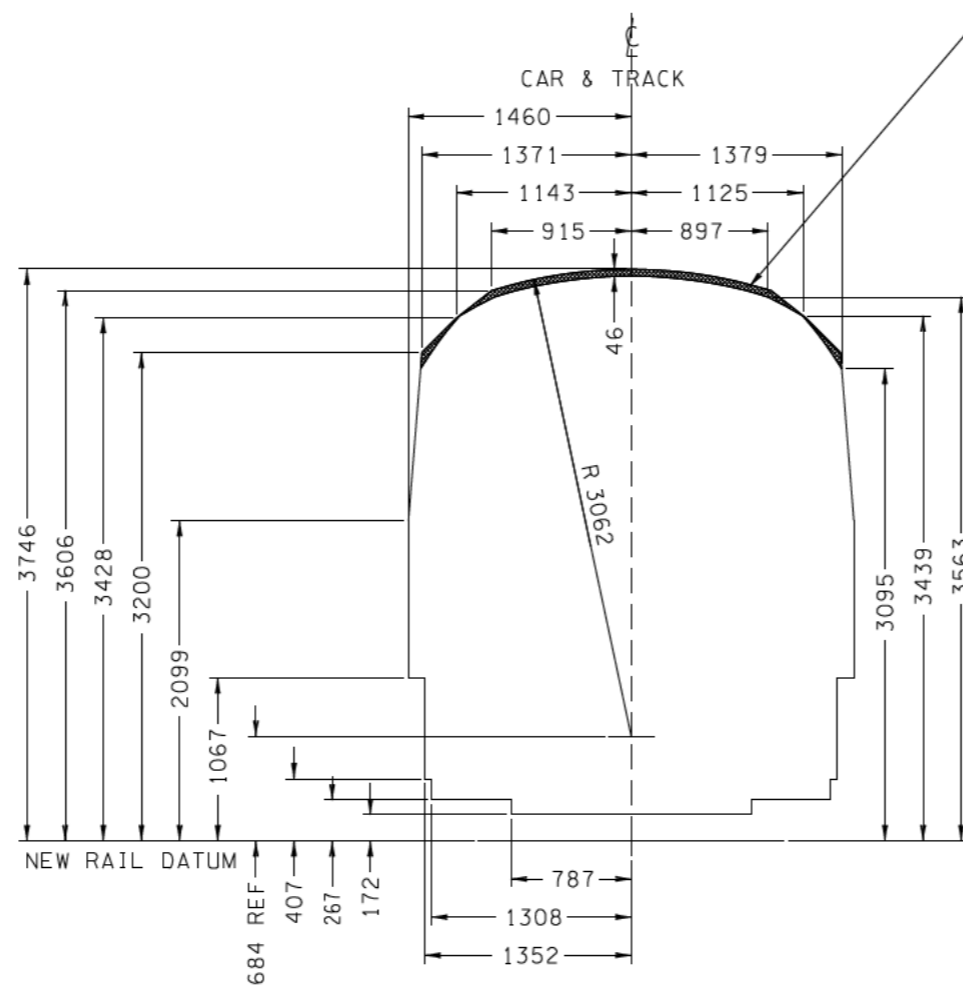
6. ANY VARIATION IN ROLLING STOCK DIMENSIONS FROM THOSE GIVEN IN NOTE 5 WILL REQUIRE CORRESPONDING ALTERATIONS IN THE DIMENSIONS OF THE VEHICLE BODY BASED ON A MINIMUM HORIZONTAL RADIUS OF 91m AND A MINIMUM VERTICAL RADIUS OF 402m.
7. THIS DIAGRAM IS NOT TO BE USED WITHOUT REFERENCE TO THE TRACK / VEHICLE INTERFACE DIAGRAM "F1" AND THE EXPLANATORY TEXT IN THIS STANDARD (S1156).

C	12/02/20	Symmetry & platform issues addressed for RTR project	AM	FY	MB
B	16/04/08	Editorial changes	JR	EEF	TAJ
Issue	Date	Revision	Rev.	By	CHK App
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TRACK ENGINEERING					
HEAD OF TRACK ENGINEERING					
Title: ENGINEERING STANDARD S1156					
ENGINEERS VEHICLE PROFILES AND GAUGES UNIVERSAL KINEMATIC LIMIT					
Drawing Type: DIAGRAM					
Project: ANGLE		DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED			
Tolerances: DRAWN IN ACCORDANCE WITH BS 518		Checked by: E.E.Eng Date: 01/08/97			
Drawn Scale: C.C. SHARP		Checked by: S.D. SMITH Date: 01/08/97			
Drawn: S. TAILOR Date: 01/08/97		Approved C.E.G.-The R.S.Eng: J.W. VINT Date: 01/08/97			
Approved C.E.G.-The T.Eng: T.A. JIPSON Date: 01/08/97		Approved C.E.G.-The R.S.Eng: J.W. VINT Date: 01/08/97			
Contract Number:		Diagram Number:		Issue:	
Sheet:		of G1		C	

EXISTING LG2 REMAINS UNCHANGED TO COVER EXISTING RCAs
 BUT ANY NEW ENGINEERING VEHICLES / LOADED WAGONS ETC.
 WILL NEED TO BE ASSESSED FOR DYNAMIC MOVEMENT IF
 THEIR STATIC DIMENSIONS FALL INTO THE SHADED AREA.

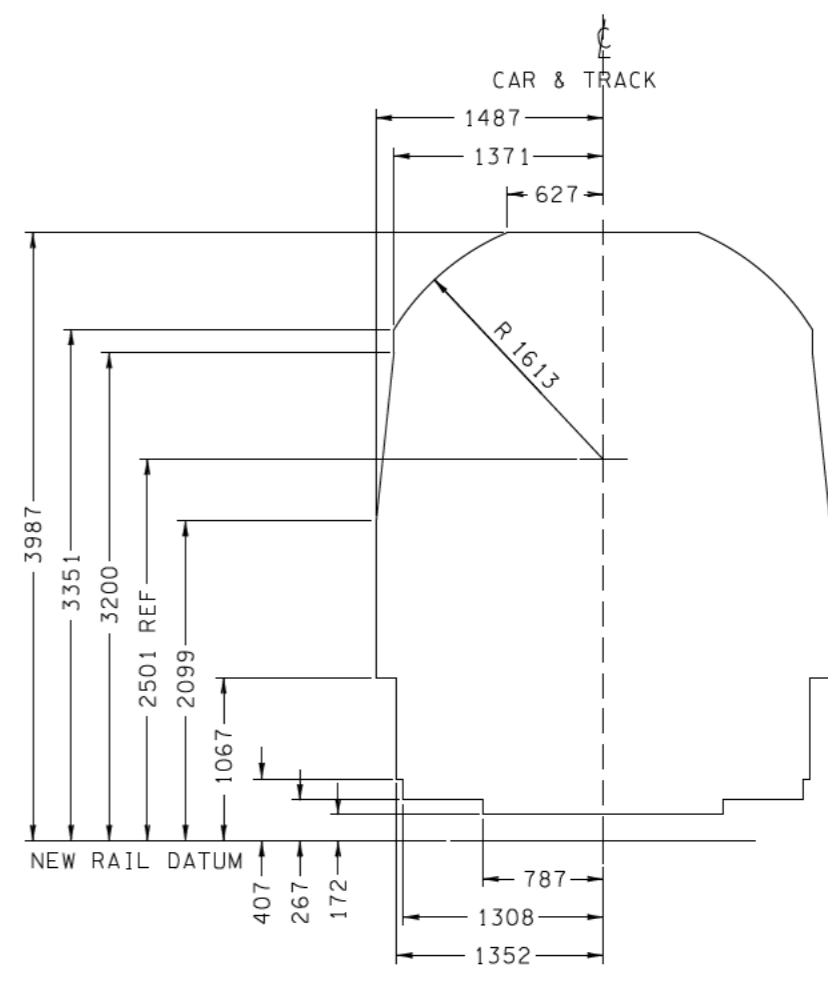


LG1
ROUTE AVAILABILITY ALL LUL LINES
MAXIMUM BODY LENGTH 15240mm
MAXIMUM BOGIE CENTRES 10060mm



LG2
ROUTE AVAILABILITY SUB-SURFACE AND NR/LUL JOINT LINES (AND LINES MAINTAINED TO THE SAME STRUCTURE GAUGES)
MAXIMUM BODY LENGTH 15240mm
MAXIMUM BOGIE CENTRES 10363mm

ANY ROUTE CLEARANCE APPROVAL FOR LG2 AREAS
 WILL NEED TO CONSIDER AN ALLOWANCE FOR
 KINEMATIC MOVEMENT AT THE ROOF LINE IN ORDER
 TO ENSURE COMPLIANCE WITH THE KINEMATIC LIMIT.



LG3
ROUTE AVAILABILITY NR/LUL JOINT LINES (AND LINES MAINTAINED TO THE SAME STRUCTURE GAUGES) ONLY
MAXIMUM BODY LENGTH 16165mm
MAXIMUM BOGIE CENTRES 10827mm

TO AID CLARITY IT IS RECOMMENDED
 THAT THIS COLOURED DRAWING IS
 NOT PRINTED AT SMALLER THAN A1

- NOTES:
1. THESE LOAD GAUGES ARE TO BE USED FOR LOADING ENGINEERS VEHICLES ONLY. ALL VEHICLES MUST CONFORM TO EITHER THE UNIVERSAL KINEMATIC LIMIT SHOWN ON DIAGRAM "G1" OR THE APPROPRIATE MAINTENANCE KINEMATIC LIMIT FOR THE AREA OF OPERATION.
 2. THE APPLICATION AREAS FOR THESE LOAD GAUGES ARE AS SHOWN ON DIAGRAM "A1".

3. ANY VARIATION IN ROLLING STOCK DIMENSIONS FROM THOSE GIVEN ABOVE WILL REQUIRE CORRESPONDING ALTERATION IN THE DIMENSIONS OF THE VEHICLE BODY BASED ON A MINIMUM VERTICAL RADIUS OF 402m AND A MINIMUM HORIZONTAL RADIUS OF 55m (LG2 AND LG3) AND 91m (LG1).
4. THIS DIAGRAM IS NOT TO BE USED WITHOUT REFERENCE TO THE TRACK / VEHICLE INTERFACE DIAGRAM "F1" AND THE EXPLANATORY TEXT IN THIS STANDARD (S1156).

Issue	Date	Revision	Rev.	By	CHK	App.
C	17/09/17	Editorial changes		AMJ	EPH	ME
B	16/04/08	Editorial changes		JH	EEF	TAJ

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TRACK ENGINEERING
 HEAD OF TRACK ENGINEERING

Title: **ENGINEERING STANDARD S1156**

ENGINEERS VEHICLE PROFILES AND GAUGES
 MAXIMUM LOAD GAUGES

Working Type: **DIAGRAM**

Project: **ANGLE**

Tolerances: **UNLESS OTHERWISE STATED**

Drawn: **C.C. SHARP** Date: **01/08/97**

Checked by: **S.D. SMITH** Date: **01/08/97**

Drawn: **S. TAILOR** Date: **01/08/97**

Checked by: **S.D. SMITH** Date: **01/08/97**

Approved: **T.A. JIPSON** Date: **01/08/97**

Approved: **J.W. VINT** Date: **01/08/97**

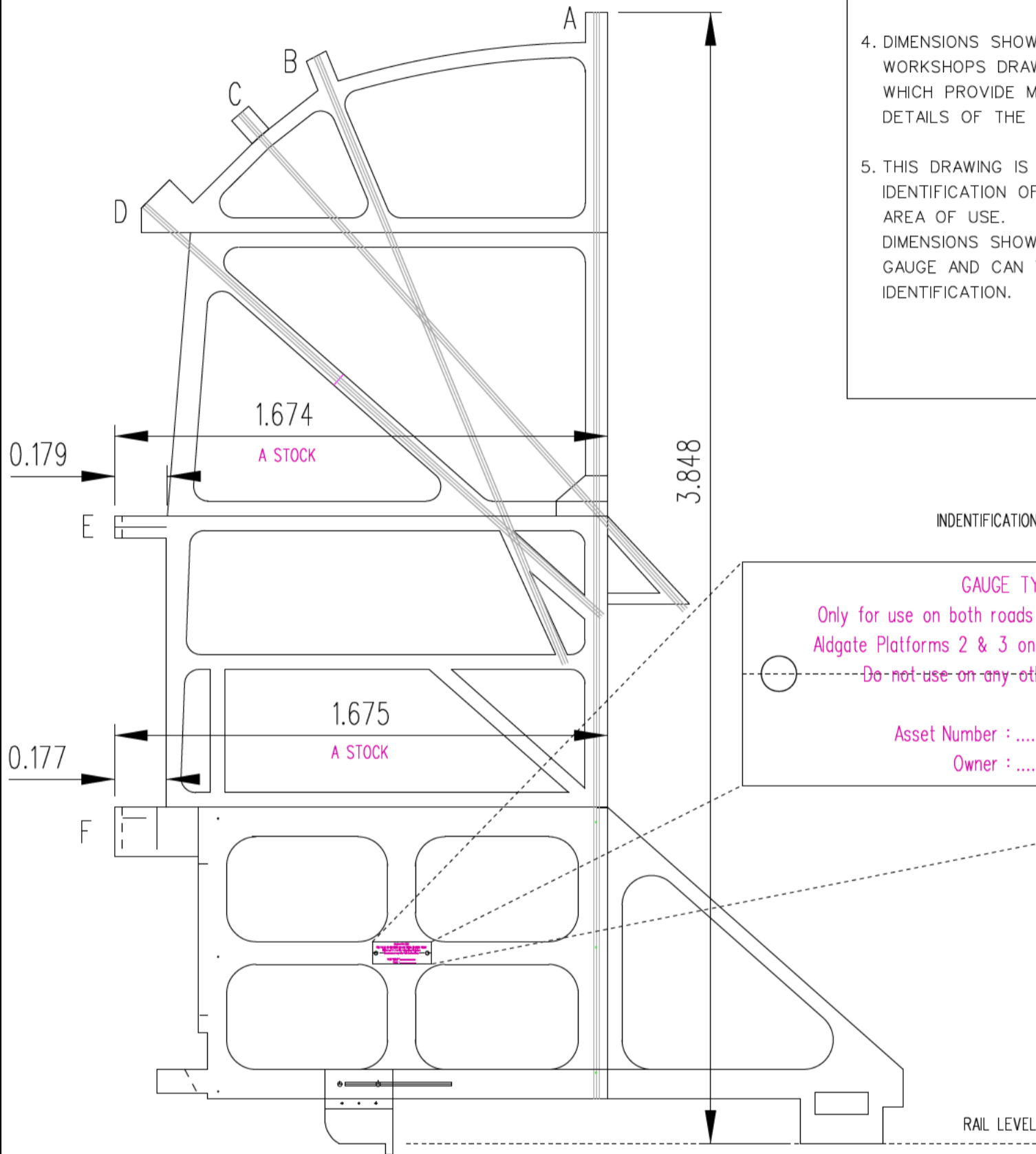
Contract Number: _____

Diagram Number: _____

Sheet: **G2** of **C**

NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE
2. DO NOT SCALE OFF DRAWING
3. THIS DRAWING MUST BE READ IN CONJUNCTION WITH STANDARD S1156, DIAGRAM No.A2 WHICH DEFINES THE AREA OF USE FOR THIS GAUGE.
4. DIMENSIONS SHOWN ARE FROM LUL TRACK WORKSHOPS DRAWING LBW0019/B SHEETS 1 TO 3 WHICH PROVIDE MANUFACTURE AND FABRICATION DETAILS OF THE GAUGE.
5. THIS DRAWING IS FOR THE PURPOSE OF IDENTIFICATION OF THIS GAUGE AND ITS APPLICABLE AREA OF USE. DIMENSIONS SHOWN ARE UNIQUE TO THIS TYPE OF GAUGE AND CAN THEREFORE BE USED TO CONFIRM IDENTIFICATION.



IDENTIFICATION PLATE DETAIL

GAUGE TYPE 5602

Only for use on both roads between Finchley Road and Aldgate Platforms 2 & 3 on the Metropolitan/Circle line.
~~Do not use on any other Sub-Surface lines.~~

Asset Number :

Owner :

Rev	Date	Description	By	Chk'd	Apr
B	14-11-17	Minor amendments	AMV	DW	AB
A	14-06-11	Issued for information and comment	KB	ZW	TJ

Scale at A4	1:25				
Date	28-02-2011	Drawn	K.BADU	Checked	Z.WORMALD
Engineer	Z.WORMALD	Approved	T.JIPSON		



Location BOTH ROADS FINCHLEY ROAD TO ALDGATE PLATFORMS 2&3 METROPOLITAN/CIRCLE LINE

Project TUNNEL GAUGE IDENTIFICATION

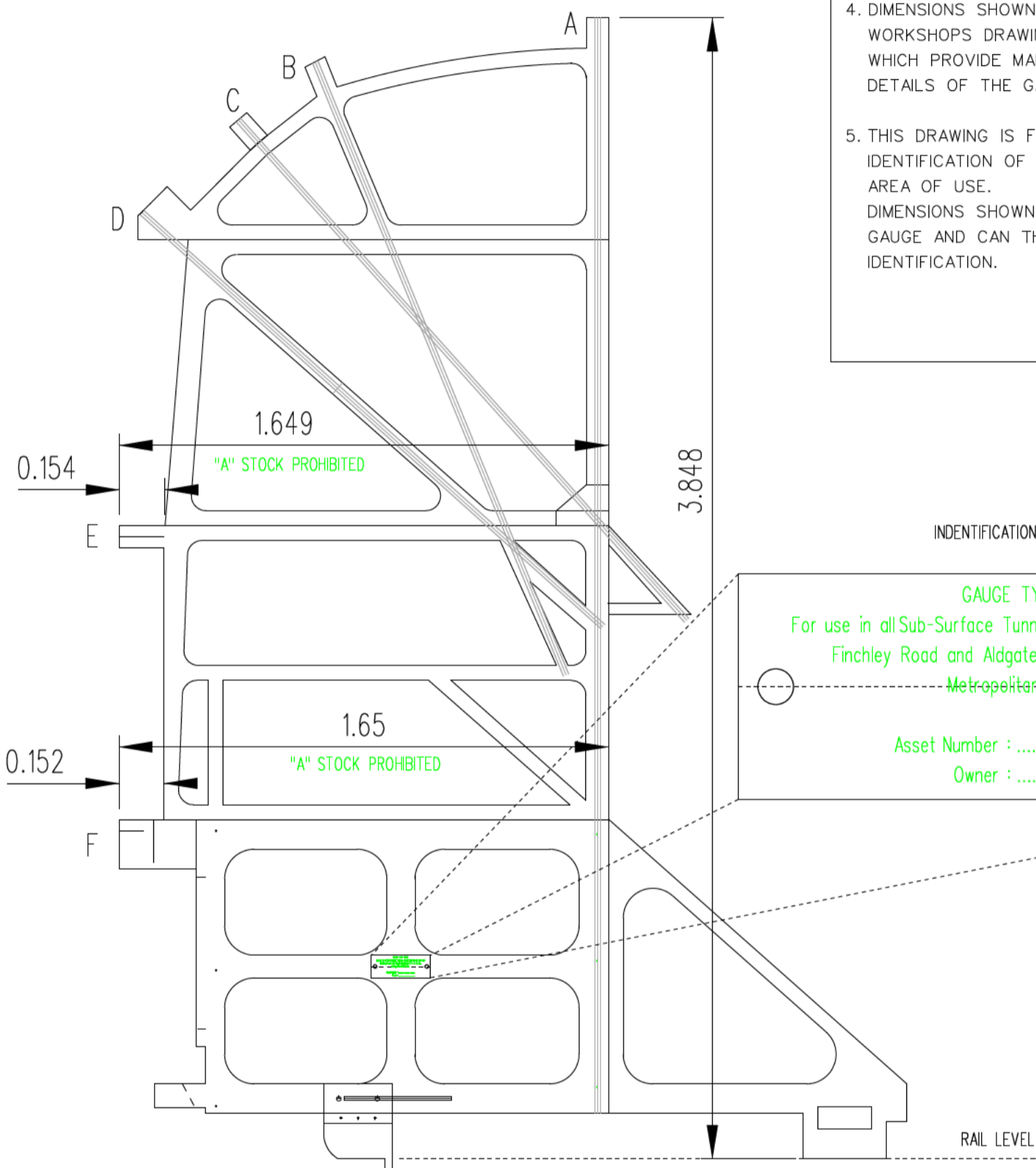
Title ——— 5602
TUNNEL GAUGE IDENTIFICATION DRAWING

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DRAWING NUMBER	REV
1907882-DWG-TRK-R001-0005602	B

NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE
2. DO NOT SCALE OFF DRAWING
3. THIS DRAWING MUST BE READ IN CONJUNCTION WITH STANDARD S1156, DIAGRAM No.A2 WHICH DEFINES THE AREA OF USE OF THIS GAUGE.
4. DIMENSIONS SHOWN ARE FROM LUL TRACK WORKSHOPS DRAWING LBW0019/B SHEETS 1 TO 3 WHICH PROVIDE MANUFACTURE AND FABRICATION DETAILS OF THE GAUGE.
5. THIS DRAWING IS FOR THE PURPOSE OF IDENTIFICATION OF THIS GAUGE AND ITS APPLICABLE AREA OF USE. DIMENSIONS SHOWN ARE UNIQUE TO THIS TYPE OF GAUGE AND CAN THEREFORE BE USED TO CONFIRM IDENTIFICATION.



IDENTIFICATION PLATE DETAIL

GAUGE TYPE 5603
 For use in all Sub-Surface Tunnels except both roads between
 Finchley Road and Aldgate Platforms 2 & 3 on the
 Metropolitan/Circle line

Asset Number :
 Owner :

Rev	Date	Description	By	Chk'd	Apr
A	14-11-17	Minor Amendments	AMV	DW	AB
A	14-06-11	Issued for information and comment	KB	ZW	TJ

Scale at A4	1:25
Date	28-02-2011
Drawn	K.BADU
Checked	Z.WORMALD
Engineer	Z.WORMALD
Approved	T.JIPSON



Location ALL SUB-SURFACE TUNNELS
 EXCEPT BOTH ROADS FINCHLEY ROAD TO
 ALDGATE PLATFORMS 2&3
 METROPOLITAN/CIRCLE LINES

Project TUNNEL GAUGE IDENTIFICATION

Title █ 5603
 TUNNEL GAUGE IDENTIFICATION DRAWING

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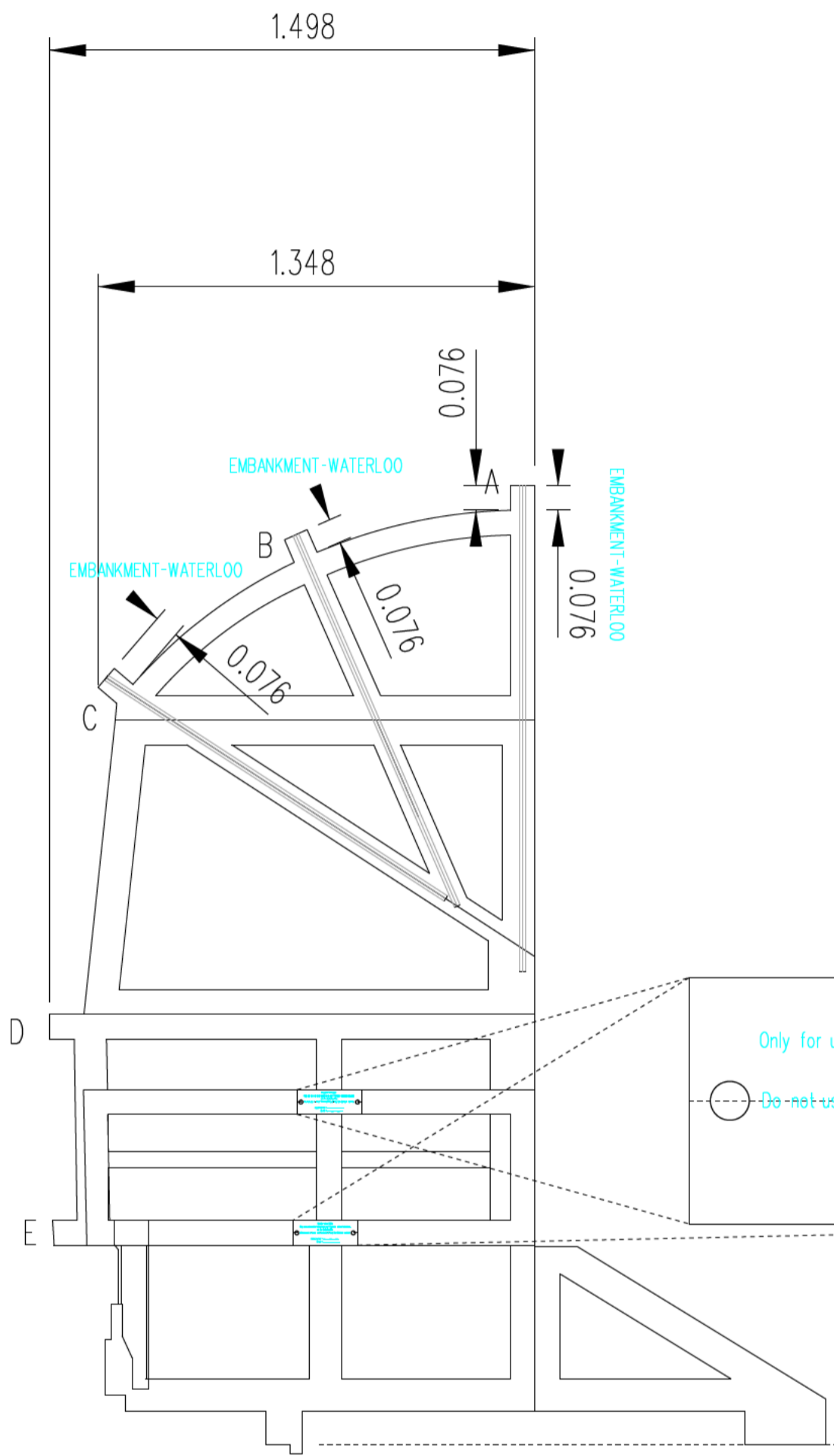
DRAWING NUMBER	REV
1907882-DWG-TRK-R001-0005603	B

A4

A4

NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE
2. DO NOT SCALE OFF DRAWING
3. THIS DRAWING MUST BE READ IN CONJUNCTION WITH STANDARD S1156, DIAGRAM No.A2 WHICH DEFINES THE AREA OF USE FOR THIS GAUGE.
4. DIMENSIONS SHOWN ARE FROM LUL TRACK WORKSHOPS DRAWING LBW0019/C SHEETS 1 TO 2 WHICH PROVIDE MANUFACTURE AND FABRICATION DETAILS OF THE GAUGE.
5. THIS DRAWING IS FOR THE PURPOSE OF IDENTIFICATION OF THIS GAUGE AND ITS APPLICABLE AREA OF USE. DIMENSIONS SHOWN ARE UNIQUE TO THIS TYPE OF GAUGE AND CAN THEREFORE BE USED TO CONFIRM IDENTIFICATION.



IDENTIFICATION PLATE DETAIL

GAUGE TYPE 5604
 Only for use on both roads between Waterloo and Embankment on the Bakerloo line.
~~Do not use in other Tube Tunnels or any Sub-Surface Tunnels.~~
 Asset Number :
 Owner :

Rev	Date	Description	By	Chk'd	Apr
B	14-11-17	Minor amendments	AMV	DW	AB
A	14-06-11	Issued for information and comment	KB	ZW	TJ

Scale at A4	1:25				
Date	28-02-2011	Drawn	K.BADU	Checked	Z.WORMALD
Engineer	Z.WORMALD	Approved	T.JIPSON		



Location	BOTH ROADS WATERLOO TO EMBANKMENT BAKERLOO LINE
Project	TUNNEL GAUGE IDENTIFICATION
Title	— 5604 TUNNEL GAUGE IDENTIFICATION DRAWING

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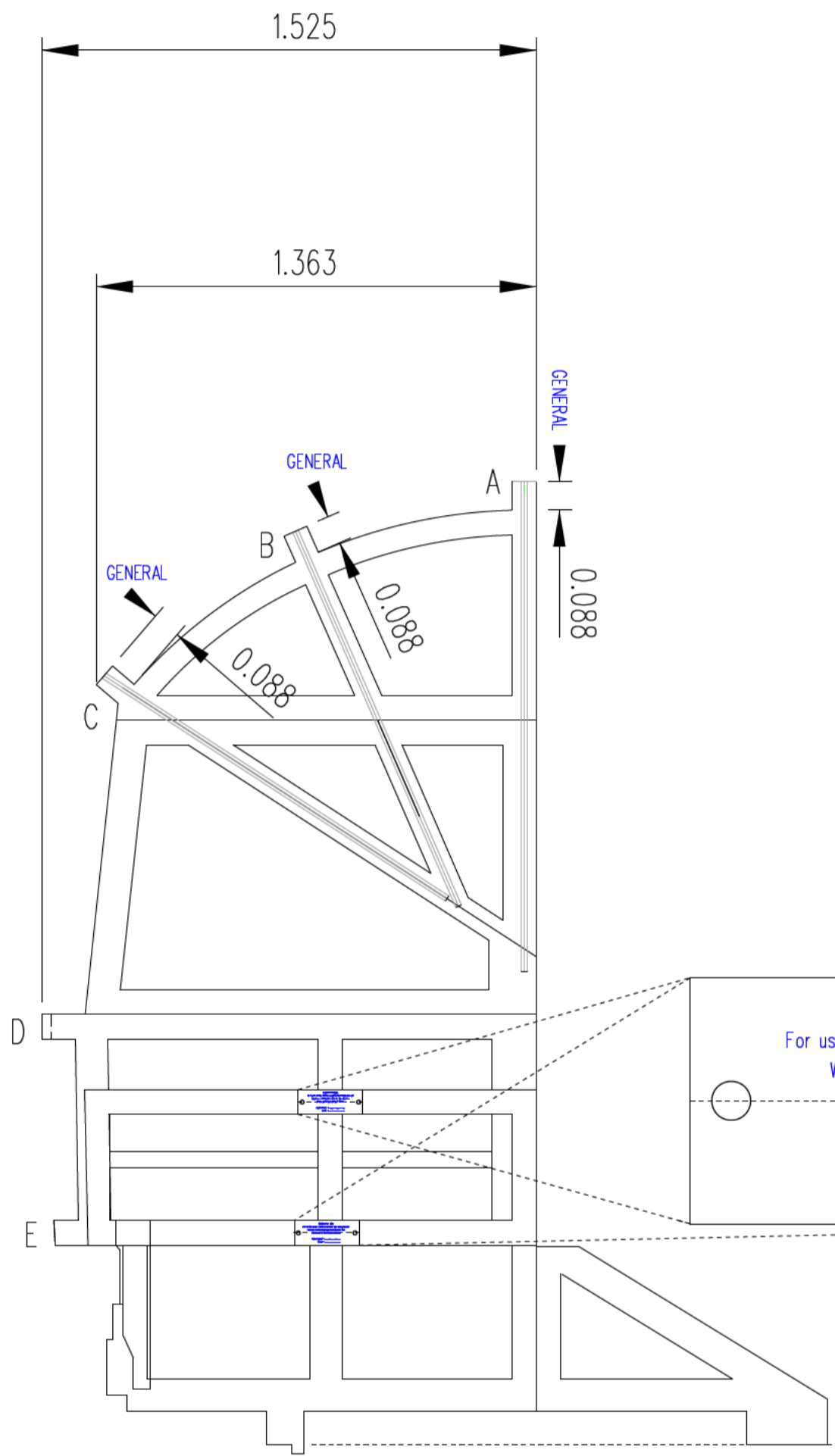
DRAWING NUMBER	REV
1907882-DWG-TRK-R001-0005604	B

A4

A4

NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE
2. DO NOT SCALE OFF DRAWING
3. THIS DRAWING MUST BE READ IN CONJUNCTION WITH STANDARD S1156, DIAGRAM No.A2 WHICH DEFINES THE AREA OF USE FOR THIS GAUGE.
4. DIMENSIONS SHOWN ARE FROM LUL TRACK WORKSHOPS DRAWING LBW0019/A SHEETS 1 TO 3 WHICH PROVIDE MANUFACTURE AND FABRICATION DETAILS OF THE GAUGE.
5. THIS DRAWING IS FOR THE PURPOSE OF IDENTIFICATION OF THIS GAUGE AND ITS APPLICABLE AREA OF USE. DIMENSIONS SHOWN ARE UNIQUE TO THIS TYPE OF GAUGE AND CAN THEREFORE BE USED TO CONFIRM IDENTIFICATION.



INDENTIFICATION PLATE DETAIL

GAUGE TYPE 5605
 For use in all Tube Tunnels except for both roads between
 Waterloo and Embankment of the Bakerloo line.
~~Do not use in Sub-Surface Tunnels.~~
 Asset Number :
 Owner :

Rev	Date	Description	By	Chk'd	Apr
B	14-11-17	Minor amendments	AMV	DW	AB
A	14-06-11	Issued for information and comment	KB	TJ	AB

Scale at A4	1:25
Date	28-02-2011
Drawn	K.BADU
Checked	Z.WORMALD
Engineer	Z.WORMALD
Approved	T.JIPSON



Location ALL TUBE TUNNELS EXCEPT FOR BOTH ROADS WATERLOO TO EMBANKMENT ON THE BAKERLOO LINE

Project TUNNEL GAUGE IDENTIFICATION

Title █ 5605
 TUNNEL GAUGE IDENTIFICATION DRAWING

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DRAWING NUMBER	REV
1907882-DWG-TRK-R001-0005605	B

A4

A

B

C

D

E

F

A4