RAILWAYS

Track Installations

For further information on British railways contact Safety and Standards Directorate, Railtrack PLC, London.
For further information on European railways, contact the Union of European Railway Industries, Brussels.

1. The common rail sections

<table>
<thead>
<tr>
<th>Rail section</th>
<th>G (kg/m run)</th>
<th>A (cm²)</th>
<th>Wₓ (cm³)</th>
<th>Wₓ (cm³)</th>
<th>Wₓ (cm³)</th>
<th>L₁ (cm)</th>
<th>L₂ (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S 41</td>
<td>40.95</td>
<td>52.2</td>
<td>196.0</td>
<td>200.5</td>
<td>41.7</td>
<td>1368</td>
<td>260</td>
</tr>
<tr>
<td>S 49</td>
<td>49.43</td>
<td>63.0</td>
<td>240.2</td>
<td>248.2</td>
<td>51.0</td>
<td>1819</td>
<td>330</td>
</tr>
<tr>
<td>S 54</td>
<td>54.54</td>
<td>69.4</td>
<td>262.4</td>
<td>276.4</td>
<td>57.0</td>
<td>2073</td>
<td>369</td>
</tr>
<tr>
<td>S 64</td>
<td>64.92</td>
<td>72.5</td>
<td>305.9</td>
<td>403.5</td>
<td>60.5</td>
<td>2532</td>
<td>604</td>
</tr>
<tr>
<td>UC 60</td>
<td>60.34</td>
<td>76.9</td>
<td>335.5</td>
<td>437.4</td>
<td>68.4</td>
<td>3055</td>
<td>513</td>
</tr>
<tr>
<td>Ri 59</td>
<td>58.96</td>
<td>75.1</td>
<td>372.6</td>
<td>351.8</td>
<td></td>
<td>3257</td>
<td>781</td>
</tr>
</tbody>
</table>

*Wₓ = 118 cm³ because of asymmetry

2. Rail dimensions

3. Wooden sleeper

4. Steel sleeper

5. Concrete sleeper B70

6. Concrete sleeper B58

7. Standard cross-section for a single track bed

8. Standard cross-section for a twin track bed

9. Distance between centre-lines of tracks

The key standard distances (d) between track centre-lines are as listed below:

- On open stretches of track 4.00 m (3.5m on older stretches)
- where signals are installed 4.50 m
- as safety space after every second track 5.40 m
- on newly built stretches (V >200km/h) 4.70 m
- In stations 4.50 m (4.75m)
  - main lines, straight through 4.00 m
  - in sets of 5-6 lines 6.00 m
  - for brake inspection/test tracks 5.00 m
  - in sidings for carriage cleaning 5.00 m

The standard gauge for the UK (and for 71% of all the railways in the world) is 1.435 m. Tolerances on the gauge width are, as follows:

- ±3/-9 mm on main lines
- ±3/-13 mm on branch lines

Gauges in other countries are: Russia 1.520 m, Spain and Portugal 1.668 m, South and Central Africa 1.067 m, Chile, Argentina and India 1.673 m.

Typically, the expected life of sleepers can be taken to be as follows:

- timber sleepers, impregnated with creosote 25-40 years
- timber sleepers, unimpregnated 3-15 years
- steel sleepers about 45 years
- concrete sleepers (estimated) at least 60 years

The depth of trench in a cutting should be ≥0.4-0.6 m below grade and the slope of the trench 3-10%, depending on the type of consolidation of the trench floor.

Ground water in the case of retaining walls must be conducted away by pipes or drainage holes.

The longitudinal gradient for open stretches of main line should be ≤12.5‰, and ≤40% for branch lines. For lines in stations it should be ≤2.5‰. In exceptional circumstances, where special permission is granted, gradients up to 25% can be used on main lines.

When stationary, the permissible wheel load is 9 tonnes. On stretches with sufficiently strong track and supporting structures, a greater wheel loading is possible (up to 12.5 tonnes).
RAILWAYS

Track Installations

Curved radii (to the centre-line of the track), R:
- for direct main line fast track: \( \geq 300 \text{ m} \)
- for sidings in stations: \( \geq 180 \text{ m} \)
- for branch lines with main line rolling stock: \( \geq 180 \text{ m} \)
- without main line rolling stock: \( \geq 100 \text{ m} \)
- for sidings, used by main line engines: \( \geq 140 \text{ m} \)
- for sidings, not used by mainline engines possibly \( \geq 100 \text{ m} \)
- minimum: \( \geq 35 \text{ m} \)

Note that if \( 100 \text{ m} \) \( > R \geq 35 \text{ m} \) carriages should only be pulled. In addition, \( R > 130 \text{ m} \) might not be suitable for all rolling stock so the types involved should be checked at an early stage.

Radii for narrow gauge railways:
- for 1.00 m gauge track: \( \geq 50 \text{ m} \)
- for 0.75 m gauge track: \( \geq 40 \text{ m} \)
- for 0.60 m gauge track: \( \geq 25 \text{ m} \)

For track that will be used at speeds greater than shunting speed, a transitional section of curve must be laid between the straight section and the circular arc itself, giving a continuous curvature change from 1:1 to 1:R \( \rightarrow \) 2. Under certain circumstances the curves must be canted in order to keep the centrifugal force that arises during travel through the curve within reasonable limits. Canted curves and transition curves should be blended together. All details should satisfy the Service Regulations of the relevant Railway Authority.

Sets of points are designated in accordance with the rail shape, the branch line's radius and the pitch of the frog (e.g. 49–190–1:9). Below are example lengths of sets of points switch rails:

<table>
<thead>
<tr>
<th>R</th>
<th>L</th>
<th>l</th>
<th>m</th>
<th>ramp gradient</th>
</tr>
</thead>
<tbody>
<tr>
<td>180–200</td>
<td>40</td>
<td>0.370</td>
<td>1:320</td>
<td></td>
</tr>
<tr>
<td>250–360</td>
<td>30</td>
<td>0.333</td>
<td>1:320</td>
<td></td>
</tr>
<tr>
<td>400–2000</td>
<td>20</td>
<td>0.107</td>
<td>1:400</td>
<td></td>
</tr>
<tr>
<td>500–2000</td>
<td>10</td>
<td>0.012</td>
<td>1:400</td>
<td></td>
</tr>
<tr>
<td>600–2000</td>
<td>20</td>
<td>0.107</td>
<td>1:400</td>
<td></td>
</tr>
</tbody>
</table>

The diameters, D, of normal turntables are: for axles, 2–3m; for wagons, 3–10m; and for engines, 12.5–23.0m.

The sizes of transfer tables should be calculated as minimum axle base of the carriage to be transferred \(+0.5 \text{ m}\).

Details for level crossings can be obtained from the Service Regulations of the relevant Authority.

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**Display Symbols**

- (a) set of points with outside curve, remotely controlled
- (b) double set of point, remotely controlled
- (c) double slip points, remotely controlled
- (d) simple set of points, hand operated
- (e) double slip points, locally operated
- (f) crossing

**Dimensions for sets of points**

<table>
<thead>
<tr>
<th>set of points</th>
<th>radius (m)</th>
<th>pitch ratio</th>
<th>overall length (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 49</td>
<td>215</td>
<td>1.48</td>
<td>22.100</td>
</tr>
<tr>
<td>(b) 49</td>
<td>190</td>
<td>1.75</td>
<td>30.039</td>
</tr>
<tr>
<td>(c) 49</td>
<td>190</td>
<td>1.9</td>
<td>27.138</td>
</tr>
<tr>
<td>(d) 49</td>
<td>190</td>
<td>1.9</td>
<td>33.230</td>
</tr>
<tr>
<td>(e) 49</td>
<td>190</td>
<td>1.9</td>
<td>37.661</td>
</tr>
<tr>
<td>(f) 49</td>
<td>190</td>
<td>1.9</td>
<td>37.661</td>
</tr>
</tbody>
</table>
RAILWAYS

Typical Continental European Structure Gauging and Clearances

1. Standard clearance profiles (straight track plus curves with radii ≥ 250 m)

2. Standard structure gauging and clearances at low level

3. Necessary increase in the standard clearance for curves with radii < 250 m

4. Top limit of clearance for stretches with overhead conductor wire (15 kV)

5. Dimensions for half the width of the upper limit of the clearance

6. Minimum clearance under structures

Other dimensions: European standards (Germany)
For entrance doorways the clear width should be ≥ 3.35 m and for new structures ≥ 4.00 m.

For tunnels, the extra clearance needed beyond the trains' kinematic envelope clearance to the wall for a single-track stretch of line is 0.40 m; for a double-track stretch of line it is 3.0 cm.

There are minimum distances required between buildings and railway tracks for new structures. These vary according to location. Typical examples are: a fire resistant structure with suitable cladding must be separated by ≥ 7.50 m from railway land; the corresponding distance for soft covered structures that are not fire resistant is ≥ 15 m. The latter also applies to structures in which combustible materials are stored.

Platform heights vary from country to country, and can be as small as 0.38 m. However, access to platforms must not involve passengers having to cross the track. This requires tunnels or bridges, which should have a width of 2.5-4.0 m. If there is circulation in both directions, 4.00-8.00 m is desirable. Steps on bridges or in tunnels should be the same width as the bridge or tunnel.
RAILWAYS

UK Structure Gauges and Clearances

Further information: Safety and Standards Directorate, Railtrack PLC, London

This information is based on the Railway Group Standard which applied to all new design and new route clearances for railway vehicles and loads from 3 February 1996.

The purpose of this Railway Group Standard is to set down the engineering requirements for the safe passage of rail vehicles and their loads by reconciling their physical size and dynamic behaviour with the opportunities offered by the railway infrastructure.

This standard applies to infrastructure owned by Railtrack PLC and any other infrastructure interfacing with it and affecting its physical clearances (e.g. private sidings or works into which, or out of which, trains will work onto Railtrack lines).

It shall be complied with in the design, maintenance and alteration of the railway infrastructure, in the design and modification of traction and rolling stock and in the conveyance of out of gauge loads.

Standards are constantly evolving as faster trains are developed and heavier loads are transported. The national rail administration should, therefore, always be contacted for the latest standards and details.

1 UIC (International Union of Railways) reference profiles for kinematic gauges (GA, GB+, GC)

2 New construction gauge (derived from the UIC GC reference profile)
RAILWAYS

UK Structure Gauges and Clearances

Railtrack shall give consideration to passenger safety by limiting the maximum stepping distance from the top edge of the platform to the top edge of the step board or floor of passenger rolling stock.

The following maximum dimensions for stepping distances, calculated from the centre of the bottom of the door opening, shall apply unless dispensation has been sought from HSWMRI for site specific cases relating to identified rolling stock. All such cases must be recorded in writing and maintained for future reference.

- horizontal: 275mm
- vertical: 250mm
- diagonal: 350mm

3 Standard structure gauge

- Centre line of adjacent tracks
- If for standard 6 foot
- Centre line of track
- 1 All dimensions are in mm.
- 2 The minimum dimension of a single face platform shall be 2080mm for speeds up to 165km/h and for speeds greater than 165km/h the minimum dimension shall be 3000mm. The minimum distance to the face of any column shall be 2000mm.
- 3 Relaxation of 1524 (5140) clear area
- 4 As far as practicable this space to be kept clear of permanent obstructions, but may be used for conveying apparatus and bridge girders
- 5 Longitudinal length of approach track for platform gauge and platform at both ends. Note: see note 11
- 6 Vertical clearance from platform rail to underside of bridge for platform gauge. See note 11.
- 7 Boundaries of platform rails and station footbridges which cater for 25kV electrification
- 8 Nearest face of all other structures including masts carrying overhead line equipment of electrified railways
- 9 Nearest face of signal posts and other isolated structures less than 2m in length but excluding masts carrying overhead line equipment on electrified railways
- 10 Vertical clearances to the canopy above the platform shall be 2500mm up to 2000mm minimum from the platform edge or up to 3000mm where the line speed exceeds 165km/h. At distances beyond 2000mm or 3000mm from the platform edge, as applicable, the minimum headroom shall be 2300mm.
- 11 Platform clearances are subject to the maintenance of NMRI stepping distances and specific requirements shall be calculated from the particular kinematic envelope with an allowance made for structural clearance. The minimum lateral dimension is 730mm and is shown for guidance.
- 12 Where reasonably practicable these dimensions shall be increased by 360mm to facilitate the provision of an access walkway in accordance with CR/RT5203 Infrastructure Requirements for Personal Safety in Respect of Clearance and Access.
RAILWAY FREIGHT YARDS

The freight yard is the traditional transfer point for goods being moved using a combination of rail and road transport.

Typical functional buildings and installations are: goods sheds, the freight office building and perhaps a customs hall. The loading yard will usually have end or side platforms and ramps. In addition, loading gauges, sidings for bulk offloading (e.g. coal and oil) and transfer terminals may also have to be installed. And, with the increasing use of standard containers, additional plant such as portal cranes will also be needed.

The effective depths for goods sheds are 10–18m or even 16–24m, depending on the freight to be handled, and they are usually 3.50–5.00m high. They can consist of any number of bays between structural frames, at 5m centres, up to a maximum of 400m.

The width of the platform on the track side of the shed should be at least 3.50m and for the loading dock on the service road side of the shed it is 2.50m. The height in both cases should be 1.20m above the rail level or, alternatively, the road surface of the freight yard. Both platform and loading dock should be covered by a canopy.

The area required for goods sheds depends on the type and size of the goods and also the quantity of goods to be held in the store. To be able to determine the surface area required, the specific area needed for the types of goods involved (i.e. containers, pallets and goods which are not palletised) has to be known. A rule of thumb for values to be used in the calculation of the area requirement is as follows: for small containers with an area of 2m², allow approximately 6.9m²/t; for pallets, each needing 1.2–1.4m², allow 5.6–6.5m²/t; and for goods not on pallets and occupying 0.13–0.2m² each, allow 6.5–10.0m²/t. The exact storage area requirement should only be calculated when planning a particular project. This is done by carrying out a physical count of the quantity of goods to be stored. Peak periods of traffic movements during the week (for instance Saturdays or Mondays) should be taken into account because they can be 25–30% higher than the daily average. Surface area requirements for traffic movements, and also adequate space between the goods in the store, must be determined at the very outset. For small containers this can be 80–100% of the actual space for storage, for pallets 180–210% and for goods not on pallets 100–160% of the storage area.

Examples of goods sheds: A, B, and C with siding outside, D with siding inside

Plan view of a goods shed type A

Plan view, cross-section type C

Plan view, cross-section type D

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RAILWAY STATIONS

The layout of the rooms for push button signal controls should follow the schematic drawings set out below. The control rooms do not have to have windows but all rooms should have a clear room height of ≥2.80 m, with the exception of those for the battery and electrical power. The clear widths for the doors should be ≥1.00 m.

The signal control manager’s room should be near to the relay and telecommunications rooms and a full view out over the track layout must be ensured. The bottom edge of the lintel or window soffit should be 1.60–1.80 m above floor level, with the top of the window sill at a height of 0.40–0.50 m above the floor.

The relay room should have a minimum width calculated using the following formula: 0.23 m wall clearance + 0.66 m per rack + 1.25 m gangway.

SCMR signal control manager's room  
TR telecommunications room  
WC rest room and toilets  
ATCR automatic train control room  
RR relay room  
SCFR signal control foreman’s room  
EPSP emergency power supply room  
CR control room  
BR battery room  
SPS spare parts store  
WS workshop  
FS fuel store  

H heating  
EPR electrical power room  
CTR cable terminal room  
FA first aid room  
DP data processing room  

Equal allocation for signaling equipment  
Protection for people and objects  
Entries and exits  
Ventilation and extraction
RAILWAY STATIONS

Further information: Railtrack PLC

Railway lines frequently pass through small and medium-size towns at street level, in which case the station buildings are on the same level as the tracks. At some small stations in continental Europe (e.g. Rudesheim), access to the platforms for passengers and luggage is achieved by crossing the tracks. Pedestrian tunnels are generally used for medium-size installations, such as Bonn—Cologne. In large terminals there are gently inclined tunnels for both pedestrians and luggage.

An improvement in layout can be achieved by raising the level of the track installation, as at Cologne and Hanover, or by lowering the level as in Darmstadt, Copenhagen and London. This problem of access to the platforms does not arise in terminal stations.

1. Station concourse on one side, at track level; passengers and baggage must cross the tracks (Only for small branch-line installations; not permitted in Britain)

2. As 1 but with tunnel for passengers, staircase access; luggage transported across the tracks (Only for medium-size installations)

3. Concourse on one side, below track level; tunnel for passengers and baggage; staircase and lift access to platforms (Typical, cost-effective solution)

4. Station concourse on one side, below track height; waiting room between the tracks (Suitable for interchange stations)

5. Concourse in the middle, underneath the tracks: short walking distances and good natural lighting for the waiting room

6. Concourse in the middle, underneath the tracks: spacious access via forecourt and short walking distances

7. Concourse over the tracks: acts as a bridge for passengers and baggage

8. Concourse at end of track, where possible at track height (Only suitable for terminal stations)

9. Plan view: workstation layout for open counters

10. Side view: side unit and printer

11. Plan view of a travel centre

12. Pedestrian arcade, Düsseldorf Main Station

Prof. K. Endemann

left luggage office

MFR microfilm reader
VOU monitor
K keyboard
P printer
SU side unit
CU central unit
PU payment unit
1 parcel shelf
2 cash desk
3 cash desk
4 information
5 seating
6 travel centre
7 leaflets
8 destination board
9 waiting room
10 left luggage check-in
BUS STATIONS

Special provision has to be made for the widening of curves to match the turning circles of buses → 2 → 5. Bus stops require shelters and special layouts (see also figures 1–8 on the next page).

Ramps should be provided at the front to allow easy access up to a 30–40 cm high step → 3 → 6. Short-stay car-parking space should be incorporated for passengers on the edge of towns (i.e. park and ride).

<table>
<thead>
<tr>
<th>bus</th>
<th>L</th>
<th>L'</th>
</tr>
</thead>
<tbody>
<tr>
<td>two buses</td>
<td>12.00</td>
<td>40.50</td>
</tr>
<tr>
<td>articulated bus</td>
<td>47.62 (49.05)</td>
<td>50.00</td>
</tr>
</tbody>
</table>

1. **Bus dimensions**

2. **90° turning circuit for 12 m long rigid vehicles**

3. **180° turning circuit for 12 m long rigid vehicles**

4. **180° turning circuit for 17 m long articulated vehicles**

5. **Turning circuit**

6. **Small turn-around station**

7. **Platform on the outside of the turning loop**

8. **Bus stop**

9. **Space requirement for platforms**

10. **Space for parking spaces**

11. **Standard interlocking layout**

12. **Radial layout providing more room at the front**

13. **Platform inside the turning loop**

14. **Semi-circular platform outside loop; no pedestrian crossing necessary**

<table>
<thead>
<tr>
<th>platform shape</th>
<th>without passing lane</th>
<th>with passing lane</th>
</tr>
</thead>
<tbody>
<tr>
<td>platform width (m)</td>
<td>2.2</td>
<td>2.3</td>
</tr>
<tr>
<td>number of loading points</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>area of platform, roadway and arrival spur in m²</td>
<td>200</td>
<td>260</td>
</tr>
<tr>
<td>articulated bus</td>
<td>306</td>
<td>415</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>relation to line of arrival</th>
<th>parallel</th>
<th>at 45°</th>
<th>at 90°</th>
</tr>
</thead>
<tbody>
<tr>
<td>length of parking space (m)</td>
<td>32</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>parking options</td>
<td>3</td>
<td>G</td>
<td>D</td>
</tr>
<tr>
<td>width of parking space (m)</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>width of arrival spur (m)</td>
<td>0.4</td>
<td>0.8</td>
<td>8.0</td>
</tr>
<tr>
<td>parking area incl. roadway area in m² per bus</td>
<td>80</td>
<td>135</td>
<td>140</td>
</tr>
<tr>
<td>articulated bus</td>
<td>110</td>
<td>110</td>
<td>192</td>
</tr>
</tbody>
</table>