Transport for London
Surface Transport

Management System Document – Guidance Note

Design for Signalised Junctions

Document reference: SQA-0643 - Issue: 4

1 Purpose

1.1 The purpose of this document is to provide guidance for the design of signalised junctions in London.

2 Scope

2.1 This guidance note applies to all signalised junctions in London.

3 Guidance Description

3.1 General

3.1.1 The standards outlined in TD50/04 shall apply to all new junctions which are signal-controlled, signalised roundabouts and to all existing uncontrolled priority junctions, which are being modified or improved to operate with signal control.

The advice in this document sets out the standards, design criteria and good practice for Designers when modifying existing signalised junctions. Where signal control is installed for safety reasons and where there are constraints perhaps due to the existing road layout and surroundings (a typical situation

in London), the design standards in TD50/04 should be incorporated where possible.

3.2 Geometric Considerations of Primary and Secondary Signals (see TD50/04, TAL1/06, TAL 2/03)

3.2.1 The Traffic Signs Regulations and General Directions 2016 statutory instrument (TSRGD 2016) requires all junctions to have at least two identical sets of signals facing the traffic proceeding in a particular direction, where one of those is a primary signal (Schedule 14 Direction 4). NB. This does not apply to cycle signals to diagram 3000.2 or 3000.2A - see SQA-0651.

3.2.2 At least one secondary signal shall be provided on each approach so that the signal is visible from the centre of the associated stop line. It should be sited within an arc of 30° to the offside from the centre of the stop line.

3.2.3 Secondary signals typically have the same information as the primary and may have additional information, which must not conflict with that shown on the primary signal. An example is a right turn indicative arrow which in TSRGD 2016 Schedule 14 Part 1 Provision 2(1) and TAL1/06, is considered as an additional aspect.

3.2.4 The secondary signal should be sited no further than 50m from its relative stop line.

3.2.5 Closely associated signals (CASS) should be considered early in the design process as correct use can lead to a reduction in right turning traffic collisions (London Accident Analysis Unit Report ATWP25 and ATWP37).

3.2.6 CASS should always be installed on the approach opposite to one with a right turn overlap facility, unless the approach opposite to the one with a right turn overlap has a prohibited right turn Traffic Regulation Order in place. Providing this approach is signed with the appropriate regulatory box sign, a far-sided secondary signal can be installed.

3.2.7 Where possible, consideration should be given to the reduction of street furniture. Examples of good practice include mounting signals on lamp columns, designing out internal stop lines requiring additional street furniture, and placing multiple signals on a single pole.

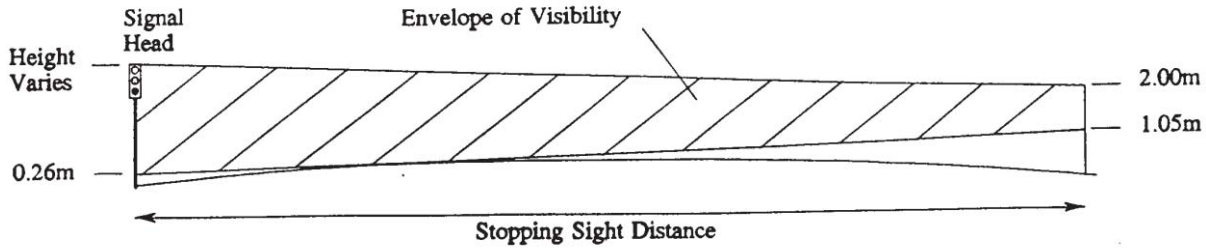
3.2.8 The layout of green arrows on signal heads shall be in accordance with TSRGD 2016 Schedule 14 Part 3.

3.2.9 Each traffic lane shall have a clear vision of at least one primary signal associated with its particular movement. The Desirable Minimum Stopping Sight Distance (DMSSD) is defined in TD50/04 and calculated using Table 3 in TD9/93.

85^{th} percentile speed (mph)	85^{th} percentile speed (kph)	Visibility distance of signals
31	50	70
37	60	90
44	70	120
53	85	160
62	100	215
75	120	295

3.2.10 The traffic signals warning sign (TSRGD 2016 Diagram 543) should be used if the visibility distance is less than this and should always be used where the 85^{th} percentile speed exceeds 50mph (80kph) (Traffic Signs Manual Chapter 4 (2013), Section 8).

3.2.11 The measurement shall also take into account the vertical traffic signal alignment. See figure 2/1



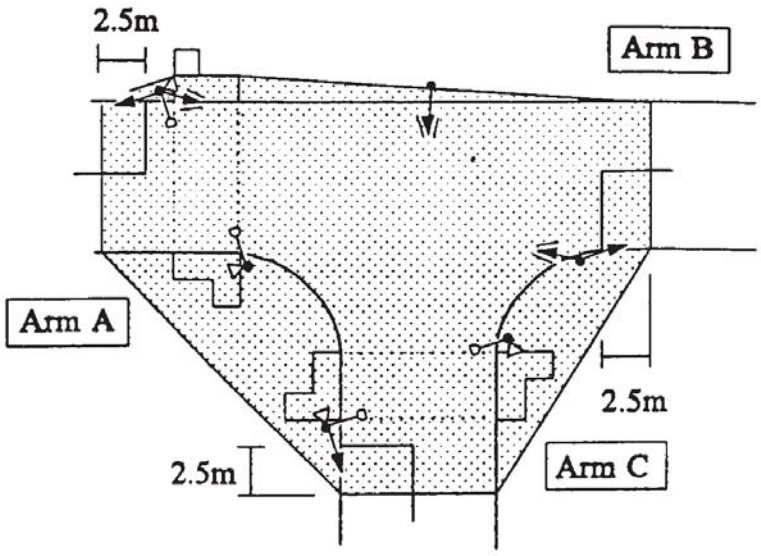
Source: TD50/04 Figure 2/1

3.2.12 Due to historical highway layout it may not be possible to achieve the full DMSSD. Where an approach does not meet the DMSSD, the Designer shall identify the available stopping sight distance and propose the most appropriate signals layout, to maximise the available visibility distance.

3.3 Inter-visibility Envelope (new Junctions)

3.3.1 Designs of new signalised junctions should follow the junction inter-visibility zone guidelines outlined in Chapter 2 of TD50/04. Major obstructions to inter-visibility should be avoided.

3.3.2 The junction inter-visibility zone is defined as the area bounded by measurements from a distance of 2.5m behind the stop-line extending across the full carriageway width for each arm. If an Advance Stop-Line is provided the inter-visibility zone is measured from a point 2.5m behind the cyclists' stop-line. This is because the cycle reservoir behind the Advance Stop-Line does not create any physical impediment to inter-visibility.



Source: TD50/04 Figure 2/2

3.4 Swept Paths Analysis

3.4.1 Adequate turning radii shall be provided by the highway designer for the swept paths of all classes of vehicle using the junction. For new junctions, and geometric modifications of existing junctions, the initial design should include proof that movements can be made by all classes of vehicles that are expected to use the junction (TD50/04 Chapter 2, TD42/95).

3.4.2 Swept paths output shall demonstrate a safe waiting area, where turning vehicles do not overrun:

a) Conflicting traffic movements, such as stop-lines and centre lines

b) Pedestrian / cyclists waiting areas

c) Separation islands

d) Kerb lines

3.4.3 The swept paths should also take into account any issues with clearances to street furniture, including all traffic signal equipment.
NB: For sites with an advance cycle stop line and lead-in cycle lane, the width of carriageway should be taken from the outer edge of the cycle feeder lane and not from the kerb edge when undertaking swept paths analysis.

3.5 Clearance

3.5.1 A minimum horizontal clearance of 450mm must be provided between the edge of the vehicle carriageway and any street furniture (TD50/04 Chapter 4). Additional clearance may be required if the crossfall of the carriageway is greater than 2.5%, at roundabouts or at high speed sites where the equipment is not protected behind safety fencing. At these locations a clearance distance of 600mm is a suggested value but could be increased if the setback does not impede pedestrian routes. Horizontal clearance may be reduced below 450mm if the carriageway is used exclusively by pedal cycles (see SQA-0651).

3.5.2 All signal heads must be installed with a minimum vertical clearance of 2100mm (TSRGD 2016 Schedule 14 Part 2) or 2300mm above a cycle track / shared footway (Traffic Signs Manual Chapter 3 (2008), Section 1). A signal head may be mounted at a maximum height of 6100mm measured to the centre of the amber aspect if the character or layout of the road affects the visibility of the signals (TAL1/12).

3.5.3 Diagrams of signal installations with their dimensions and clearances are given in Appendix A.

Illustration - Pole installed close to kerb line to avoid utility services.
To achieve the necessary 450mm clearance to the signal head a cranked pole was installed.

3.6 Lane Widths

3.6.1 Entry Lane widths should be between 3.0m and 3.65m, unless there are specific reasons for wider or narrower lanes.

3.6.2 If there are a significant number of cyclists a minimum of 4.0m should be provided. Nearside lane widths of 3.2m – 3.9m should be avoided (LCDS 2016).

3.6.3 Consideration should be given to the safety of cyclists when narrow lanes are proposed (TD50/04 Chapter 2).

3.7 Cycle Lanes

3.7.1 Cycle lanes should be a minimum of 1.5m wide (recommended width is 2.0m), provided the adjacent traffic lane does not have fast moving traffic and a high proportion of HGVs, and is not less than 3.2m wide (LCDS 2016 Chapter 4).

3.7.2 Mandatory cycle lanes, bounded by a solid white line require a Traffic Regulation Order. Advisory cycle lanes, bounded by a broken white line, can only be used by other vehicles if safe to do so. Cyclists are normally permitted to use a with-flow bus lane, so a separate cycle lane is not required on such an approach (Traffic Signs Manual Chapter 5 (2003) Section 16, TD50/04 Chapter 4).

3.8 Bus Lanes

3.8.1 Bus lanes should be a minimum of 3.0m wide. However a width of 4.5m is recommended, as this allows a bus to overtake a cyclist without leaving the lane (LTN1/97, LTN2/08, LCDS 2016 Chapter 4).

3.9 Road Markings

3.9.1 Carriageway markings are specified in TSRGD 2016 Schedule 9 Part 6 (mandatory), Schedule 11 Part 4 (advisory), Schedule 14 Part 2 (for traffic control) and the Traffic Signs Manual Chapter 5 (2003).

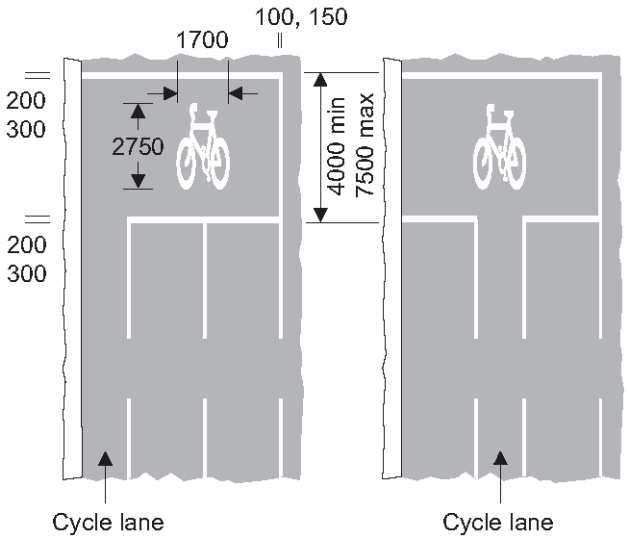
3.10 Stop Lines

3.10.1 The stop line must be a minimum of 200mm wide (300mm wide where the 85th percentile speed of the road is over 35mph) and should be positioned at right angles to the centre line of the carriageway. It should be at least 1.5m from the nearside primary signal but preferably 2.5m (TSRGD 2016 Schedule 14 Part 2, Traffic Signs Manual Chapter 5 (2003), Section 9).

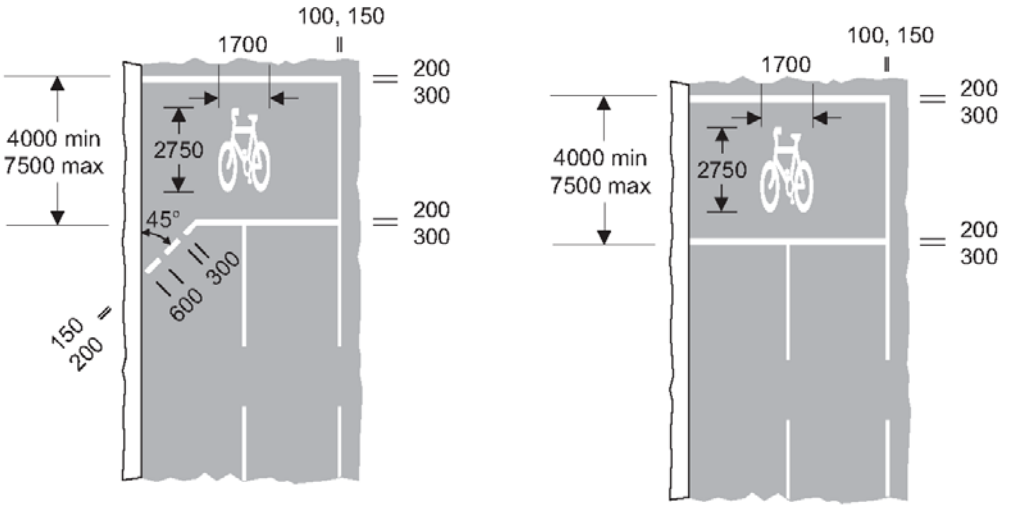
3.10.2 The nearest line of crossing studs should be positioned 0.5m from the nearside primary signal.

3.11 Advance Cycle Stop Lines

3.11.1 Advance Cycle Stop Lines (ASLs) may be placed at signal controlled junctions and standalone crossings (TSRGD 2016 Schedule 14 Direction 33). They are recommended at junctions on the TLRN where there is no off-carriageway cycling provision.



Source: TSRGD 2016 Diagram 1001.2



Source: TSRGD 2016 Diagram 1001.2A (left) & 1001.2B (right)

3.11.2 The length of the reservoir must be between 4.0m and 7.5m, extending across all traffic lanes. The recommended minimum length of the reservoir is 5.0m (LCDS 2016) Part width ASLs still require DfT authorisation.

3.11.3 The recommended distance between the advanced stop line to the studs is between a minimum of 1.7m to a maximum of 3.0m.

3.11.4 A lead-in lane to the ASLs is recommended, with a minimum width of 1.5m, but where this is not possible due to space constraints there can be a narrow diagonal broken line which cyclists may cross to enter the priority reservoir (TAL1/12). Optionally, TSRGD 2016 permits this 'gate' to be omitted (diagram 1001.2B).

3.11.5 The approach cycle lane should normally be located on the nearside of the carriageway, but if there is a significant left turning flow of motor vehicles with cyclists travelling straight ahead, an advisory lane could be positioned centrally. For more details, see the London Cycling Design Standards and SQA-0651 for other options, including Hold the Left Turn.

3.11.6 Other factors that should also be taken into account during design include:

a) Intergreens should always be calculated for the worst case scenario, considering both the vehicle and cycle stop lines, from the furthest to the nearest point.

b) An appropriate method of detection for cyclists.

c) At existing sites where ASLs are being installed, it may be necessary to relocate the existing stop line detection or replace with overhead detection and consider the relocation of any red light cameras.

NB: Intergreens for cycle only movements should take into account the lower speed of cyclists and hence the longer time taken to clear the conflict point.

3.12 Safety Cycle Mirrors

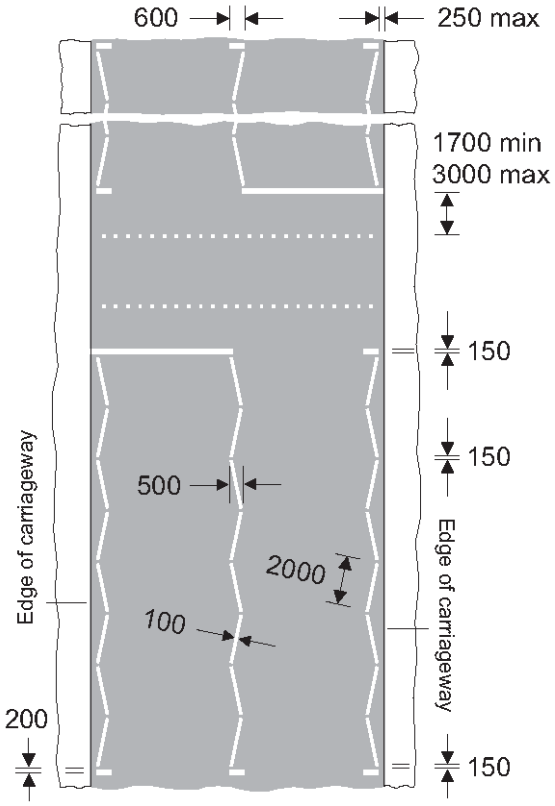
3.12.1 TSRGD 2016 Schedule 14 Part 1 Provision 27 permits the use of 300-500mm diameter mirrors for the purpose of improving road safety for cyclists.

3.12.2 In London, 500mm blind spot safety mirrors have been installed on primary traffic signal poles at junctions with ASLs to give motorists (especially drivers of large good vehicles) a better view of cyclists in the lead-in lane on their nearside and in the ASL box Their use is the decision of the highway designer but may be considered at junctions with ahead and left turn movements where there are high cycle and HGV flows (LCDS 2016)..

3.13 Zig-Zags

3.13.1 Zig-zag markings must only be used at stand-alone crossings. They cannot be used at junctions or on exit streams (Traffic Signs Manual, Chapter 5 (2003), Section 15, TSRGD 2016 Schedule 14 Part 6 Direction 41).

3.13.2 No other road markings are permitted within the zig-zag area, with the exception of cycle markings to TSRGD diagram 1057.



Source: TSRGD 2016, Diagram 1001.3

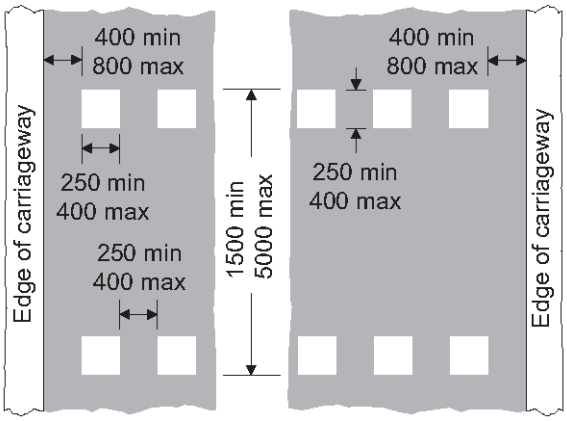
3.14 Yellow Boxes

3.14.1 Yellow box markings may be used at signal controlled junctions or roundabouts where traffic is controlled by signals at all times (TSRGD 2016 Schedule 9, Traffic Signs Manual Chapter 5 (2003), Section 12). However it is recommended that consideration is given to using advisory “Keep Clear” markings where legal enforcement is not necessary (TfL Streetscape Guidance 2016).

3.15 Elephant’s Footprints (markings to TSRGD 2016 Diagram 1055.3)

3.15.1 The markings known as “Elephant’s Footprints” may be used to indicate a route for traffic consisting solely of pedal cycles across a signal controlled junction or parallel crossing (TSRGD 2016 Schedule 14 Part 2 Item 57).

3.15.2 The minimum width of the marked route is 1.5m, up to a maximum of 5.0m.



Source: TSRGD 2016 Diagram 1055.3

3.16 Coloured Surfacing

3.16.1 In London, the following coloured surfacing is in use:

a) Red - Bus Lane or pedestrian crossing zone (installed between crossing studs)

b) Green - Cycle lane or ASL area

c) Blue - Cycle lane or ASL area on a Cycle Superhighway

3.16.2 Some local Highway Authorities have different policies on the use of coloured surfacing and some, notably Westminster City Council do not permit any coloured surfacing.
NB: Coloured surfacing is not prescribed in TSRGD 2016 and has no legal significance.

3.17 High Friction Surfacing

3.17.1 For all new installations on the TLRN, the installed road surface shall meet a minimum Polished Stone Value (PSV) of 68 (HD36/06 Table 3.1) for a minimum of 50m ahead of the stopline on all approaches. The PSV is a measure of the resistance of an aggregate to the polishing action of a pneumatic tyre under conditions similar to those occurring on the surface of a road.

3.17.2 High friction road surfacing may need to be considered where the minimum PSV cannot be met. Where high friction surfacing is required on an approach, the minimum treatment length must be 50m.

3.17.3 On a gradient, or on roads with a speed limit greater than 30 mph, it may be necessary to increase the length of the skid resistant / high friction surfacing beyond the 50m length. Consideration should also be given to extending the surface to the centre of the junction, as this will help to reduce cross-road and right turning collisions (TD 50/04 Chapter 2).

3.17.4 For information regarding the requirements of high friction surfacing that is appropriate to be installed, see HD36/06 (DMRB 7.5.1).

3.18 Traffic Islands/Refuges

3.18.1 Where a pedestrian crossing phase is timed to permit pedestrians to cross a whole carriageway in one movement, then the width of a refuge in the carriageway shall be a minimum of 1.5m (TD50/04 Chapter 4). However, a width of 2.0m is recommended to permit a pedestrian with a pram or wheelchair to wait in safety (LTN2/95, Inclusive Mobility).

3.18.2 Islands that are not used by pedestrians can be reduced to 1.3m wide for a simple 3 aspect signal head or 1.7m if the signal head has a side mounted arrow or box sign, or a double head.

3.18.3 Islands not used by pedestrians located between a vehicle carriageway and cycle track may be reduced to 0.9m, whilst ensuring 450mm clearance to the carriageway (see SQA-0651).

3.18.4 Where there is a staggered pedestrian facility the island should be a minimum of 3.0m wide. This can be reduced to 2.5m if guard railing is not provided on the central island.

3.18.5 Where there is a staggered facility catering for shared-use (i.e. Toucan crossings), the island should be a minimum of 4.0m wide. This can be reduced to 3.5m wide if guard railing is not provided on the central island.

3.18.6 With a staggered pedestrian facility the minimum recommended distance between crossings (i.e. the distance between the inside line of studs on each side of the island) is 4.0m. To reduce “see through” issues, louvred hoods should be considered on the far-sided green figure aspects.

3.18.7 At locations where the central island is very wide, in excess of 7.0m, the stagger can be eliminated. In this scenario, louvred hoods should be fitted to the far-sided green figure aspects.

3.19 Crossing Width

3.19.1 The minimum width of a pedestrian crossing is 2.4m. The recommended width of a Toucan crossing is 4.0m, but absolute minimum is 3.0m. The maximum width of a crossing (from stud to stud lines) is 10.0m, usually dependent on the number of pedestrians expected to use it (TSRGD 2016 Schedule 14 Part 2, TD 50/04 Chapter 4).

3.19.2 The preferred orientation of the staggered crossing is such that pedestrians in the central reserve are facing oncoming traffic as they approach the crossing, but this may not always be possible (TD50/04, Chapter 4).

3.20 Footway Width

3.20.1 It is recommended that a footway has a clear width of at least 2.0m (this allows two wheelchairs or pushchairs to pass one another comfortably). If there is an obstacle, the absolute minimum clear width should be 1.0m for a maximum length of 6.0m (Inclusive Mobility section 3).

3.21 Tactile Paving

3.21.1 Tactile surfaces and dropped kerbs shall be provided where pedestrians are expected to cross an arm of a junction. Tactile paving should be laid in an “L” formation on the extremities of the crossing points, with the upright of the “L” aligned in the direction of the crossing. Tactile paving should not be laid on a pedestrian refuge where pedestrians are intended to cross in one movement (TD50/04 chapter 4).

3.21.2 However, the installation of tactile surfaces is the responsibility of the highway authority who may have their own local policies, examples include not using a “tail” in the “L” formation and matching the colour of tactile paving to the surrounding finish. Further information can be found in the DfT document Guidance on the Use of Tactile Paving Surfaces (DETR 1998).

4 Signalised Pedestrian Facilities At Junctions

(See TAL5/05, LTN2/95, TD50/04 and TA68)

4.1 General

4.1.1 Where signalised pedestrian facilities are being provided, audible and/or tactile devices must be provided for the visually impaired in addition to the Red and Green Man. Tactile devices should be provided as a minimum where it is not possible to provide both (see section 7.7.4 for exclusions). Tactile and audible devices should always operate at the same time as and be interlocked with the Green Man indication. Red Lamp Monitoring must be provided to monitor any vehicle phase that conflicts with a pedestrian phase.

4.1.2 The location of the signal equipment is stated in LTN1/98 ‘The installation of Traffic Signals and Associated Equipment’, but the Designer must assess site conditions before determining the final layout. The TI Engineer shall be responsible for deciding whether far sided, nearside or countdown signals are suitable for use.

4.2 Farside

4.2.1 Farside is the standard type of pedestrian facility to be installed at junctions across London and can be used in conjunction with pedestrian countdown.

4.3 Nearside

4.3.1 Nearside facilities can be installed, but it is recommended that these are only used if in an area where other nearside crossing facilities are installed to reduce pedestrian confusion.

4.4 Pedestrian Countdown

4.4.1 Pedestrian Countdown at Traffic Signals (PCaTS) provides additional information to pedestrians during the blackout period. The PCaTS timer improves pedestrian understanding that the Green Man is only an invitation to cross and is followed by a safe clearance period.

4.4.2 PCaTS may be used at permanent signals installations with far-sided pedestrian or toucan signals with fixed blackout periods.

4.4.3 PCaTS must not be used at Pelican crossings, on crossings with variable blackout periods or with nearside pedestrian facilities (e.g. Puffins).

4.4.4 Timings must be in compliance with SQA-0645 timings for pedestrian countdown and fulfil the below conditions;

- The minimum green man invitation period must be at least 6 seconds.
- The all red period must be fixed at 3 seconds (the remaining intergreen time shall be the blackout period).
- Blackout period is determined by the crossing width as per SQA-0645.
- The blackout period must not be variable, and can only be amended via a change of controller configuration.
- At standalone crossings the preferred minimum blackout value is 4s.

The use of phase delays, introduction of identical clearance periods or a change of stage order may be used to ensure the above.

4.4.5 The designer should consider whether provision of PCaTS at a site is likely to cause confusion or be liable to misinterpretation due to layout or other site specific factors.

4.4.6 PCaTS should not be used with the following obsolete controllers:

- Plessey/Siemens T200 or T400
- Microsense MTC or MPC
- Peek TSC3 or Mk1 Pelican

4.4.7 Each PCaTS must have a separate controller input, with naming convention *Phase-PCaTS-Pole*, e.g. APCATS5.

4.4.8 PCaTS operation should be bound to that of the associated stream via special conditioning;

Lamps on streams/s = Power to PCaTS unit
Lamps off stream/s = No power to PCaTS unit

4.4.9 Upon a PCaTS failure the detector fault bit ‘JM’ shall reply for fault monitoring purposes at junctions with PCaTS; the ‘PM’ bit shall be used at standalone crossings. These bits will reply upon a DFM timeout of a PCaTS

detector input. Where PCaTS are driven by a controller output rather than a switched sign phase, the reply bits will be ‘JD’ and ‘PD’ respectively.

4.4.10 Where PCaTS are installed at a crossing including a green cycle aspect it is recommended that the PCaTS unit is installed on the inside of the crossing.

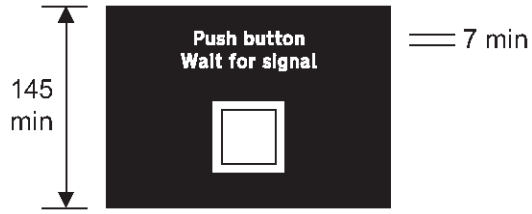
4.5 Push Buttons

4.5.1 In the majority of cases push buttons should be located to encourage pedestrians to look towards the nearest flow of oncoming vehicles, although this may not be possible depending on the layout of the site.

4.5.2 Where audible and/or tactile devices are provided for parallel crossings without the protection of a stop line, 'All Red' extending detectors may be desirable to inhibit the pedestrian signal while vehicles are still on the crossing. If 'All Red' detectors are used in a CLF or UTC region, care must be taken in arranging the group timings in order to prevent stage skipping.

4.5.3 Pedestrian push button units associated with far side signals should normally be mounted at an angle of 45° to the kerb line with the base of the unit 1.0m from the surface of the footway. Where near side signals are used they should generally be mounted at an angle of 25-30° to the kerb line.

4.5.4 TSRGD 2016 authorised the use of small pedestrian push buttons to diagram 4003.8 with farside pedestrian signals. These are the preferred type for all farside pedestrian facilities due to their reduced impact on the streetscape.



Small push button to TSRGD Diagram 4003.8

4.6 Centre Islands

4.6.1 Where central refuges are provided a push button (without tactile unit) should be provided on the most appropriate side. Where the crossing width is greater than 3.2m, consideration should be given to provision of push buttons (without tactile units) on both sides.

4.7 Timings

4.7.1 Pedestrian crossing timings are covered in SQA-0645 Traffic Signal Timings.

5 Signalised Cycle Facilities at Junctions

5.1 General

5.1.1 Where safety considerations, traffic flow, speed or demand provide justification, signal controlled cycle facilities can be used to enable cyclists to cross roads. Cycle facilities can come in the form of Toucans, parallel cycle/pedestrian crossings and segregated / unsegregated facilities (see SQA-0651).

Cycle aspect to TSRGD 2016 Diagram 3000.2

5.2 Parallel cycle and pedestrian crossings

5.2.1 Such layouts should be adopted where there is a high demand by cyclists and/or pedestrians; the segregation helps reduce potential conflicts on the crossing. They are also useful where cyclists approach from a different direction to pedestrians.

5.2.2 If a route through a signalised junction is specifically for cyclists, it may be appropriate to provide “Elephants’ footprints” markings as per 3.15.1, where the cyclists route may not be obvious.

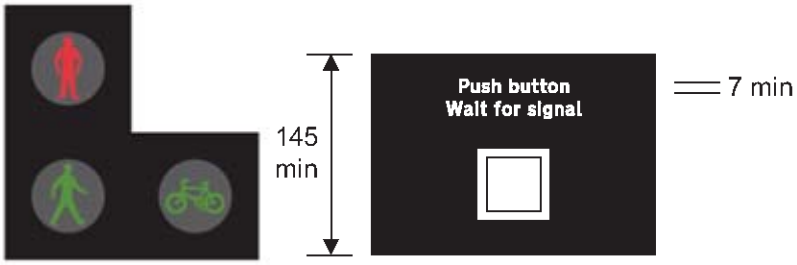
5.2.3 As at other facilities, there should be at least two signals visible from each approach when pedestrian facilities are provided for red lamp monitoring purposes, however this can be reduced to a single signal head if this is not the case.

5.2.4 If a cycle phase is demanded by a pushbutton, only the Toucan push button unit to TSRGD 2016 Diagram 4003.6 or the small push button unit to Diagram 4003.8 may be used.

5.3 Toucan facilities

5.3.1 Toucan facilities should be considered when the flow of pedestrians and cyclists is lower and they are able to share the same area. Footway segregation is created by a feature such as a white line, unless it is a designated shared route, in which case pedestrians and cyclists can mix freely and share the full width of the footway. Further guidance is given in LTN 2/08 Cycle Infrastructure Design and LCDS 2016.

5.3.2 Farside



Farside is the preferred type of Toucan facility installed at junctions across London.

5.3.3 Nearside

Nearside facilities can be installed at junctions, but it is recommended that these are only used in an area where other nearside Toucan crossing facilities are present.

5.3.4 Toucan facilities should be installed to a minimum width of 4.0m, reducing the feeling of overcrowding. Depending on the volume of cyclists and pedestrians this may be reduced to 3.0m or increased to a maximum width of 10.0m.

5.3.5 Dropped kerbs and tactile paving are to be designed by the highway designer.

5.3.6 A push button to the right hand side of the crossing should be provided; push buttons on both sides may be provided if deemed beneficial due to crossing width or volume of pedestrians/cycles. Push buttons should be located so that the front wheel of cyclists does not protrude into the carriageway.

5.3.7 Detection
Where nearside push button units are installed, the use of kerbside and on-crossing detection is optional. These are not required at farsided signals.

5.3.8 Timings
Pedestrian crossing timings are explained in SQA-0645.

6 Equestrian Facilities at Junctions

6.1 General

6.1.1 Information on provision for equestrians is contained in TA57/87, TA68/96 and TAL3/03.

6.1.2 Where specific measures are being considered for equestrians it is important for Designers to recognise that the reaction of horses is not predictable, which can make control difficult for the rider. Designers should consider the effect of such behaviour and other road users when providing specific measures for equestrians. The following measures should be considered:

a) Increase eye height to 2.7m when considering visibility requirements for riders

b) Avoid situating crossing points in soft verges which contain dangerous items such as manholes, gullies and ditches

c) Ensure that there is sufficient verge width to accommodate the horse(s)

d) Avoid excessive use of large road markings on the carriageway or crossing, which can disturb horses

e) Avoid locating crossings where sudden noises are likely to occur

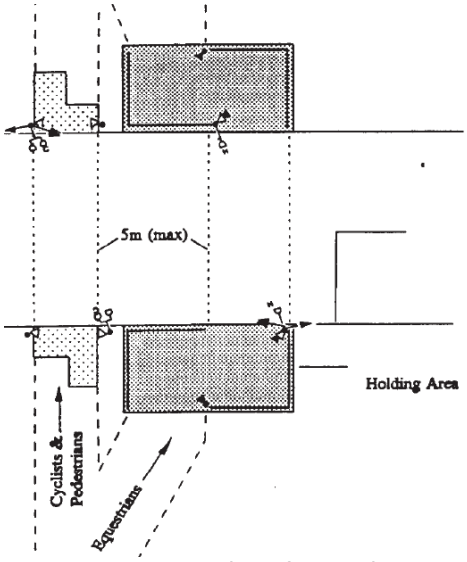
f) Push button units should be installed at 2.0m height for mounted equestrians with additional units at standard height for the dismounted rider leading the horse

g) Staggered crossings are not advised for equestrians

h) Timings should take into account the special needs of equestrians and the additional intergreen period

i) Segregation of equestrians from pedestrians and cyclists. (Source: TA90/05)

6.1.3 The figure below illustrates an example of a segregated pedestrian/equestrian crossing where a bridleway approaches and crosses a single carriageway.



Source: TD50/04 Figure 4/4

Equestrian facility as installed across Roehampton Vale

6.1.4 TA68/96 does not encourage the use of central refuges on single carriageway roads; however where a signalled equestrian crossing is being provided the use of central islands with a single stage crossing may be considered appropriate, to:

a) focus drivers' attention on the crossing;

b) prevent overtaking;

c) act as a speed reduction measure.

6.1.5 TA57/87 recommends that uncontrolled at-grade equestrian crossings of dual carriageways are not provided. When determining the requirements for bridleways, Designers should consider diversions to avoid the need to cross the dual carriageway at-grade. Where diversions cannot be provided, Designers should consult with the highway authority and local equestrian groups.

6.1.6 Consideration during the design process should be given to the fact that although an equestrian facility has been chosen as the appropriate crossing facility it may not solely be used by horse and rider alone and other users should be considered.

6.2 Highway Layout

6.2.1 Equestrian facilities should only be provided where ridden horses are to be accommodated, usually where a bridleway crosses a major route.

6.2.2 It is a common practice to provide a cyclist and/or pedestrian as well as an equestrian crossing facility. Where this is the case the pedestrian/cyclist and equestrian parts of the crossing must be segregated as outlined in TSRGD Schedule 14. A minimum of 3.0m is recommended between the two parts. The prescribed maximum is 5.0m in order to deter drivers from stopping between the two crossings.

6.2.3 Direction on an appropriate layout and materials for holding areas can be found in TA90/05 and TAL3/03.

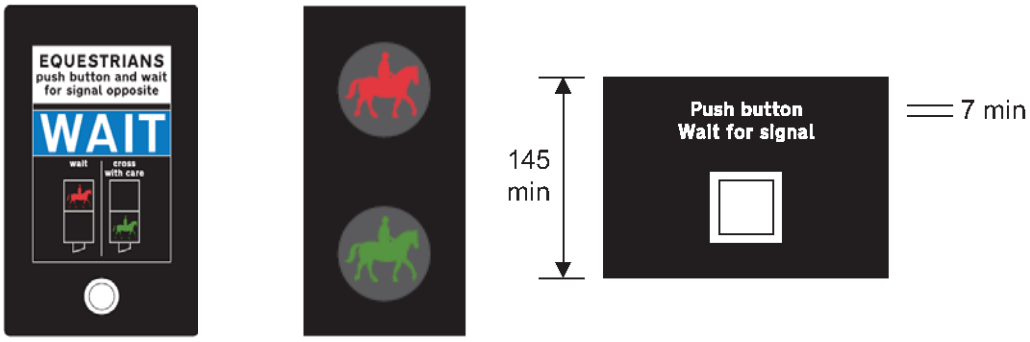
6.3 Push Buttons

6.3.1 As a rider of a horse can be 1.8m from the nose of the horse, it is crucial that any push button is sited sufficiently far enough back from the carriageway edge. It is thought that a minimum of 2.0m is a reasonable minimum distance but depending on the speed of the road and size of vehicles that use the road the Designer should amend this according.

6.3.2 High level repeater units should be mounted at height above ground level, 1.5m to 2.0m range is recommended. Additional push button units can be located some distance from the junction, for example to insert an early demand, or hurry call to a specific stage.

6.4 Legend

6.4.1 Both far sided and near sided equestrian crossing facilities are acceptable although at junctions far sided equipment is recommended.



Farside Signal Equipment

Nearside signal equipment
(Which can be used in conjunction with single demand unit)

6.5 Timings

6.5.1 The timings for Equestrian Crossings are based on those for Toucan Crossings, as per SQA-0645.

7 Equipment

7.1 Signal Poles

7.1.1 The following traffic signal pole variations are available to the Designer:

a) 4.0m standard pole –
This is the most common traffic signal pole used in London.

b) 2.0m short pole –
Used to mount push button unit only.

c) 3.0m pole -
Used to mount Low Level Cycle Signal where no High Level Cycle Signal is present.

d) Formed 4.0m pole –
Used to overcome design limitations, examples include substandard footway width, existing services at proposed signal post location, unfavourable road curvature.

e) 4.25m pole –
Used in conjunction with formed 4m pole, to match the height of the amber signal.

f) 4.85m pole –
Used to help achieve the required signal visibility.

g) 6.0m pole –
Used to install an elevated signal, to further improve signals visibility. Duplicate primary signals are recommended on high speed approaches (TAL12/07).
The Designer should consider using retention sockets and allow for a 1200x1200mm foundation footprint.

h) Mast arms –
Not specified in London due to maintenance difficulties and lack of foundation space. However if they are provided, they must be installed with a minimum clearance of 5.5m from the carriageway (TR2206 appendix E).

i) Removable pole –
Used in locations where special events require the removal of traffic signals equipment.

j) Plated pole –
In situations where it is not possible to achieve the required installation depth, a custom made plated pole can be specified.

7.1.2 If a plate is fitted to the foot of the pole, the minimum dimension must be not less than 0.3m in length for each side (TR2206A Appendix E).

Further information about the installation of traffic signal equipment can be found in TCSU8 Specification for the Installation of Traffic Signals and Associated Equipment.

7.1.3 In order to install and maintain 4.85m and 6m poles a HIAB fitted vehicle is required. This has initial and ongoing cost implications which should be considered during the design stage.
NB: A 4m standard pole fitted with additional bracketry is the preferred option to a 4m formed pole.

7.2 Signal Brackets

7.2.1 If there are footway width restrictions, a signal pole may need to be installed 500mm from the kerb, which would not allow sufficient clearance for the signal head. In this instance the signal head can be side mounted, or installed on a D bracket to achieve the required clearance. Similarly, if the signal pole is installed at the rear of a narrow footway the use of a D bracket will bring the signal head closer to the kerb and therefore make it more visible.

7.2.2 800mm and 250mm D brackets are available. A pedestrian signal head is commonly installed within an 800mm D bracket where this is installed on a pole together with a primary and secondary traffic signal head (see DWG GEN/TTS_6/SIGDIM3A). The 800mm D bracket has sufficient space to accommodate a Toucan aspect or a Countdown unit.

7.2.3 Where both a Toucan aspect and a PCaTS unit need to be accommodated, the combined pedestrian signal head assembly will need to be front mounted on the pole, with the pole set back from the kerb edge to maintain clearances, or a cranked pole used to achieve the same.

7.2.4 250mm D brackets are commonly used at sites with nearside pedestrian facilities to give extra room for the installation of the above ground detectors.

7.2.5 Above ground detectors are commonly supplied with spacer brackets which allows them to be installed above the signal heads or backing boards. Also, a 4-in-line bracket can be used in situations where high sided vehicles strike side mounted detectors.

7.3 Hoods And Louvres (TR2206A, Section 3)

7.3.1 Hoods shall be fitted to traffic signal aspects. The Designer may consider the use of special hoods to avoid “see through” problems. Available permutations include louvred (vertical or horizontal), long and long cutaway hoods. Louvred hoods should never be used on red aspects.

7.3.2 Typically, vertical louvred hoods are fitted to farsided green pedestrian aspects and horizontal louvred hoods are used to mask traffic green and amber aspects. Designers may consider mixing vertical and horizontal alignments, for example, to improve visibility for turning traffic.

7.3.3 When installing special hoods, the correct alignment should be checked at commissioning.
NB: At standalone crossings, the secondary signal shall be fitted with primary hoods.

7.4 Backing Boards

7.4.1 Schedule 14 Direction 5 of TSRGD 2016 allows for backing boards to be fitted to traffic signals.

7.4.2 Backing boards are normally not fitted in London except to LV signals on TLRN roads with speed limits greater than 30mph and on other roads where, in the designer's judgement, there is a problem with the sun on east/west alignments, street lighting or other valid reason.

7.4.3 Backing boards must always be provided with outreach signals on mast arms (TR2206A Section 3).

7.5 Dimming

7.5.1 The dimming facility shall be used on all installations unless specifically requested by the Highway Authority.

7.6 Detection

7.6.1 All vehicle detection shall comply with TOPAS 2505A Performance Specification for Above Ground Vehicle Detector Systems for use at Permanent Traffic Signals Installations, and TOPAS 2512A Performance Specification for Below Ground Vehicle Detection Equipment.

7.6.2 Magnetometer sensors are considered to be below ground detection. Further advice regarding Magnetometer sensors can be found in SQA-0589 Wireless SCOOT Magnetometers: Installation and Commissioning Specification.

7.6.3 Above ground detection is the preferred choice for vehicular detection for both approaching vehicles and those stationary at the stopline. The Designer should consider using two vehicle detectors per approach; an infra-red detector as a stopline detector, and a microwave detector to identify approaching traffic from 40m (TAL16/99). Additional detectors may be required on multi-lane approaches.

7.6.4 If a stopline features separately controlled movements, the Designer should consider additional stopline detection, to differentiate traffic movements.

7.6.5 In order to reduce erroneous demands, the Designer should consider the use of alternative technologies, options include; image, narrow angle and unidirectional detection. It shall be possible to enhance the operation by delaying latched demands or configuring a call cancel logic.

7.6.6 The Designer should consider the extendable all-red facility where traffic flow may be obstructed or impeded. Examples include; parked vehicles close to the junction exit, two lanes into one merge, heavy opposed right turn and an all-round pedestrian movement following the opposed right turn stage.

7.6.7 Detection on high speed approaches shall be below ground systems consisting of Speed Assessment (SA) and XYZ detectors (TAL 5/07) where the site is not under UTC control. Speed Discrimination is not used in London.

7.6.8 For signal controlled installations, high speed is taken to mean a road where the speed limit is 40mph or greater, or the 85th percentile approach speeds at a junction are 35mph or above.

7.6.9 Above ground detectors are not recommended to control any approach to a junction running MOVA (TAL16/99). Speed assessment equipment is not required for MOVA sites.

7.6.10 UTC SCOOT detection shall be a below ground system. On high speed UTC sites where no SA equipment is installed, an additional and permanent 2 second all-red safety period shall be applied to the intergreen.

7.7 Push Buttons Ancillary Equipment

7.7.1 Push buttons shall be installed at all pedestrian crossings, for further details please see Pedestrian Facilities at Junctions Section. Tactile and/or audible units should be included in push buttons unless specific considerations warrant their exclusion, see 7.7.4.

7.7.2 Tactile cones shall comply with TOPAS 2508A specifications and should normally only be installed in the right hand push button when facing the crossing.

7.7.3 For consistency, the tactile unit should be installed on the right hand side of the bottom of the push button unit.

7.7.4 Tactile devices should not be fitted where there is a formal uncontrolled exit leading onto an unprotected signalised pedestrian crossing, or where the controller equipment excludes integral Red Lamp Monitoring facility (TAL5/05 Part 3, TOPAS 2500A).

7.7.5 Audible equipment shall comply with TOPAS 2509A specifications; only a single bleep output shall be used. Bleep and sweep is not used in London.

7.7.6 Audible equipment shall only be installed at junctions where a single phase output controls all pedestrian movements, i.e. an all-round pedestrian stage.

7.7.7 In sensitive residential areas it may be necessary to adjust the volume of audible equipment. Additionally, audible equipment can be inhibited using the time switch controller facility. Typically, audibles are switched off between the hours of 22:00 and 07:00 seven days a week, or other appropriate times.

7.8 Box Signs

7.8.1 There is no requirement for erecting a regulatory box sign to TSRGD 2016 Diagram 606 where an exclusive traffic movement is required at the signals, as indicated by a substitute green arrow. They should only be used in conjunction with a Traffic Regulation Order (TRO) associated with the stopline and attached to each of the primary and secondary signals.

TSRGD Diagram 606 (TL, AO, TR)

7.8.2 The Designer should ensure with the Highway Authority that a TRO exists or is proposed for any box sign associated with the signals.

7.8.3 Ideally a Turn Left (TL) sign should be mounted on the left of the signal head, a Turn Right (TR) sign should be mounted on the right of the signal head and the Ahead Only (AO) sign should be mounted on right hand side of the nearside primary, and on the left hand side of the duplicate primary and secondary signal.

7.8.4 All versions of Diagram 606 may be mounted in 4-in-line configuration under the green arrow.

7.8.5 When required, No Right Turn (NRT) and No Left Turn (NLT) signs should be mounted on the relevant approach, on all signal heads alongside the green aspect. The NRT sign should be mounted to the right of the signal head and the NLT sign should be mounted to the left hand side.

Diagram 612 (NRT)

Diagram 613 (NLT)

7.8.6 If required, No U-turn (NUT) box signs should be provided on the offside of the relevant approach, mounted in line or to the right of the signal head.

Diagram 614 (NUT)

7.8.7 The following exemption plates may be added:

Diagram 954.5 (EB)

Diagram 954.6 (EB&C)

Diagram 954.7 (EBT&C)

7.8.8 Permitted variants are:
For Diagram 954.5 – “Except cycles”
For Diagram 954.6 – “Except local buses” or “Except buses & taxis”
For Diagram 954.7 – “Except local buses & cycles” or “Except local buses & taxis”

7.8.9 See SQA-0651 for further details of regulatory box signs prescribed for use in conjunction with cycle facilities.

7.8.10 It is possible to combine exemption plates with Diagram 606, but only if the green arrow aspect is replaced with a general green signal aspect.

TSRGD Diagram 606 (AO) with Diagram 954.5 bus exemption

7.8.11 In addition to the static Diagram 616 sign, a No Entry (NE) box sign can be installed on the back of traffic signal poles. NE box signs shall be lit and mounted on both sides of the restriction. It is advisable not to install NE box signs if the static Diagram 616 contains exemptions. They should only be used in conjunction with a Traffic Regulation Order (TRO) (DfT Circular 01/2016).

TSRGD Diagram 616 (NE)

7.9 Siting Of Controllers

7.9.1 A controller shall be sited such that its position will allow unimpeded use of the footway by pedestrians, those using wheelchairs or pushing prams. It should allow the outercase door and panels to be opened to their full extent. When the doors are open they should not cause undue obstruction of the footway but there should be sufficient clearance for an operative to work. The controller should not obstruct other street furniture and should not mask waiting pedestrians from approaching vehicles (TD 50/04, Chapter 2).

7.9.2 When the controller is installed on unmade ground a concrete pad or paving should be provided in front of the outercase doors to assist maintenance.

7.9.3 The controller should be sited so that when working at the controller an engineer should preferably be able to view the junction and the stop lines.

7.9.4 Where practicable, allocated parking or a hard standing area should be provided for maintenance company vehicles, particularly at roundabouts and gyratories where the controller may be sited in the middle.

7.10 Electricity Supply Pillars

7.10.1 The Electricity Supply Pillar (ESP) should be located at the back of footway, close to a wall or fence where generally it will be safe from vehicular collision. It must not obstruct the footway or cause a trip hazard to pedestrians. It is not recommended to be positioned against guard railing in case this is removed at a later date.

7.10.2 ESPs should be located so as to allow safe isolation of the equipment following a traffic accident where the controller is damaged. It must not obstruct private property, doorways, accesses or shop windows.

7.10.3 If the ESP is located on the opposite side of the road to the controller, an additional local isolating ESP should be installed close to the controller.

7.10.4 Traffic signal installations are limited to a 2kW incoming supply.

7.11 Maintenance

7.11.1 It is the Designer's duty to consider maintenance issues during the design stage (CDM 2015).

7.11.2 The Designer must consider the impact of future servicing and decommissioning on the operation of the traffic signals equipment.

7.12 Street Clutter

7.12.1 A key component of the TfL Streetscape Guidance is to reduce street clutter. This can be achieved by: mounting signals on street lighting columns; installing equipment tight against property boundaries on narrow footways; ensuring controllers and electricity supply pillars do not create obstructions to pedestrians and ensuring the number of signal poles and heads is not excessive, whilst maintaining safe visibility of the signals.

8 Timing Periods

8.1 Traffic signal controller timings should be as follows:

a) Recommended traffic green signal minimum	7 secs
b) Recommended cycle green signal min (RAG arrangement)	5 secs
c) Green Arrow minimum	4 secs
d) Minimum traffic to traffic intergreen	5 secs
e) Minimum intergreen prior to early cut-off	4 secs
f) Mandatory leaving amber (TOPAS 2500A)	3 secs
g) Mandatory starting amber (TOPAS 2500A)	2 secs
h) Minimum red signal duration presented to traffic	3 secs
i) Dummy phase minimum	1 sec
j) Minimum “blackout period” (TOPAS 2500A)	3 secs
k) Minimum farside green man signal (TAL5/05)	6-12 secs
l) Minimum nearside green man signal (TAL5/05)	4-9 secs
m) VA extensions for XYZ loops normally	1.6 secs
n) VA extensions for MVDs normally	0.4 secs

8.2 Extension values should be determined following site observations as traffic composition and behaviour may affect the values.

8.3 Maximum recommended cycle time (TAL1/06) 120 secs

8.4 RSM OD-OM decides the appropriate cycle time. For MOVA sites, the TOTALG should not exceed 120 secs. At signal controlled roundabouts a shorter cycle time of 60 seconds or less is recommended (LTN1/09).

8.5 Other considerations –

8.5.1 When deciding on the most appropriate cycle time, pedestrian density, behaviour and waiting times should be considered. In busy pedestrian areas, the recommended maximum cycle time is 90 seconds.

8.5.2 Pedestrian Countdown at Traffic Signals Junctions (PCaTS) – Road Trial Report (TRL Project Report, TfL 2481) found over 54% of pedestrians crossed within 5 seconds of arriving at a crossing, 70% crossed within 15 seconds and 85% within 30 seconds, regardless of the pedestrian signal being displayed. Although it isn't illegal for pedestrians to cross while the red man is showing, in 2010, 20% of all fatal and serious pedestrian injuries in London took place near pedestrian crossings.

8.5.3 There is flexibility in the interpretation of the green man invitation period for signal controlled junctions. The following statement is the basis for pedestrian timings and is consistent with DfT guidance.

"Pedestrian timings should enable waiting pedestrians (who commence their crossing at some point during the invitation period) to cross the carriageway in a single movement, without stopping or turning back. Waiting pedestrians are further defined as the standing queue of pedestrians as observed at the start of the green man"

The process that determines the pedestrian invitation timings can be found in SQA-0645 "Traffic Signal Timings".

8.5.4 Intergreens – See SQA-0645.

9 OFFSET CROSSING POINTS

9.1 Offset crossing points are often used to increase junction capacity. It is important to consider the safety aspects of such installations and ensure the release point is correctly configured in the controller.

9.2 Such crossing facilities should be sited so as to give sufficient visibility of signals to vehicles turning onto the crossing, and to provide sufficient stacking space, so as not to impede other traffic streams. The Designer must also consider see-through issues and the potential for driver confusion caused by the multiple signal sets.

9.3 TI Engineers shall determine the safe release point of the pedestrian movement and include linking measures in the controller specification. The decision shall be taken following site observations, modelling outcome and discussions with RSM OD-OM Engineers.

10 Choice of Method of Operation

10.1 General

10.1.1 It is important the Designer considers the strategic policy framework (e.g. Mayor's Transport Strategy) and, where possible, incorporate the requirements of all highway users including pedestrians, cyclists, persons with specific mobility requirements and public transport. It is worth noting that the Traffic Management Act 2004 (Part 2, Section 31) considers pedestrians as traffic.

10.2 Central/Local Operation

10.2.1 In London, a large proportion of junctions operate under Urban Traffic Control (UTC) (or central computer control) using the Split Cycle Offset Optimisation Technique (SCOOT). The decision as to whether a site should operate UTC SCOOT is made by RSM OD-OM during the design process.

10.2.2 In situations where UTC mode is configured in the traffic signals controller, this shall be the highest mode of operation with a fallback mode being either

Cableless Linking Facility (CLF), Vehicle Actuation (VA), or Microprocessor Optimised Vehicle Actuation (MOVA). It shall be possible to mix fallback modes, for example, CLF mode operating during the peak periods and MOVA or VA modes during the off peak period, or at night.

10.2.3 SCOOT information is provided by RSM OD-OM and includes detector locations and the necessary infrastructure. Cabled systems require ducting information; wireless systems require street furniture information for the transmission units.

10.2.4 In areas outside central computer control, RSM OD-OM makes the decision as to the most appropriate mode of operation. VA mode should be considered first, as it is a flexible and easy to maintain system. MOVA should be considered on high volume, multi-lane approach routes; locations with red compliance problems; sites where 85th percentile approach speeds are 45mph or higher; roads with a 50mph speed limit and sites where additional capacity is required (TD35/06).
NB: Compact MOVA (CMOVA) is an alternative system to full MOVA. Trials have shown that, although not quite as effective as a full MOVA system, Compact MOVA is capable of reducing delay compared with traditional VA (TAL1/06 Part 2 of 4) at reduced cost relative to a full MOVA installation.

10.2.5 In VA mode a minimum of four MAXSETS shall be determined. An example of best practice is shown below.

MAXSET A – AM peak (typically 06:00-09:30)
MAXSET B – off peak / lunch time
MAXSET C – PM peak (typically 15:00-19:00)
MAXSET D – overnight

10.2.6 In CLF mode, the following RSM OD-OM convention should be followed.

Plan 1 – AM peak
Plan 2 – Off peak
Plan 3 – PM peak
Plan 5 – Overnight
Plan 8 – Late evening

CLF plans will need to replicate the UTC plans as closely as possible, and these plans will be provided as part of the SQA-0448 process.

10.2.7 Additional MAXSETS and CLF plans are available and can be used for special events, at the weekends, outside schools etc.

10.2.8 It is preferable to determine Stage 1 as the major road. Best practice allocates the pedestrian stage early in the controller cycle with side roads appearing last.

10.2.9 Prohibited/Ignore/Via moves should be used to prevent unsafe stage changes, for example through incorrect termination of a right turn indicative arrow or filter signal, or where there is a possibility of the controller locking up.

In Manual mode, ‘stages shall be served as requested by the operator’ (TOPAS 2500A) and prohibited moves must be defined in a stage moves matrix for this mode. Any condition that would prevent a stage in other modes shall also be inhibited.

10.2.10 Stage revert facility should be configured in all controllers. In the absence of demands, the controller should rest on the main stage (typically Stage 1), or the controller all-red stage (typically Stage 0). Reversion to an all-red stage should be considered on shuttle working sites or high speed roads where approach speeds are a concern. However, on multiple lane approaches, swift changes from a red signal may pose a threat to crossing pedestrians.

10.2.11 The controller start up sequence shall be run every time signals are restored and include the manual panel lamps on/off switch. For details of the sequence, see TOPAS 2500A.

10.2.12 The start up stage should run the main traffic movements, on high speed roads this should be the stage with the highest approach speeds. For roundabouts, circulatory traffic movements should be included.

10.2.13 The Holiday Clock facility can be used to determine special timing sets e.g. Christmas, Easter, holiday periods and one off events. Examples of use are supermarket junctions, junctions at out of town shopping centres and other busy shopping locations during Christmas.

10.3 Leaving amber link (L/A) –

10.3.1 For all locally controlled sites where the controller is running MOVA/VA/Fixed Time/CLF/Hurry Call/Priority modes the L/A link shall operate on a permanent basis. The L/A link conditioning shall include a statement to call the relevant demand dependent stage (or phase) associated with the L/A release window. This is achieved by inserting an additional controller demand.

10.3.2 An exception to the above are Manual and Linked Fixed Time modes, where the L/A stages are defined in the multi-stream operation with their appearance fixed and associated with the main stream stages.

10.3.3 For centrally controlled sites, RSM OD-OM Engineers may override this facility by transmitting the relevant UTC control bits. However, once UTC control is lost, the controller shall revert back to the L/A link facility.
NB: It is advisable not to include offset pedestrian crossings in CLF plans.

10.3.4 The TI Engineer should attempt to design out the use of the override timer, but where this is unavoidable the Engineer must ensure the override timer value is greater than the maximum possible cycle time.

10.4 Early Cut Off/Late Start Operation

10.4.1 Early cut-off operation (e.c.o.) is acceptable, but only if the opposed movement

a) Features a closely associated signals layout; or
b) Has a prohibited right turn Traffic Regulation Order and is enforced by box signs; or
c) Has no possible right turn movement.

10.4.2 Late start operation is not permitted in London except when applied in specific circumstances, such as where the approach with the early start is not able to turn right; either due to road layout, or the right turn movement being prohibited by means of a Traffic Regulation Order.

11 Modelling

11.1 The detailed analysis of the performance of a traffic signalled junction is helped by the use of modelling programs such as Linsig, Transyt or Vissim. The use of a computer modelling program shall always be considered as an aid to the design of an individual junction or network. Additional factors must be taken into account to achieve a good design, such as turning radii, lane widths, visibility, signing, environmental considerations and specific site knowledge.

11.2 Scheme promoters are expected to provide the necessary information and liaise with RSM OD-OM Engineers throughout the Modelling Audit Process (Traffic Modelling Guidelines, TfL).

11.3 The Model Auditing Process (MAP) is designed to give a common structure for all model submissions and is made up of six common stages:

Stage 1- Scheme & Network Scope Checkpoint Meeting
Stage 2 - Calibrated Base Model Submission
Stage 3 - Validated Base Model Submission
Stage 4 - Proposed Models Checkpoint Meeting
Stage 5 - Proposed Models Submission
Stage 6 - Submission of Traffic Signal Supplementary Report to Promoter

11.4 Specific MAPs are available for Linsig (LMAP), TRANSYT (TMAP) and VISSIM (VMAP) modelling software.

11.5 The TI Engineers and RSM OD-OM Engineers shall complete SQA-8448 forms for all projects requiring a revised traffic signals controller specification. The information includes proposed staging, operation and safety timings, and is essential for a successful MAP Stage 5 submission.

11.6 Once the proposals are approved, and the SQA-8448 form has been jointly signed by TI and RSM OD-OM, the TI Engineer can then complete the traffic signals design and progress the scheme through to installation.

12 Additional Controller Features

12.1 It is possible to incorporate third party equipment within traffic signals controllers and allow the traffic signals controllers to interact with such equipment or simply forward on the relevant messages. Examples of successful deployment of third party equipment include, access control, railway crossings, security and emergency services display panels.

12.2 All third party equipment requires a common interface point that is accessible to all parties, often this is a separate cabinet fitted with key operated locks available to all maintenance contractors.

12.3 If third party equipment is to be deployed, the Scheme Promoter is required to provide TI Engineers with copies of the relevant approvals and ensure TI Engineers' early involvement at the design stage.

12.4 At critical UTC junctions, RSM OD-OM Engineers may specify additional control measures, these include:

a) UTC Controllable All Red stage -
The UTC all red stage is configured in addition to the controller all red stage.

b) Contingency stages -
Often these are repeated stages with restricted movements (with certain pedestrian or traffic phases omitted). TI Engineer shall make the final decision as to which stage to stage movements are allowed and which should be prevented.

c) Traffic Management measures (ATM, SASS, Queue detection, SCOOT Gating) -
The use of additional detection allows RSM OD-OM Engineers to run different plans, for example, to hold traffic away from the congested town centre, or to deal with a public event.

13 Traffic Signals Controller Specification

13.1 All traffic signals controller equipment shall comply with TOPAS 2500A requirements. For traffic signal installations, the System Requirements Specification (TA84/06) is provided by the controller specification. In London, all junction controller specifications must be audited before being issued to the equipment manufacturer, further details of the auditing process can be found in SQA-0646.

13.2 Extra Low Voltage (ELV) controllers powering LED signals should be specified for schemes where a new controller is required.

13.3 The following controller facilities are available:

a) Manual mode -
All controller stages shall be configured with the exception of ad-hoc/contingency stages. Only suitably qualified personnel shall have access to Manual Panel operation (Handset command restriction).

b) UTC mode -
London uses a bespoke front end SCOOT UTC system, based on MCE0360C and MCE0361A principles. The associated controller hardware must conform to TOPAS 2523A specifications. A dedicated telecommunications data line is required for communications.

c) Cableless Linking Facility (CLF) -
The majority of CLF plans use immediate, demand dependent and hold stage influences. Additional influences can be used to optimise junction performance. An example of such use is the VA logic within CLF, allowing controllers to terminate a stage early or add another stage.

Traffic detection is required when employing VA logic within CLF.

d) Vehicle Actuation -
The majority of traffic approaches should feature ‘demand and extend’ controller inputs. Exceptions include private accesses, cycle movements etc.

If VA mode is the normal mode of operation, it is good practice to provide at least two controller inputs per traffic phase.

e) Fixed Time to Current Maximum -
This is available as a fall back mode which enables demand dependency for stages and phase maximums consistent with the timetable.

f) Fixed Time mode -
Simple Fixed Time and Linked Fixed Time are an alternative fall back to Fixed Time to Current Maximum. There is no demand dependency for stages as the stage sequence is fixed.

g) Light Rapid Transport (LRT) mode -
Used on Croydon Tramlink, a 28.2km light rail system running a mixture of street track shared with other highway users, dedicated track in public roads, off-street track, and one section shared with a third rail electrified Network Rail line. The requirement for the use of tram priority is outlined in Croydon Tramlink Act 1994.

Only suitably qualified personnel are allowed to work on Croydon Tramlink.

h) VA Priority mode –
Used by iBus equipment to provide selective vehicle priority at locally operated junctions.

VA Priority facility is not used in UTC.

i) Hurry Call mode –
Used to help Emergency Services, and in situations where progression is an overriding consideration.

j) Part time mode –
The mode is controlled either via a time switch or queue loop logic.

k) Integral Monitoring Unit (IMU) –
All locally controlled traffic signal installations require a Public Switched Telephone Network (PSTN) telephone line and IMU.

l) Lamp monitoring –
All junction controllers shall be capable of red and general lamp monitoring. Red lamp monitoring shall be used with pedestrian phases and configured to disable the appearance of the green man (TOPAS 2500A).
At roundabouts, part time and shuttle working installations, red lamp failure shall extinguish all lamps.
All box signs shall be monitored with failures generating a lamp fault.

m) Detector Fault Monitoring (DFM) –
All detection shall be monitored for failures. The following periods are typical values used in London:

i) Traffic detection: 30 mins active, 18 hours inactive (72 hours for car parks etc.)

ii) Push button units: 30 mins active, 96 hours inactive (extendable to 255 hours if required)

iii) Pedestrian detection: 60 mins active, 18 hours inactive

iv) iBus controller input: 3 mins active, 168 hours inactive

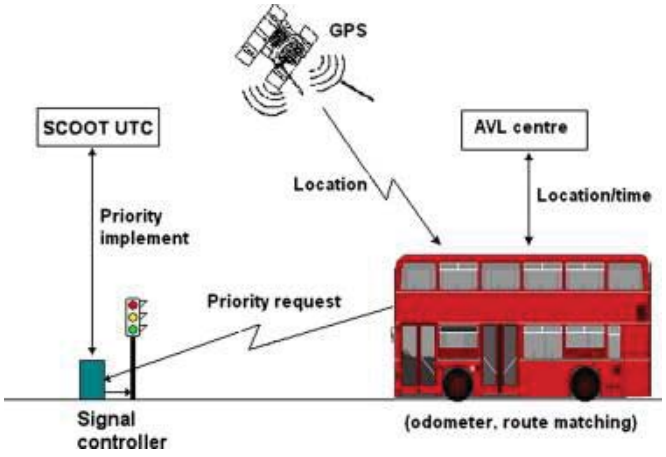
v) PCaTS DFM controller input: 15 mins active, inactive disabled. PCaTS inputs need to be inverted (open circuit active).

n) Ripple change facility – Not used in London.

14 Special Facilities

14.1 Public Transport Priority

14.1.1 In London, public transport priority is based on automatic vehicle location (AVL), also known as iBus. iBus equipment belongs to TfL Buses and is installed in traffic signal controllers at junctions.



14.1.2 iBus traffic signal equipment is designed to wirelessly communicate with the approaching bus and interface with the traffic signal controller. The traffic signals controller specification defines the level of priority and allows either the extension of green signal, should a bus be detected, or permits a recall of the green signal should the signal be on red. In situations where there are too many buses, for example near bus garages, it is possible to impose constraints at certain times of day.

14.1.3 If there are bus routes passing through a junction, TI Engineers shall follow a site suitability process to determine if bus priority is necessary, and incorporate bus priority details in traffic signal controller specifications.

14.1.4 At junctions where there is existing iBus equipment installed, as part of site works, TI Engineers shall ensure the equipment is transferred and left in an operational state following the works. At standalone crossings, any existing iBus facility is to be removed and notification of removal sent to SVD iBus@tfl.gov.uk.

14.1.5 For brand new junctions, TI Engineers shall incorporate the design / procurement / installation and commissioning of iBus equipment into the traffic signal works. All costs associated with the additional equipment shall be covered by the Scheme promoter.

15 Light Rapid Transport (LRT)

15.1 'Tramway' refers to a system of transport used for the carriage of passengers, employing parallel rails which provide support and guidance for vehicles carried on flanged wheels.

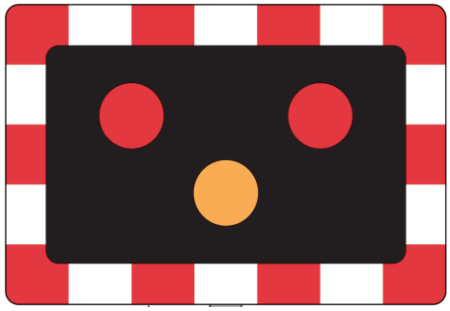
15.2 When tramways are incorporated into traffic signals layouts, additional controller facilities shall be configured in the controller. The LRT mode needs to be set as the higher mode of operation offering a form of priority over other road users. The level of priority is agreed between the tram operator, the highway and traffic authorities.

15.3 Tram aspects must conform to TSRGD 2016 Diagrams 3013, 3013.1, 3013.2, 3013.3, 3013.4 and 3013.5, and can be mounted next to traffic signals as prescribed in TSRGD 2016 Schedule 14 Part 3 Diagrams A-D.

15.4 More information on tramways design can be found in Guidance on Tramways published by the Office of Rail Regulation.

16 Wig Wags (TAL1/08)

16.1 TSRGD 2016 Schedule 14 Part 2 Item 5 permits the use of Diagram 3014 for the control of road traffic at level crossings, swing or lifting bridges, tunnels, airfields or in the vicinity of premises used regularly by fire, police or ambulance service vehicles. A narrower version of the Wig Wag signal is available (NP 3015) but needs sign authorisation.



TSRGD Diagram 3014

16.2 TOPAS 2513A Performance Specification for Wig Wag Signal Control Equipment outlines operational requirements.

16.3 Wig Wags installation is very similar to traffic signalled junctions, using 4m standard poles and a junction controller running a special Wig Wag configuration. The Designer shall adopt the junction design process when working on a new Wig Wag installation.

17 Relevant Documentation

The Traffic Signs Regulations and General Directions 2016
Construction (Design and Management) Regulations 2015 (CDM 2015)
Croydon Tramlink Act 1994
Design Manual for Roads and Bridges (DMRB)
DfT Circular 01/2016 The Traffic Signs Regulations and General Directions 2016
Disabled Persons Act 1981
Greater London Authority Act 1999
Guidance on the use of tactile paving surfaces (DfT 2007)
Guidance on Tramways (ORR)
HD 28/15 Skidding Resistance
Inclusive Mobility: A Guide to Best Practice on Access to Pedestrian and Transport Infrastructure (DfT 2002)
London Accident Analysis Unit Report ATWP25 and ATWP37
London Cycling Design Standards
LTN1/09 Signal Controlled Roundabouts
LTN1/86 Cyclists at Road Crossings and Junctions
LTN1/97 Keeping Buses Moving
LTN1/98 The Installation of Traffic Signals and Associated Equipment
LTN2/95 The Design of Pedestrian Crossings
LTN2/08 Cycle Infrastructure Design
MCE0181 Issue A Siting of Inductive Loops for Vehicle Detecting Equipments at Permanent Road Traffic Signal Installations
MCE0360 Issue C: Urban Traffic Control Functional Specification
MCE0361 Issue A: High Capacity Data Transmission System for use In Urban Traffic Control Systems
Signing the Way (DfT Traffic Signs Policy Paper October 2011)
TA 57/87 Roadside Features
TA68/96 The Assessment and Design of Pedestrian Crossings
TA90/05 The Geometric Design of Pedestrian, Cycle and Equestrian Routes
TA91/05 Provision for Non-Motorised Users
TA12/07 Traffic Signals on High Speed Roads
TAL1/06 General Principles of Traffic Control by Light Signals
TAL1/08 Wig-wag Signals
TAL2/03 Signal-control at Junctions on High-speed Roads
TAL3/03 Equestrian Crossings
TAL16/99 The Use of Above Ground Vehicle Detectors
TD9/93 Highway Link Design
TD42/95 Geometric Design of Major/Minor Priority Junctions
TD50/04 The Geometric Layout of Signal-Controlled Junctions and Signalised Roundabouts
TD 35/06 All Purpose Trunk Roads MOVA System of Traffic Control at Signals
TfL Safety Cycle Mirror Installation Method
TfL Traffic Modelling Guidelines
TfL Signal Design Memorandum – No.002 ASL to Stud Distances on Cycle Routes

17 References (continued)

TfL Signal Design Memorandum – No.003 Monitoring of Box Signs
TfL Streetscape Guidance 2016: A Guide to Better London Streets
TR2206A: Specification for Road Traffic Signals
TOPAS 2500A: Specification for Traffic Signal Controller
TOPAS 2505A: Performance Specification for Above Ground Vehicle Detector Systems for use at Permanent Traffic Signal Installations
TOPAS 2508A: Performance Specification for Tactile Equipment for use at Pedestrian Crossings
TOPAS 2509A: Performance Specification for Audible Equipment for use at Pedestrian Crossings
TOPAS 2513A Performance Specification for Wig Wag Signal Control Equipment
TOPAS 2523A: Traffic Control Equipment Interfacing Specification
Traffic Signs Manual Chapter 3 regulatory signs (2008)
Traffic Signs Chapter 4 warning signs (2013)
Traffic Signs Manual Chapter 5 road markings (2003)

18 Structure

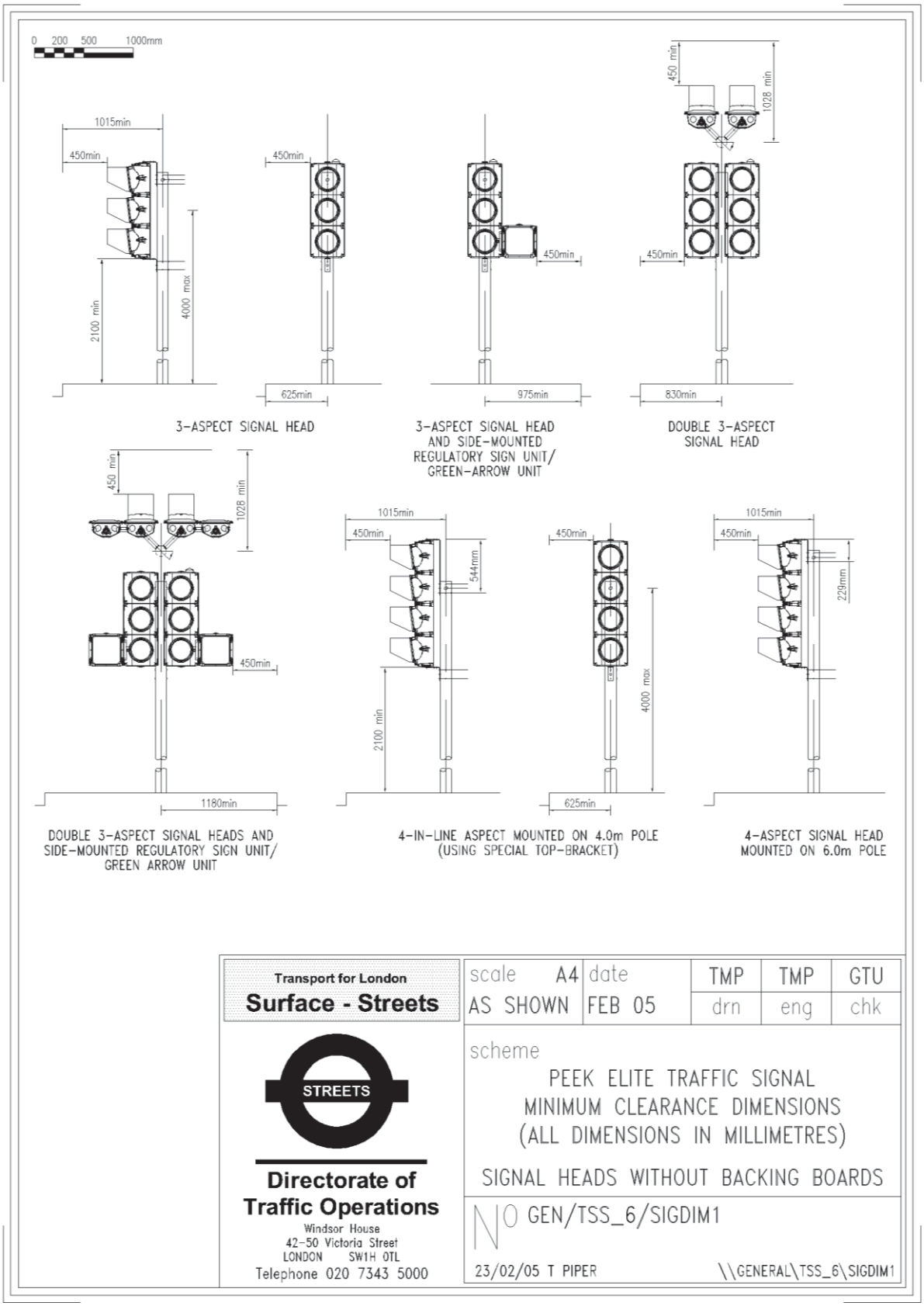
The documents listed below form a set of guidance and procedures for the design of traffic signals and signal junctions in London:

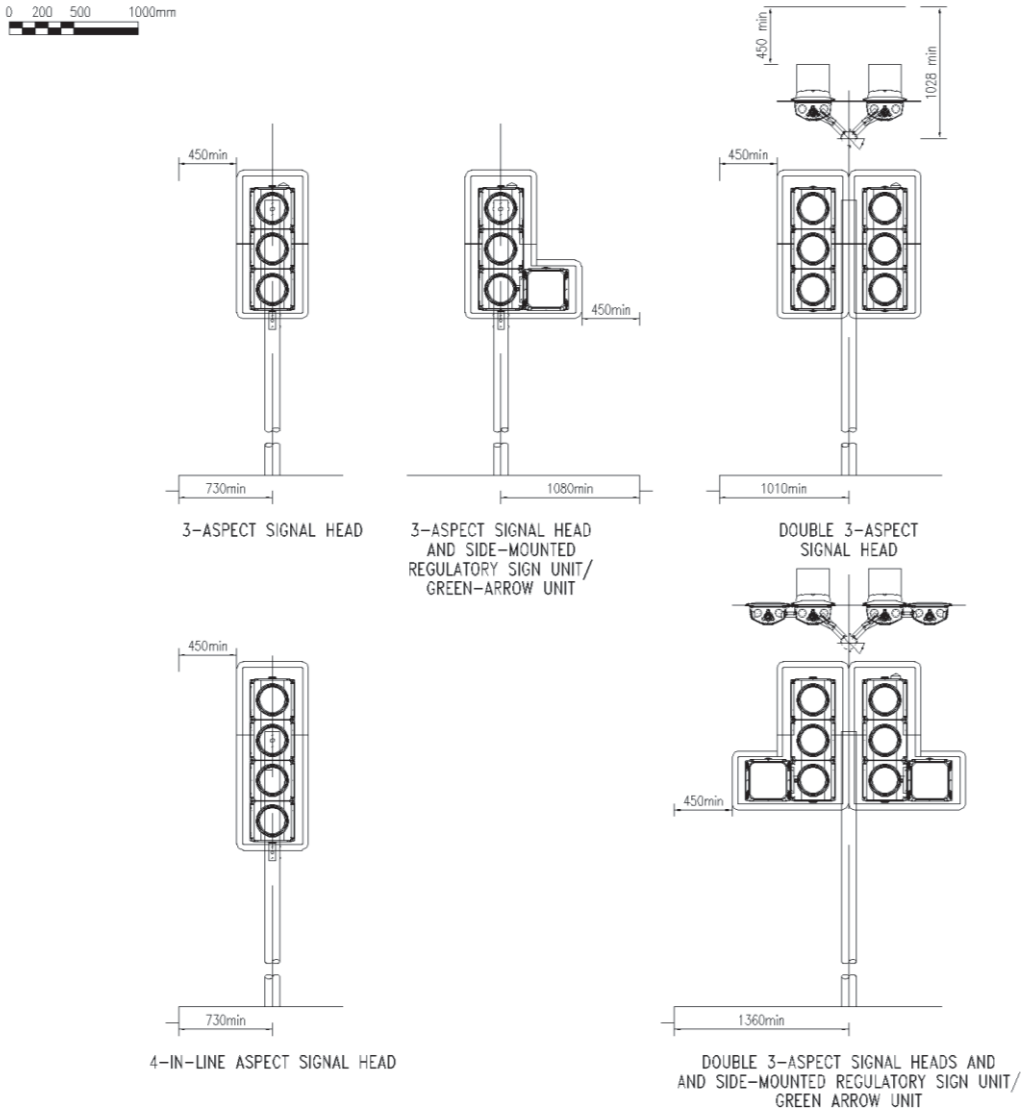
SQA-0640	Policy, Standards and Guidance to Procedures for the Design of Traffic Signals
SQA-0641	High Level Process for the Design of Traffic Signals
SQA-0642	Client Requirements
SQA-0643	Design for Signalised Junctions
SQA-0644	Design for Stand Alone Crossings
SQA-0645	Traffic Signal Timings
SQA-0646	Safety Auditing of Signal Schemes
SQA-0647	Justification for Traffic Signals
SQA-0648	Documentation for the Design File
SQA-0651	Design of Traffic Signal Control for Pedal Cycles

19 Document Control

Issue	Date	Change Summary	Author	Checker	Approver
1	June 2013	Previously incorporated in SQA-0064. Issued for use.	K Van Tuyl	S Poole	A Scriven
2	Aug 13	Revised following consultation	K Van Tuyl	S Poole	A Scriven
3	Dec 13	Reference to TD amended to RSM, TI (Signals) to AMD	R Pierson	J Fraser	J Fraser
4	Nov 16	Revised and updated for incorporation into new QMS.	R Booth (Principal Traffic Control Engineer (acting) – TI P&M)	R Hack (Senior Traffic Control Engineer) J Pulker & N Pompilis (Principal Traffic Control Engineers - TI Signals)	B Sleight (Chief Engineer (acting) - TI Signals)

Appendix A - Traffic Signal head arrangements and clearances.





Transport for London
Surface - Streets

STREETS

Directorate of Traffic Operations

Windsor House
42-50 Victoria Street
LONDON SW1H 0TL
Telephone 020 7343 5000

scale	A4	date	TMP	TMP	GTU
AS SHOWN		FEB 05	drn	eng	chk

scheme

PEEK ELITE TRAFFIC SIGNAL
MINIMUM CLEARANCE DIMENSIONS
(ALL DIMENSIONS IN MILLIMETRES)

SIGNAL HEADS WITH BACKING BOARDS

NO GEN/TSS_6/SIGDIM2

23/02/05 T PIPER \\GENERAL\TSS_6\SIGDIM2