

## Control of Movement

This section, together with the information [here](#) provides guidance on the control of tram movements on a tramway.

The guidance below is in line with best practice.

The movement of trams need to be controlled in order to prevent collisions and also to prevent potential derailments on points and crossings and at other high risk locations.

Line of sight driving is normally used on tramways. Under this mode, a tram should be able to stop before a reasonably visible stationary obstruction ahead from the intended speed of operation, by using the service brake. Such obstructions include a signal displaying a Stop aspect, or the point's indicator displaying an inappropriate aspect for the intended or expected route etc. A documented assessment should be undertaken that includes (not exclusively):

- the available sighting distance
- the intended speed of operation
- the braking performance of the tram, taking into consideration the gradient and tram brake equipment response time
- the effectiveness of the tram headlamps and any illumination of the track if it is intended to operate in darkness in unlit areas
- the expected driver reaction time, which will depend upon what other actions the driver is expected to be carrying out at the location
- the visibility and clarity of signals and points indicators
- the topology of the surrounding area including side roads / walkways
- surrounding amenities, such as mainline rail stations, playing fields, schools, residential care homes
- the geometry of the tramway alignment
- the provision of any form of active warning system, and
- areas of low adhesion potential.

## Bi-Directional Single Line Sections

There is no requirement for signalling to be provided where the visibility has been assessed and is considered adequate from one end of a single line section to the other. In such circumstances, the driver can be adequately relied upon to assess whether a tram in the opposing direction has entered, or is about to enter, the single line section.

In the case of no signals being present, a rule regarding precedence of occupation of the section is appropriate and should be reinforced by signs.

Where the distance of the single line section exceeds the driver's forward visibility or geometry or structures intervene, then signalling controls should follow highway principles for directionality. If necessary, these should be reinforced by SPAS (Signal Passed at Stop) indicators to show that a tram has entered an occupied section from the opposite direction.

The operation of trams in single track sections should always remain as line of sight, and drivers should be prepared to stop on seeing an approaching tram. They are not required to have a level of safety integrity commensurate with mainline railway signalling principles for single line sections.

However, if appropriate to the risk, railway signalling principles may be used to provide a higher level of safety integrity if higher speeds of operation are required.

## Integration of the Tramway and Highway

The design and integration of the tramway and highway should take account of the following factors that could affect the safe operation of the tramway (not exclusively):

- actual pedestrian desire lines and cycle crossing points
- design of pedestrian routes so as to encourage pedestrians to face towards any oncoming tram before crossing the track (refer to LRG 2.0 Guidance on Tramway Crossings for Non-Motorised Users [here](#))
- design and location of parking bays, equipment cabinets, overhead line poles, vegetation and other street furniture and features, so as to avoid places of concealment of pedestrians or that they will not see an approaching tram
- provision of barriers between places of concealment and the SE
- design of access routes to and from tramstops so that passengers are discouraged from crossing the track at places other than designated crossing points
- the safe and efficient passage of other road vehicles over and around the tramway
- intervisibility between approaching trams and road vehicles emerging onto the tramway or into the SE
- the creation of one-way streets to prevent road vehicles emerging from junctions where the sight lines are particularly poor
- relocation or revision of existing access and loading arrangements for frontagers and those whose access is immediately from the tramway
- speed restrictions, on both trams and other highway traffic
- audible warning by approaching trams
- measures to deter pedestrian access to some areas
- warning signs for those approaching the tramway
- elimination of features likely to distract tram drivers or divide their attention
- the turning radii of road vehicles manoeuvring in the vicinity of the tramway path, and
- levels of illumination of tramway junctions with highways should be consistent with normal highway design practice.

Reference should be made to the appropriate sections of the Department for Transport Traffic Signs Manual (TSM) [here](#)

Where necessary, conflicting road and tram movements at road intersections and places where a tramway crosses a carriageway should be controlled by highway signalling.

Part-time traffic signals may be employed to allow the use of emergency crossovers and other infrequently required tramway routes on the highway. The appropriate signing for part-time traffic signals on the highway as given in the Traffic Signs Regulations and General Directions (TSRGD) [here](#) should be provided. This may need to be supplemented by additional signage giving more information to other road users on potential 'unusual' tram movements which could include reversal of trams in the highway. Refer also to the Reversal Running section below.

Where it is necessary to control the movement of trams during roadworks or tramway maintenance, consideration should be given to adapting portable signals to show tram aspects.

### **Connections Between Tramways and Railways**

Connections between a tramway system and a railway system should be suitably managed and only be provided where an operational need has been established.

If railway vehicles need to operate over a tramway, their compatibility needs to be ensured by the tramway operator and the operation appropriately managed. Similarly, if a tram needs to operate over a railway, the requirements of the railway undertaking will need to be adhered to.

Apart from the times when movements have been properly arranged through robust controls, connections must remain secured and out of use.

Clear maintenance boundaries and responsibilities (including timescales) should be agreed between each Infrastructure Manager involved.

### **Location of Tram Signals**

On the highway, the layout and positioning of tram signals and the associated staging and phasing at intersections should follow current highway traffic engineering principles as defined in the TSM.

Particular attention should be paid to the requirements of turning traffic in the design, location and staging of traffic signals. Consideration should be given to the visibility of tramway signals such that signals are visible to tram drivers held at Stop lines irrespective of the location of other highway vehicles.

Staggered Stop lines may assist with ensuring the visibility of tram signals to the tram driver.

Tram signal heads may be placed on either side of the track to optimise visibility from the driver's cab.

All signs and signals on the highway must be agreed with the Highway Authority and appropriate Traffic Regulation Orders must be in place to ensure they are all prescribed and enforceable.

Where the tramway track layout allows for the reversal of trams in the highway in a way that would result in the tram moving in the opposite direction to other road traffic, road traffic signals to stop other road traffic while the tram reverses are required. Refer also to the Reversal Running section below.

### **Tram Detection**

Detection systems should be configured so that the failure of an individual tram detector does not compromise the safe operation of a road junction or pedestrian crossing.

If each driving position of a tram is separately identified for route calling and route releasing, then suitable arrangements should be provided to ensure only one driving position is active at any one time under normal operating conditions.

### **Point Control, Detection and Indication**

Power-operated points on a tramway are normally set by a demand from the tram on approach. The points should only throw when the tram driver is sufficiently close to them to determine that no person will be affected by the moving parts, but also in enough time for the tram driver to determine the lie of the points before reaching them. If the points cannot be established to be clear of people, then the tram driver must not allow the demand for the points to throw to be made. This can be either by operating a control or moving to a position where the driver knows demand would be initiated.

Where points have the facility to be manually operated by the use of a lever or other such means, access to and operation of such points should not present a risk of personal injury to the tram driver and they should be protected from unauthorised access. Where manual points are regularly used as part of normal operating conditions, then the stopping position for the tram should make provision for other highway users so it does not lead to hazards and should allow the tram driver to leave the tram and operate the points in safety.

Where point indication is necessary, this should be independent of the signalling control system and should be dependent only on the detection of point blades and any locking arrangements. Detection should be of both the lie of the point blades and the correct application of the locking mechanism, including spring points.

Where a road traffic signal is permitting the tram to proceed in only a specifically indicated direction, then it is the responsibility of the tram driver to ensure the correct corresponding lie of any points.

Off-highway a signal can be interlocked with the lie of points and can be dependent on them. This may help to reduce operational risk.

On a highway, the demand from a tram should in all circumstances be capable of being made to the road traffic signal controller independently of the lie of the relevant points. This independence is to ensure that the tram will always get a Proceed at a road traffic junction where it is not legal to pass a signal at Stop. (Passing a signal at Stop would otherwise normally only be possible under the control of a person holding an authority granted by the Chief Constable.)

The switch blades (or their equivalent) of any points used in the facing direction should be positively held in position during the passage of a tram. Mechanisms that allow the points to be trailed may be used.

Where spring force or hydraulic pressure is used to achieve the trailing of points, a speed restriction through the points may be required.

Points must be locked such that once they are set for a particular tram and an appropriate indication given to that tram and the points cannot be moved until the whole of that tram has passed over those points.

An indication of the lie of facing or non-trailable power-operated trailing points that are used regularly by passenger carrying trams should be given to the tram driver by a visual indicator positioned close to the points.

Operators may find it useful to have indications of out-of-correspondence points transmitted to a central location.

Indication is not required for points in depots.

Indication is also not required for emergency trailing crossovers which become facing only when used, provided that the tram driver can observe the position of the point blades from the driving position before driving the tram over them.

If the points are incorrectly set or are misaligned, in the interim whilst they are being corrected, the place where the tram should stop should be clearly marked. If this is not immediately before the points, the point indicator may be duplicated at the stopping point.

### **Reversal (or 'Wrong Direction') Running**

In general all vehicles on the highway must keep to the left side of the road (**Highway Act 1835, Section 78**) unless they have statutory authority to do otherwise, for example, through a TWA Order.

Temporary, emergency wrong direction movements (reversing) on the highway, i.e. those not authorised by statute, must only be made when necessary for safety or to permit trams to turn during an emergency operation. The distance of wrong direction / reversal operation should be minimised and when making this manoeuvre, the driver must be in the leading cab.

There is no requirement to have such wrong direction moves authorised by a police officer, but drivers of trams should take appropriate care. The operator should have written procedures for wrong direction moves that are documented within the SMS. Also refer to The Road Vehicles (Construction and Use) Regulations 1986, Regulation 106 **here**.

When wrong direction operations may be required for an extended period, operators should come to agreement with the relevant local Highway Authority over the most appropriate arrangements for the safe control of other highway users.

Road traffic signals will be required in order to stop the other road traffic while a tram is making a wrong direction movement.

### **Design and Construction of Tramway Points, Signals and Other Indicators**

Careful consideration and choice of track components for points and crossings on a tramway should be made to ensure compatibility with tramway point mechanisms and equipment.

For normal operating conditions, point mechanisms should be trailable. Mechanisms that are not trailable can present a significant derailment hazard to a tram if run through.

Where point position indicators are used these should ideally conform to the format set out in the Point Indications section [here](#).

A tram signal should be provided for the trams at all road traffic signalled installations for each direction from which a tram may approach.

Two or more trams should not normally operate through a signalled highway junction consecutively in the same direction and within the same phase. Any proposal to do so should be based on two successive tram Proceed phases within the same stage of the junction signalling.

Traffic signals applicable to tramways must comply with the TSRGD that defines the appropriate signs and signals that a tram driver must obey. Further guidance on signs is given in the TSM.

The prescribed tram signals for on-street tramways should ordinarily be used throughout systems to ensure consistency i.e. also on segregated sections of the tramway.

Consideration should be given to the provision of Pre-start or Demand Received indications. This could be displayed either in the driver's cab or at a suitable location on or near the relevant signal.

Primary tram signals should normally be located on the left-hand side of the track. They may be located on the right-hand side of on-street tramways (i.e. between pairs of tracks), subject to the clearance requirements being met.

### **Tramway and Road Traffic Signs**

The need for signage and road markings is linked intrinsically with the need for suitable training to provide tram drivers with appropriate route knowledge, and the need for the signs and road markings to remind drivers of safety related issues that they should already be conversant with.

Signs for other road users following the introduction of a tramway are prescribed in the TSRGD. Signs that are not prescribed in these regulations should be specifically authorised by the DfT. Further guidance on signage is given in the TSM and in LRG 4.0 Signing and Marking of Tramways and Highway Interface guidance [here](#).

All signs must be prescribed signs that can be legally placed on the highway. Only prescribed signs can be legally enforced, for example, in relation to obstructions of the tramway and trespass. Therefore, any use of non-prescribed signs is not only unlawful, but of little practical use and could expose the tramway operator to legal proceedings.

A proliferation of signs should be avoided. For example, where generic speed restrictions are applied at specific locations like through tramstops, application of operational procedures may be more appropriate than individual signs for each restriction.

Signs applicable to only tram drivers should be mounted so as to be conspicuous to drivers of trams but presenting as little distraction to other road users as possible, for example on electric traction poles. Details of these signs and further guidance is provided in LRG 4.0 Signing and Marking of Tramways and Highway Interface [here](#).

Off highway there is no requirement to use prescribed highway signage. However, it is strongly advised that signs for tram drivers follow the prescribed signs in order to provide consistency with the on-street sections of the tramway as well as simplicity and driver familiarity with prescribed signage.

## **Speed Limits**

Prescribed retro-reflective lineside signs indicating the maximum permitted speed as shown in Diagram 976 in the TSRGD [here](#) should be provided throughout a tramway. All signs should be similarly mounted and located at the tram driver's eye level. These signs would normally be fitted wherever:

- the maximum permitted speed on a section of tramway changes, or
- the maximum permitted speed of a tramway located in the carriageway differs from the limit for other road vehicles.

In certain situations, generic speed restrictions would normally be applied at specific locations (for example through tramstops) where it may be more appropriate to apply operational procedures, rather than signs for each restriction.

The maximum permitted speed of a tram on a carriageway shared with other road traffic should be approximately the same as, or lower than that for other highway traffic.

The maximum permitted speed of a tram on a segregated on-street section may be higher than that for other road traffic provided that the presence of the tramway is clearly indicated to other road users. Any higher speed should be agreed with the Police and the Highway Authority. An Order under Section 84 of the Road Traffic Act [here](#) may be required.

## **Control of Tram Signals**

Where tram signals are associated with ordinary road traffic signals on on-street tramways, they should be controlled by the local road traffic signal controller with appropriate tramway functionality.

Whatever additional tramway controls are superimposed upon the local road traffic signal controller, the traffic system should be able to function independently and process tram demands if the transmission link to a central controller fails.

The local road traffic signal controller should not be involved with determining route information for the tram, but should be presented with the appropriate demand being received from the tram detection equipment.

In certain circumstances, it may be necessary for an interface unit to be interposed between the road traffic signal controller and the tram detection equipment. This arrangement should also be able to function on its own if the link to any tramway supervisory or control system fails. The fundamental system may be developed further to encompass higher order traffic control systems.

Wherever the control of the tram signals is through a normal road traffic signal controller, the detection of the lie of the points on a running line should be shown through a separate point indicator.

The design of the control system should be such that intersections can be safely controlled, allowing such precedence for trams as may be agreed with the Highway Authority, as described in the Road and Tram Traffic Signal Integration section [here](#).

In fixed-time systems, the tram phases should run irrespective of the presence of a tram. For demand-dependent systems, tram signal phases should run in conjunction with parallel and complementary phases for other road users.

Where tram movements conflict with other road traffic flows, separate stages or phases should be provided solely for tram movements. Proceed aspects for trams should not return to Stop before any parallel Proceed signal for other road vehicles. An allowance should be made to give the tram earlier warning of the impending Stop, and so reduce the risk of the tram overrunning the Stop line and a longer all-red period (i.e. the inter-green period) may be required following the termination of the tram phase.

The design of a pedestrian crossing should ensure that, subject to a timeout in the event of an undue delay, the Proceed aspect for pedestrians (and the Stop aspect for a tram) cannot be given if an approaching tram is within its service braking distance of the crossing.

### **Traffic Control Room**

The tramway operations control room and electrical control room should normally be combined.

The design of the tramway control room should provide a working environment that minimises distraction and fatigue, to avoid the risk of error by the staff responsible for the control of operations.

A human factors study should be carried out at the design stage or when there is a significant change to the control room or systems.

The integrity of controls and indications should be appropriate to the extent to which safety depends upon their correct operation. Both normal operating conditions and degraded operating conditions should be taken into consideration when assessing the risks and the level of integrity required.

The control room equipment essential for the safe operation should be protected from the consequences of electrical supply failure at the control room. Any loss of power or changeover to battery supplies should not cause a loss of integrity in the ability to control the system.

All information necessary to control the system safely should be continuously displayed. Display screens capable of showing the track layout and positions of tramstops should be provided. Display screens for the electrical supply systems should be provided that are capable of showing the locations of feeding points, and the actual position and status of circuit-breakers and section isolators.

If any diagram or diagrams respond to the position of trams, the location of points or switches, position of circuit breakers or aspect of tram signals, such information should be clearly displayed.

Switching between displays in the course of an operation is not acceptable if this gives rise to a consequent need to remember the status of relevant items.

A fixed line diagram or diagrams should also be provided to enable operations to continue in the event that the display screen equipment is unavailable.

There should be a high integrity recordable telephone line for use between the local emergency services control room(s) and the tramway control room. Tramway control room staff should be made aware of any incoming calls on such a line, even if other communications systems share the same equipment. A similar line should be provided to the controlling signal-box of any railway system that

crosses or shares an alignment with the tramway. All such communication lines should continue to function if mains power is lost at the tramway control room.

Whenever control-room staff pass messages that are critical to safe operation, all messages should be recorded, and the recordings kept for at least 48 hours. Where safety is dependent on communications between control-room staff, these communications should be similarly recorded.

### **Radio Communication Systems**

An adequate system of radio communication between the tramway operational control room and trams should be provided.

A system allowing selective calling and identification of individual trams, or groups of trams, should be provided if instructions that are critical to safe operation are to be passed by radio. The radio system should incorporate the facility for each of the emergency services and tramway personnel to use their own portable radios within their own command structure. Any such facility should be functional throughout any running tunnels and within any access shafts and cross passages.

Voice communications between control and the tram driver should be kept separate from those between the tram driver and the passengers so as to prevent the latter from overhearing control messages.