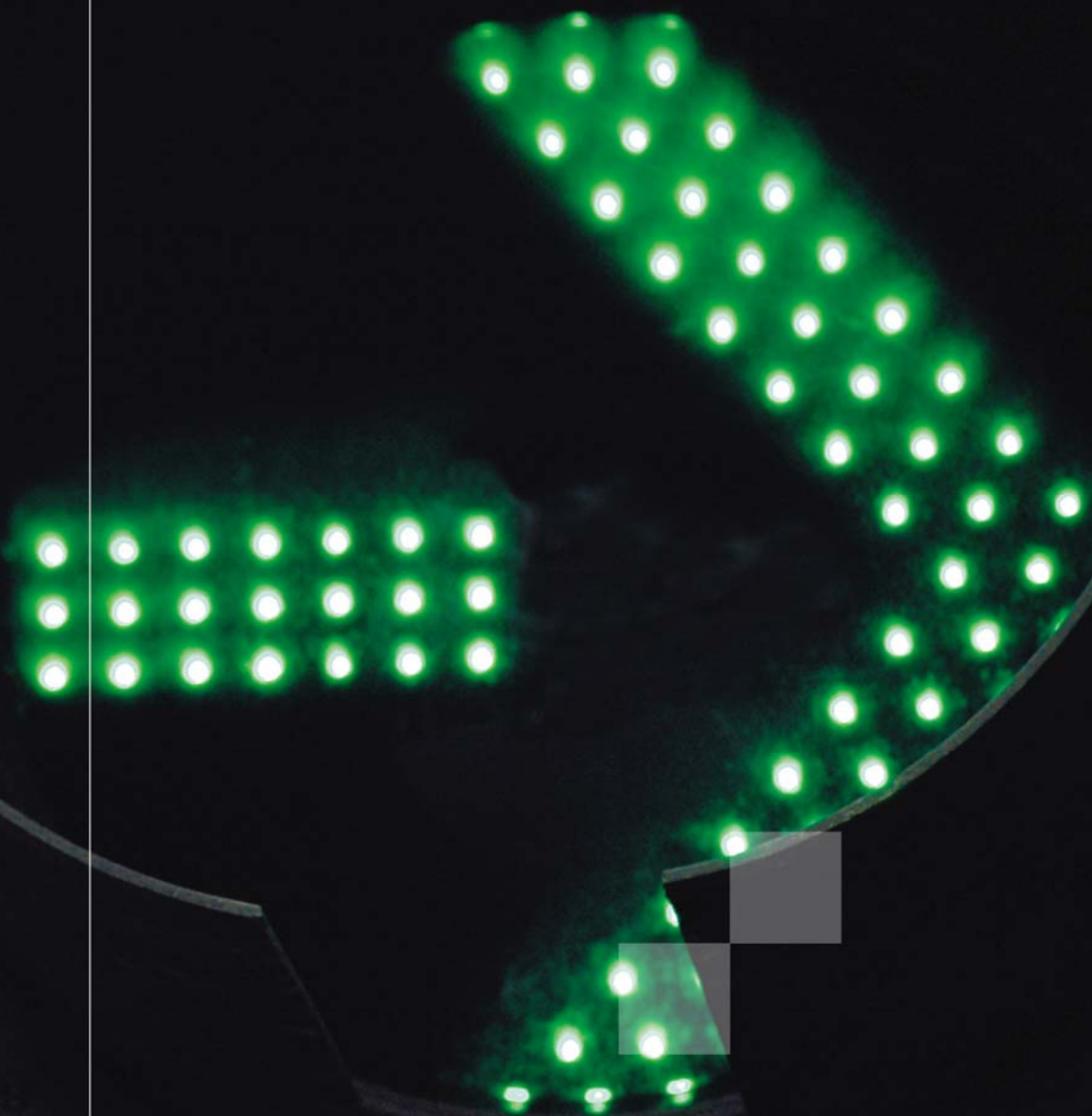


Traffic signal design

Section 8 – Lanterns



The traffic signal design guidelines have been developed to assist in designing traffic control signals.

The guidelines are to comprise 16 sections and 5 appendices. These are initially being released individually and in no specific order. The sections which are to be released are as follows:

| Part | Title |
|-------------|---|
| Section 1 | Investigation |
| Section 2 | Warrants |
| Section 3 | Design Process |
| Section 4 | Plan Requirements |
| Section 5 | Geometry |
| Section 6 | Pavement Marking |
| Section 7 | Phasing and Signal Group Display Sequence |
| Section 8 | Lanterns |
| Section 9 | Posts |
| Section 10 | Signs |
| Section 11 | Detectors |
| Section 12 | Controller |
| Section 13 | Provision for Future Facilities |
| Section 14 | Signalised Mid-block Marked Footcrossings |
| Section 15 | Special Situations |
| Section 16 | References |
| Appendix A | Design Plan Checklist |
| Appendix B | Traffic Signal Symbols |
| Appendix C | Location and Function of Lanterns |
| Appendix D | Location and Dimensions of Components |
| Appendix E | Left Turn on Red |

To determine which sections are currently available go to:

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The information contained in the various parts is intended to be used as a guide to good practice. Discretion and judgement should be exercised in the light of the many factors that may influence the design of traffic signals at any particular site. The guidelines make reference, where relevant, to current Australian Standards and are intended to supplement and otherwise assist in their interpretation and application.

Traffic Signal Design

Section 8

LANTERNS





Roads and Traffic Authority

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APPROVED BY:

SIGNED

Phil Margison
General Manager
Traffic Management

SIGNED

Steve Levett
A/General Manager
Safer Roads

AUTHORISED FOR USE BY:

SIGNED

Michael Bushby
Director
Network Management

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For policy and technical enquiries regarding these guidelines please contact:

Traffic Management Branch
Email: technical_directions_publication@rta.nsw.gov.au
Phone: (02) 9218 6287
Fax: (02) 9218 6693

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Amendment record

Please note that the following updates have been made to this document.

| Version Number | Page | Description | Issued |
|----------------|------------------------|---|---------------|
| 1.0 | | Original issue | February 2008 |
| 1.1 | 8-2 8-4 8-11 | Amended Section 8.6 Aspect Size Amended Section 8.8 Visors Amended Section 8.10 Lantern Mounting Height Fig 8.5 amended to reflect new marked foot crossing markings | August 2008 |
| 1.2 | 8-3 | Amended Section 8.6 Aspect sizes for mast arms | May 2009 |
| 1.3 | Various | Drawings VD018 series updated to TS-TN series | August 2009 |

8.1 INTRODUCTION

Traffic signal lanterns are the medium by which vehicles and pedestrians are controlled.

Lanterns intended for vehicle control may consist of full roundels with or without arrows, 'B', 'T' and bicycle masks, each in red, yellow, green or white. Each different coloured roundel or arrow is called an aspect. Thus, a lantern with one aspect is called a one-aspect lantern, a lantern with two aspects is called a two-aspect lantern and so on. An assembly with more than three aspects arranged in two columns is called a dual lantern. For example, an assembly consisting of three left-turn arrows and three full roundels is called a dual three-aspect lantern.

Lanterns intended for pedestrian control always use two aspects. These consist of a symbol of a standing pedestrian in red and a symbol of a walking pedestrian in green. Lanterns intended for bicycle control also use two aspects, both consisting of a bicycle symbol, one red and one green.

8.2 LANTERN TERMINOLOGY

Lanterns are basically classified as primary, secondary or tertiary. Depending on location the basic classification can be qualified e.g. dual primary or overhead primary, secondary or tertiary. Refer to Appendix C [Location & Function of Lanterns](#) for location.

8.3 FUNCTION OF LANTERNS

To be effective, traffic signal lanterns must command attention, convey a simple message and satisfy the functions of:

- warning
- stopping
- starting
- manoeuvring

Primary (including the dual and overhead) lanterns provide the warning and stopping functions, while the secondary and tertiary (including the overhead) lanterns provide the starting and manoeuvring functions. Refer to Appendix C [Location & Function of Lanterns](#).

These four functions are generally satisfied by three lanterns per signal group. The absolute minimum is two. Where possible, each lantern should be used to fulfil more than one function, provided that it is fully effective in its main function. This is illustrated in Appendix C [Location & Function of Lanterns](#).

With the introduction of Light Emitting Diodes (LED's) for traffic signal displays, their vastly improved efficiency, increased longevity, and gradual loss of illumination eliminates the need to allow for possible lamp failure when choosing the number of lanterns required. Accordingly, the aim should be to restrict the number of lanterns to only what is essential for safety and effectiveness. The ideal number is three lanterns per signal group.

8.4 LANTERN ASSEMBLIES

Lantern assemblies should be limited to the aspect combinations shown in Appendix B [Traffic Signal Symbols](#), i.e. no more than six aspects (in the form of dual three-aspect lanterns) per approach on each post. In some circumstances nine aspects (in the form of three three-aspect lanterns) may be considered, but this would be unusual.

In any approach where all vehicles turn left or right and have no conflicting vehicle or pedestrian movements, the full green roundel should be replaced by a green arrow. However, due to the poorer conspicuity of arrow signals, the full yellow and red roundels should be retained in each case as shown in Figure 8.1.

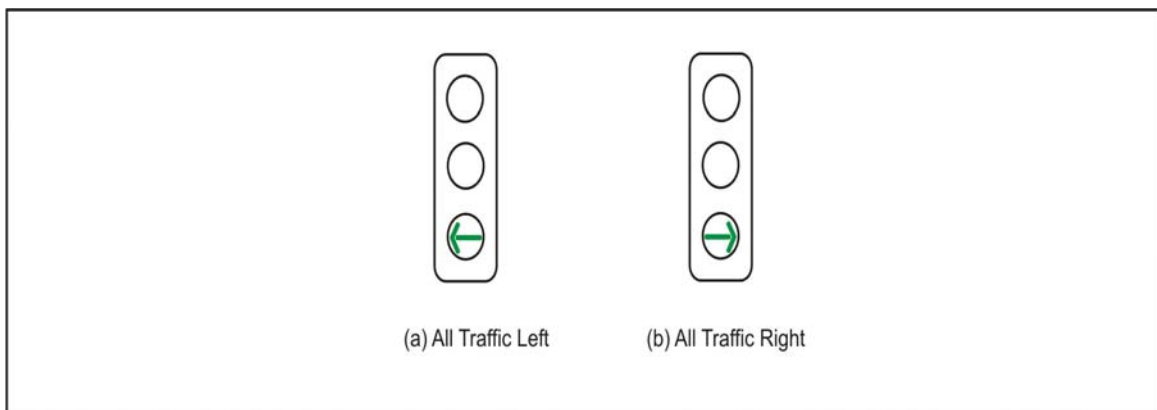


Figure 8.1 Lanterns where all traffic turns left or right

When a lantern consists solely of left or right turn arrows, the lantern must never have all arrows blacked out unless an adjacent three-aspect lantern consisting of full roundels is provided in the same dual lantern assembly.

8.5 TARGET BOARDS

To be effective vehicle lanterns are provided with a target board to improve conspicuity against distracting backgrounds. The size of the target board depends on the size of the aspects and whether single or dual lanterns are used. These target boards must have a minimum clearance of 300 mm to all traffic movements.

8.6 ASPECT SIZE

All new aspects are now LED and are available in two sizes, i.e. 200 mm diameter and 300 mm diameter.

Lanterns using 200 mm diameter aspects are usually adequate as a warning or stopping signal on the primary and dual primary posts where the approach speed limit is 70 km/h or less. Above this speed, (but not more than 80km/h) 300 mm diameter aspects should be used. These requirements are in consideration of 3 aspect lanterns only.

If a 4 aspect lantern is required in a single column then only 200mm diameter aspects are to be used, irrespective of the speed limit. 300mm lanterns are not available as a 4 aspect display.

Aspect sizes used on the outreach of all mast arms are 300 mm diameter. Exceptions to this requirement are:

- where there are urban design considerations or where the speed zone is 70 Km/h or less, then they are to be 200mm unless there is unusual geometry or conditions that require high visibility lanterns. This may be allowed, subject to the concurrence of the Manager Network Operations, Transport Management Centre;
- where it is necessary to tilt or provide louvres to an overhead lantern to prevent unwanted viewing, then a 200 mm diameter aspect should be used.

Starting and manoeuvring signals on the secondary and tertiary posts are normally only required to be visible over a little more than the width of the intersection. As this distance rarely exceeds 40 m, the standard 200 mm diameter aspects are usually adequate. If this distance is exceeded consideration should be given to installing mast arms to overcome any perceived lack of visibility. In exceptional circumstances, it may be acceptable to use post mounted 300 mm diameter aspect lanterns, provided that adequate screening can be achieved.

Under no circumstances should aspect sizes be mixed within the same lantern assembly.

8.7 AIMING AND SHIELDING OF LANTERNS

A traffic signal lantern is an assembly of optical components and must be properly aligned relative to its function. It is essential that lanterns are not visible to drivers on approaches other than those the lanterns are meant to control. Where lanes are separately controlled, it may also be desirable to limit the visibility to drivers in adjoining lanes. These requirements are achieved using visors and louvres as discussed in the following Sections 8.8 & 8.9.

Visors and louvres are also used to shield traffic signal lanterns from railway lines so that the lanterns do not confuse train drivers. This aspect should always be considered when traffic signals are to be installed near a railway line. If adequate shielding cannot be provided, a special screen may need to be constructed adjacent to the railway line.

The aiming of pedestrian lanterns is also important, particularly at staged crossings. One pedestrian lantern on each side of the crossing is normally sufficient. However, where the length of the crossing is more than 25 m a median post must be provided and a secondary pedestrian lantern must be placed on the median post with accompanying pedestrian push buttons.

8.8 VISORS

Visors are used to shield the lantern from incident light and to restrict the angular coverage of a lantern. Visors are classed as Type A (open), Type B (closed). The Type C (cut-away) is no longer used.

The Type A (open) visor is used on all lanterns where no restriction of angular coverage is required, usually on primary lanterns. Only shielding from incident light is provided. Open visors are 200 mm long for 200 mm diameter aspects and 300 mm long for 300 mm diameter aspects.

The Type B (closed) visor is approximately tubular and restricts the effective angular coverage of the lantern as shown on drawing No. VD019-2. Closed visors are normally 200 mm long for 200 mm diameter aspects and 300 mm long for 300 mm diameter aspects. However, extended versions are available to restrict the angular coverage even further. These are 300 mm long for 200 mm diameter aspects and 400 mm long for 300 mm diameter aspects. The latter are rarely used. Closed visors are used on all overhead lanterns.

All LED secondary and tertiary lantern visors should be 300mm long.

8.9 LOUVRES

Horizontal and vertical louvres may be provided under certain conditions to further restrict the angular coverage and the intensity of the signal. They are effective even at small angles from the direction the lantern is facing, so their use should be restricted to situations where these limitations are needed. Louvres can also produce strong reflected images of the signal under low ambient light conditions.

Horizontal louvres may be used to restrict the vertical coverage of a lantern (i.e. its vertical cut-off) to control very strong incident light or to minimise sun-phantom effects brought about by the reflection of sunlight or skylight on the optical surfaces of the lantern at certain times of the year.

Vertical louvres may be used where the required horizontal cut-off cannot be achieved by visors alone. This typically occurs at acute-angled intersections or where it is required to restrict visibility of the lantern to particular lanes.

Care should be taken to ensure that the display at one traffic signal site does not confuse drivers at closely spaced sites. If this occurs, it is generally sufficient to insert horizontal louvres in only the green aspects of the distant signal group.

Louvres should not be used in lanterns with 300 mm diameter aspects as their purpose is to be seen and not screened.

Louvres should not be used in association with symbolic aspects as the combined effect reduces visibility to unacceptable levels.

8.10 LANTERN MOUNTING HEIGHT

The mounting height from ground level to the bottom of pedestrian and bicycle lantern assemblies and target boards on vehicle lanterns should be a minimum of 2.4 m to allow overhead clearance for pedestrians and cyclist.

Where a driver's view of the lantern is blocked by awnings, signs etc, the mounting height can sometimes be adjusted to avoid the obstruction. This is done by lowering the mounting brackets to decrease the mounting height, or using Z-brackets to increase the mounting height.

The mounting height for overhead lanterns on mast-arms should ensure that the bottom of the target board is a minimum of 5.4 m above the road surface. The extra 0.1 m over the normal road clearance of 5.3 m is to allow for the mast arm swaying in a strong wind.

8.11 LANTERN LABELLING

The labelling of lanterns is necessary to distinguish between different signal groups. Previously, there were two methods of labelling, phase labelling and signal group labelling, however, with advances in controller technology, only signal group labelling is now currently used for new or reconstructed installations.

8.11.1 Signal group labelling

With this method, all vehicle signal groups are labelled with a "V" and all pedestrian signal groups are labelled with a "P". Each label is supplemented by a numeric suffix to distinguish between the different signal groups, e.g. V1 and V2, P1 and P2, hence each signal group has a unique label.

The vehicle signal groups are numbered in the following order with no gaps in the numbering sequence:

- (a) V1 shall be the lowest alphanumeric through vehicle signal group on the major road, or non-terminating leg of a "T" junction. Therefore, for most non-diamond sites, V1 will be A phase. For diamond sites V1 will be A/B/E1 or A/B/F1 or A/B/G1.
- (b) the through signal group on the approach opposite (a)
- (c) the through signal group at the second stop line (where two stop lines are provided in the same approach such as at staggered T-junctions or widely separated freeway ramps) on the same approach as (a)
- (d) the through signal group at the second stop line on the approach opposite (a)
- (e) the right-turn signal group on the same approach as (a)
- (f) the right-turn signal group on the approach opposite (a)
- (g) the through signal group in the minor leg of an intersection and the signal group in the stem of a T-junction or whose primary lantern is the first encountered in a clockwise direction from the V1 primary lantern
- (h) the through signal group on the approach opposite (g)
- (i) the right-turn signal group on the same approach as (g)
- (j) the right-turn signal group on the approach opposite (g)
- (k) the left-turn signal group on the same approach as (a)
- (l) the left-turn signal group on the approach opposite (a)
- (m) the left-turn signal group on the same approach as (g)
- (n) the left-turn signal group on the approach opposite (g)

An example of lantern labelling with signal group numbers is shown in Figure 8.2. This example is for a single diamond overlap.

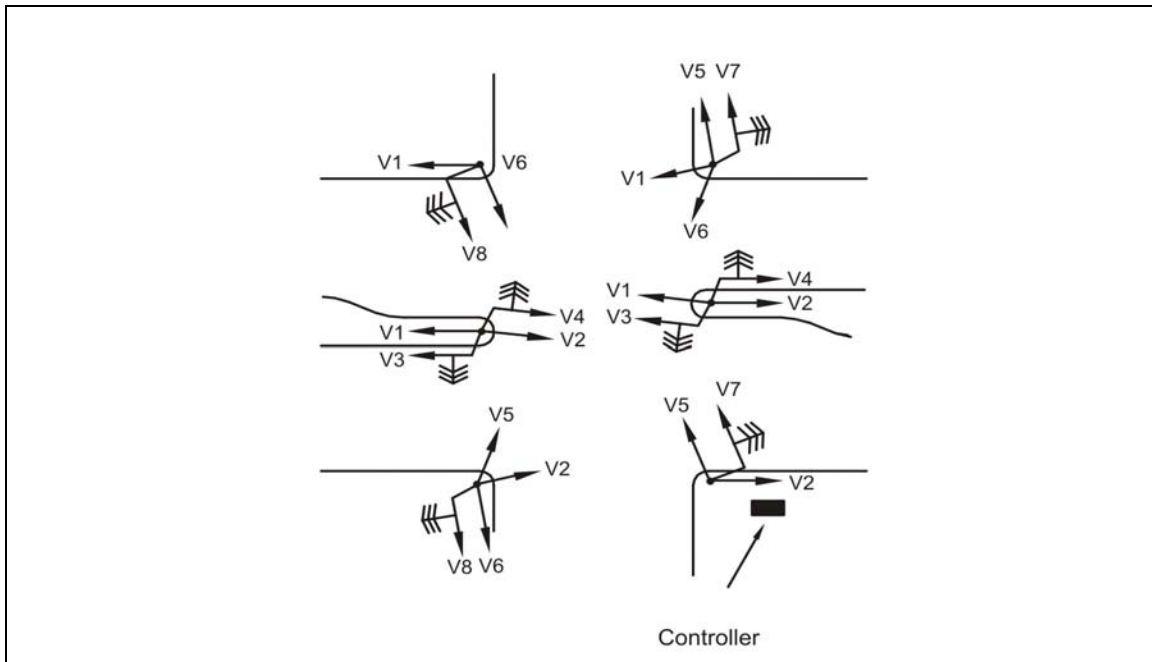


Figure 8.2 Lantern labelling using signal group numbers

The pedestrian signal groups are numbered in the following order with no gaps in the numbering sequence:

- (a) the pedestrian movement running parallel to the vehicle movements controlled by the V1 vehicle signal group
- (b) the pedestrian movement opposite (a)
- (c) the pedestrian movement running parallel to the through signal group in the side street whose primary lantern is the first located in a clockwise direction from the V1 primary lantern
- (d) the pedestrian movement opposite (c)
- (e) the pedestrian movement across the left-turn slip lane on the same approach as (a)
- (f) the pedestrian movement across the left-turn slip lane on the same approach as (b)
- (g) the pedestrian movement across the left-turn slip lane on the same approach as (c)
- (h) the pedestrian movement across the left-turn slip lane on the same approach as (d)

When lantern labelling using signal group numbers is used at sites other than signalised marked foot crossings or two phase intersections, a signal group/phase chart must be provided on the design layout as described in Section 4.3.4 of [Plan Requirements](#). This should indicate the phases during which the green is displayed, the overlaps permitted, the conditions applying to overlaps and the duration of any special features such as timed red arrows. When appropriate, the columns for overlaps, overlap conditions and special features may either be replaced or supplemented by a column indicating the standard signal group display sequence table for the relevant signal groups. This applies to all left-turn signal groups for standard diamond overlaps and signal groups in the minor road of a single diamond overlap. Examples of signal group/phase charts may be found in drawing Nos TS-TN-026 and TS-TN-027.

When lantern labelling using signal group numbers is used at a two-stage signalised mid-block pedestrian crossing, a sequence table should be provided as shown in Section 14 [Signalised Mid-block Marked Footcrossings](#).

8.12 LANTERNS FOR BUSES IN BUS ONLY LANES

A “Bus Only” lane is legally and operationally different from a “Bus Lane”. A driver of any vehicle may drive in a bus lane for the permitted distance of up to 100 m, to enter or exit property, to pass an obstruction or when turning at an intersection. Whereas, only a bus is permitted to drive in a Bus Only lane.

Similarly, a Transitway (in some jurisdictions called a Bus Way) is operationally the same as a Bus Only lane, except that access is restricted to authorised buses **and** authorised vehicles under the relevant Act.

Buses travelling in Bus Lanes are controlled by standard traffic signals, signs and pavement markings, in the same manner as other vehicles and no special provision is required for signal control.

Buses travelling in Bus Only lanes can be controlled by exclusive bus signals and phasing, signs and pavement markings, such as directional arrows (see Section 6.9 of [Pavement Marking](#)).

It is likely that sections of road reserved for buses might be a combination of Bus Lanes and Bus Only lanes.

At a signalised intersection with a Bus Only lane on approach, B aspects may be provided in bus lantern assemblies as shown in Figure 8.3.

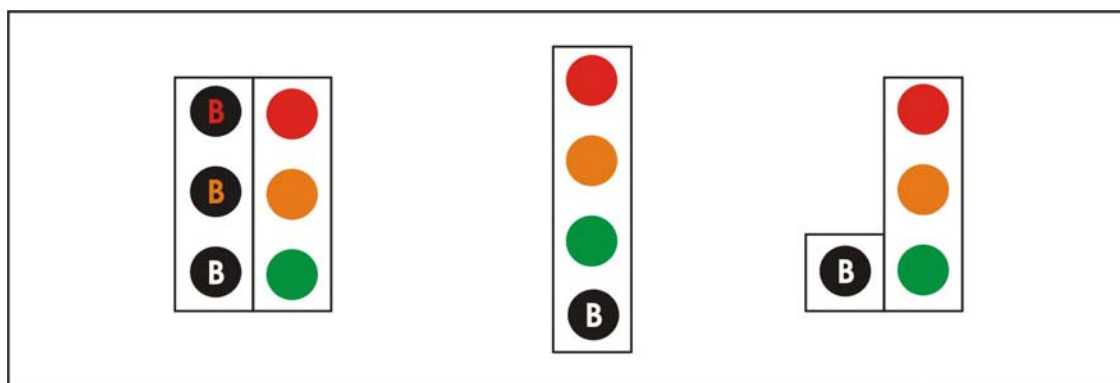


Figure 8.3 Use of B aspects in bus lantern assemblies

A green B aspect **must not** be used under any circumstances.

Plan VD003-6, Sheet 1 of 7, Symbols and Abbreviations, shows these lantern assemblies and their relative plan symbol.

A white B display legally permits a bus to move **in any direction** from the stop line of a Bus Only lane. The move must be made with safety to the public and in accordance with any regulatory requirements. Consequently, pavement markings may also be used to regulate the movement of a bus facing a white B display. For example, it may be a requirement that a bus can only turn left or can only turn right, in which case a left or right turn arrow would be the necessary pavement marking. If it is a requirement that a bus can only move in a straight ahead direction then a straight ahead arrow would be the required pavement marking.

The display of a white B aspect applies to a bus occupying a Bus Only lane on that approach and does not apply to a bus in an adjacent general traffic lane.

The use of white B aspects should only be used where:

- the lane is a Bus Only lane,
- aspects controlling buses can be seen by other drivers and not only the bus drivers in the Bus Only lane (this is to avoid possible confusion to other drivers who observe buses moving off, seemingly against a red signal),
- bus movements would not conflict with any pedestrian walk or clearance period.

In cases where bus aspects can only be seen by bus drivers in the Bus Only lane, or in the case of a Transitway, where other authorised vehicles are permitted access, it is preferable to use the standard vehicular aspects (roundel or arrow), not the white B aspects.

8.12.1 Bus lantern assemblies combined with other lantern assemblies

If mounting bus aspects in a lantern assembly with aspects controlling other vehicles, lantern assemblies should be no more than six aspects. However, lantern assemblies with more than three aspects may be necessary to control other vehicles in adjacent approach lanes. If bus aspects are also required in such a case, the three aspect bus lantern should be mounted under the other vehicle lantern assembly, whilst still maintaining a minimum clearance of 2.0 m above ground level to the bottom of the target board (see Figure 8.4). This arrangement would also apply where the width of a median will only accommodate single column lanterns. Care should be taken to maintain minimum vertical clearances for pedestrians and a note to that effect should be shown on the design layout.

8.12.2 Three aspect bus lantern

Use a three aspect bus lantern to provide an exclusive bus phase where lanterns controlling a bus, in a Bus Only lane, are visible to drivers of vehicles in other lanes, on any approach.

An exclusive bus phase will allow buses to safely proceed in any direction from the stop line, subject to any regulatory signs or pavement markings and public safety. This will avoid conflicts occurring with signalised pedestrian and other vehicle movements.

Do not use three aspect bus lanterns if through and turning conflicts between bus and other vehicle movements do not exist.

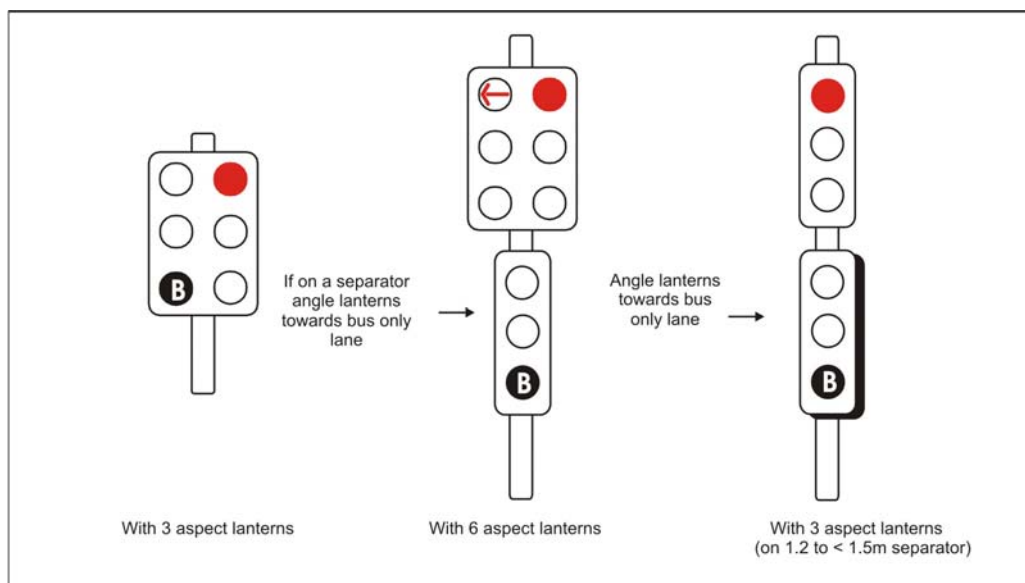


Figure 8.4 Mounting positions for bus lanterns in multi-column assemblies

8.12.3 Four aspect bus lantern

Safety requirements will limit the use of four aspect bus lantern assemblies. These should be used to provide a priority start for a bus in a Bus Only lane where:

- adjacent vehicle movements on the same approach proceed in the same direction as the bus and have to merge on the departure (in this case the lane would then not be a Bus Only lane),
- adjacent vehicle movements on the same approach do not cross paths with the bus
- vehicle movements from another approach will not conflict with the bus during the priority start period,
- there is no conflict with a signalised marked foot crossing.

Do not display the white B in a four aspect bus lantern assembly concurrently with:

- the green display in that assembly,
- any other conflicting green display.

8.13 LANTERNS FOR LIGHT RAIL

Priority for light rail is controlled differently to bus priority as the tram direction is controlled by tracks located centrally on a shared roadway or in a dedicated tram reserve. Tram lanterns usually comprise a 3 aspect column with a white T below a yellow T and a red T aspect (see Appendix B [Traffic Signal Symbols](#) for examples of light rail lanterns).

8.14 LANTERNS FOR BICYCLES

Bicycle routes can travel through signalised intersections as either off-road paths or on-road lanes, and each needs to be carefully considered, for efficiency of the intersection and safety of the cyclist. The [NSW Bicycle Guidelines](#) details some of the design parameters that should be followed in regard to both signalised and unsignalised intersections.

8.14.1 Off-road crossings

At signalised intersections where one of the three types of bicycle paths (bicycle only path, shared path or separated path) is present on one or more approach, bicycle lanterns similar to pedestrian two aspect lanterns, comprising a green symbolic aspect below a red symbolic aspect, should be provided. They are often placed alongside pedestrian lanterns. In some situations a 3 aspect bicycle lantern is used to control a bicycle only approach.

Signalised bicycle only and separated path crossings should be planned and executed alongside any required marked foot crossings. Consideration should be given to which side of the marked foot crossing the bicycle crossing is placed so that potential conflicts within the intersection are minimised, however, the crossings must align with the approach and departure facilities. Pedestrian and bicyclists use the same signalised crossing when travelling along shared paths.

8.14.2 On-road crossings

At intersections where bicycle lanes are present on one or more approaches, provision should be made for safe and convenient travel through the intersection. The primary aim of the signals is to provide a clear indication of the path the rider should take and when the manoeuvre should be made through the intersection. In most cases the normal vehicle lanterns will adequately cater for on-road bicycle movements. However, in those circumstances where bicycle movements may differ from other vehicles, consideration should be given to providing specific signal control. Specific on-road bicycle movements are controlled by a three aspect lantern, i.e. a green symbolic aspect, below a yellow symbolic aspect, below a red symbolic aspect (all masked roundels). If bicycle lanes are provided on the approach they should be resumed on the departure. See Appendix B [Traffic Signal Symbols](#) for examples of bicycle lanterns.

Refer to Section 15 [Special Situations](#) for details on the use of Bicycle Storage Areas and Advanced Bicycle Stop Lines at signalised intersections. Further details on treatments for bicycles at intersections go to the [NSW Bicycle Guidelines](#).

8.15 LANTERNS FOR PEDESTRIANS

Pedestrian lanterns are provided at all signalised marked foot crossings, whether at intersections or mid-block (see Section 2.4 and Section 2.5 in [Warrants](#)). They comprise a symbolic walking pedestrian aspect (green) below a symbolic standing pedestrian aspect (red). Bicycle lanterns are sometimes placed alongside (see Appendix B [Traffic Signal Symbols](#)).

A pedestrian signal face must be provided at each end of a signalised crossing. It should be located on the post near the projection of the crossing lines and aimed at the opposite end of the crossing. If the marked foot crossing width exceeds 10 m, two pedestrian signal faces should be provided at each end of the crossing (See Figure 14.1, Figure 14.2, Figure 14.3 in [Signalised Mid-block Marked Footcrossings](#), Figure 15.11 in [Special Situations](#) and Appendix C [Location & Function of Lanterns](#)). The top of the lantern assembly should be approximately 3 m above ground level.

If crossings are greater than 25 m, a median, median posts, pedestrian push-buttons and lanterns must be provided. This provision is in consideration of the difficulty in sighting pedestrian lanterns over a long distance and reassurance for pedestrians who are not able to complete the crossing in one stage. This is particularly important if the crossing is frequently used by children, elderly or disabled pedestrians.

If a median width of 3.0 m or greater is available a median post with a pedestrian push-button must be provided, irrespective of the availability of an associated mast arm.

Regardless of the median width, if a median post is provided it must include a pedestrian push-button. Tactile only push-buttons must not be used without discussion with peak organisations representing the vision impaired (such as Guide Dogs NSW/ACT or Vision Australia) and concurrence by the Manager Network Operations, Transport Management Centre (see Section 9.3 in [Posts](#) and Section 11.4.2 in [Detectors](#)).

At an intersection where a scramble crossing has been installed (see Section 2.6 in [Warrants](#), Section 6.4 in [Pavement Marking](#) and Section 7.9.2 in [Phasing & Signal Group Display Sequence](#)), additional diagonal pedestrian lanterns may be necessary, as well as the conventional parallel pedestrian lanterns, as shown in Figure 8.5. Additional diagonal pedestrian lanterns should be considered at large intersection sites or angled sites where it may be difficult for pedestrians, crossing diagonally, to view the conventional lanterns and be aware of the status of the “walk” and “don’t walk” symbols.

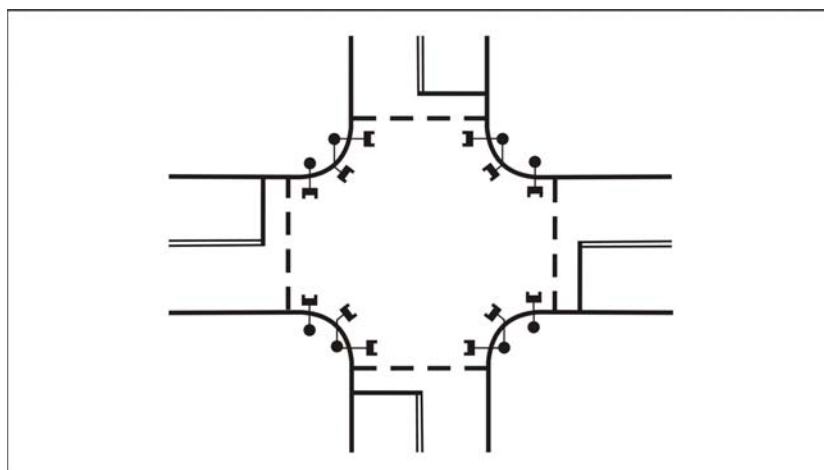


Figure 8.5 Position and Orientation of additional diagonal pedestrian lanterns at a Scramble Crossing

For further enquiries

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