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1.0 Introduction

The function of a traffic control signal is to alternate the right-of-way between conflicting streams of traffic with maximum efficiency. Maximum efficiency implies the minimum delay and minimum hazard reasonably obtainable. Installation of a traffic control signal, which as the name implies, is primarily a control device rather than a safety device, rarely can be justified as a safety measure alone since its installation does not necessarily guarantee a reduction in accident experience.

The meaning and position of the various traffic control signal indications as described in the balance of this division are standardized and should not be varied. The meaning may be qualified, where appropriate by an official sign.

Once a traffic control signal has been installed, it should always display some indication. It should never be turned off unless control is provided by a police officer.

When the traffic signal is to be taken out of service for an extended period of time, the signal heads should either be removed or the lenses covered in such a manner that they are no longer visible to motorists and/or pedestrians. If this practice is followed, the absence of any signal indication will warn motorists of a malfunctioning of the traffic signal. When signals are removed some alternative form of control shall be introduced for that period. If due to an accident or reconstruction some or all of the existing traffic signal heads have to be replaced or relocated, then the installation of temporary signal heads should conform to the minimum requirements for a standard signal head.

2.0 Traffic Control Signal Heads Indications

2.1 Typical Standard Traffic Control Signal Indication

Traffic control signal lenses for vehicular traffic shall be circular with a visual diameter of not less than 200 mm.

The standard traffic control signal indications shall be shown by means of lenses having neither lettering nor insignia of any kind on their surface except as noted in Sections 2.2 and Figure 1, illuminated in such a way as to be clearly distinguishable under all normal conditions of visibility. The meaning of the standard indications shall be as stipulated by the Ontario Highway Traffic Act.

Typical types of signal heads are shown in Figure 1.

2.2 Arrow Indications for Traffic Control Signals

In certain circumstances the green ball signal may be replaced or supplemented by arrow signals to separate and provide discrete time intervals for various directions of traffic movement.

Arrows can be used:

1. where separate and adequate lanes are provided for each direction of movement and where correct lane usage is strictly enforced.

2. on a one-way street system to discourage wrong vehicular movements into an opposing one-way stream of traffic.

When two or more arrow indicators are shown simultaneously, separate lenses shall be used for each. The shape and illumination of the arrow shall be clearly distinguishable under all normal conditions of visibility. A 300 mm diameter lens shall be used for arrow indications. The meaning of the green arrow indications shall be as stipulated by the Ontario Highway Traffic Act.

3.0 Signal Head Locations

The effectiveness of any traffic control signal installation will, to a great extent, depend on the ease with which the signal heads can be seen and recognized, especially by a driver passing through the intersection for the first time. This means that a driver should not be forced to search for the signals or to take his attention away from the road in order to see their indications. Their presence should be immediately and easily noticeable. During installation, all signal heads should be covered to show drivers that the signals are not operating. This is especially necessary where a head faces either the rising or setting sun, which by reflection could simulate signal indications with consequent confusion and some probability of accidents. Signals should be put into normal operation as soon as the installation is complete and has been tested.

3.1 Distance Visibility

A driver approaching a signal must be able to see the indication in sufficient time to take any necessary action and therefore the signal head must be clearly visible for a distance as shown in the accompanying table:

Posted Speed (km/h)	Distance from stop bar at which signal must be clearly visible Distance
40	65m
50	85m
60	110m
70	135m
80	165m
90	200m
100	230m

Signals normally should be visible over greater distances than those shown but in exceptional cases where even this minimum distance cannot be realized, a Wb-2 (signal ahead) sign should be used. Under extreme circumstances, additional signal heads or signal ahead signs with an amber flasher should be considered.

3.2 Visibility of Signal Heads

The effectiveness of the control resulting from any signal installation will depend, to a large extent, on the attention-getting qualities or, visual attraction of the signal heads. If the heads are such that they may be easily seen and recognized their indications also will be seen and obeyed. On the other hand, if the signal heads are non-standard, dirty or badly placed, a driver, especially a motorist not familiar with the road may not see nor recognize them. Poor observance and probability of accidents will result.

3.3 Visibility from Stop Line

If a signal is located so as to require the movement of the driver's eye away from activity within the intersection, the driver may not be aware of pedestrians, turning vehicles or movements of the vehicle immediately in front in time to take preventive action. On the other hand, should the driver concentrate on intersection movements, he may not be able to recognize immediately changes in the signal indications. In order that the best compromise under the above conditions may be reached, one signal head (preferably the primary signal), should be placed so that the driver is not required to turn his head and therefore should lie within a 30 degree cone of vision extending from the drivers' eye.

It is unlikely that a driver will maintain this line of sight perfectly straight and level and, due to the visual fatigue involved, it is not even desirable that he does so. If a normal eye movement of 2.5 degrees from side to side and up to down is assumed, the cone of perception may be taken as 30 degrees.

3.4 Background

The background against which a signal head must be viewed should provide a good contrast for the indications and at the same time contain nothing, which might distract attention from them. Precautions must be taken to see that illuminated street lights, advertising signs, etc., do not conflict with or distract from the indications.

3.5 Backboards

Backboards are to be used to increase the effectiveness of traffic signals both by making the head stand out from its surroundings and by helping to prevent confusion due to advertising signs.

3.6 Recommended Signal Head Location

Signal heads may be pole, mast-arm or gantry mounted or they may be suspended over the roadway on a span wire. Section 124(20) of the Ontario Highway Traffic Act, R.S.O. 1990 requires that a minimum of two heads must be used for each approach direction. The locations of these may be as set out in the following paragraphs.

A typical signal layout at an intersection is shown on Figure 5. Other typical signal layouts are shown on Figures 6, 7, 8, 9, 10, 11 and 12.

3.6.1 Primary Head

The primary head shall be of the highway type fitted with a backboard. It shall be mounted on the far right side of each intersection approach. When practicable, the primary head should be located in such a position that it will be situated within the driver's cone of vision (Figure B-8), at a minimum height of 4.5m clear of the pavement and at a distance normally in the range of 12 to 55m from the near side stop line, with a desirable minimum distance of 15m. Standard mounting height is 4.9m clear of the pavement.

3.6.2 Secondary Head

The secondary head shall be of the highway type fitted with a backboard and shall be mounted on the far-left side of each intersection approach. When the signal is mounted clear of the traveled roadway the bottom of the signal head shall be not less than 2.75 meters above the sidewalk however the standard mounting height is 4.9m clear of the sidewalk. Where a sidewalk does not exist these measurements refer to the pavement surface of the center of the highway.

3.6.3 Auxiliary Head

An auxiliary head may be located on the near right side of each intersection approach or in any other position, which may appear necessary due to local conditions. When the signal is mounted clear of the traveled roadway the bottom of the signal head shall be not less than 2.75 meters above the sidewalk however the standard mounting height is 4.9m clear of the sidewalk. Where a sidewalk does not exist these measurements refer to the pavement surface of the center of the highway. Auxiliary heads are to be of the highway type. Auxiliary heads must display the same indications as the primary and/or secondary heads.

3.6.4 Pedestrian Head

As per the Ontario Highway Traffic Act (HTA) Regulations, the mounting height of pedestrian signals shall be not less than 2.75m.

The sideline of a pedestrian signal shall be within 10 degrees of a pedestrian's viewpoint along the centre of the crosswalk. Where possible, the pedestrian signal shall be within the extensions of the crosswalk lines (see Figure 3).

Pedestrian signal heads must incorporate a portland orange silhouette of a hand for the "don't walk" pedestrian control indication and a lunar white silhouette or symbol of a walking pedestrian for the "walk" pedestrian control indication (as per HTA).

Pedestrian signals are normally mounted on a steel traffic pole. Alternatively, pedestrian signals may be mounted on the poles of other utilities such as Bell or Hydro, provided that permission is granted.

3.6.5 Optically Directed Signal Heads

Optically directed signal heads can limit the visibility of an indication exclusively to the roadway area where it must be seen, thereby eliminating conflicting and confusing traffic signal displays in certain geometric and phasing conditions. These conditions can generally

be divided into two categories:

1. Intersection approaches where the angle of the approach is such that a driver on that approach can incorrectly respond to signals designed to control another movement at the intersection.
2. Intersections where the distance between two or more conflicting signal displays is such that drivers and pedestrians can incorrectly respond to indications designed to control a particular movement or intersection.

3.7 Detector Location

Correct positioning and installation of detectors is of the utmost importance if actuated control is to be effective. As a check to ensure that the proposed location is right, the outline of the detector may be chalked on the road surface. The behavior of vehicles crossing this mark may then be observed. If any number of vehicles moving away from the intersection cross the mark, either the position must be changed or a detector time delay unit used. The possibility of the proposed detector being rendered ineffective by parked vehicles and transit stops also should be noted and any necessary adjustments made.

3.8 Pushbuttons and Pedestrian Information Signs

Pedestrian information signs provide the necessary guidance for pedestrians who may not be familiar with the operation.

3.8.1 Types of Signs

The three types of variations of pedestrian information signs are shown in Figures 13, 14 and 19. These signs are made from aluminum and have the following dimensions:

- Type A - semi-actuated/"Helping Hand" display (405mm by 200mm)
- Type B - fixed time/"Helping Hand" display (315mm by 200mm)
- Type C1 - "right direction" pedestrian crossover (345mm by 200mm)
- Type C2 - "left direction" pedestrian crossover (345mm by 200mm)
- TM6010 - mini sign "right direction" "Helping Hand" display (197mm by 127mm)
- TM6011 - mini sign "left direction" "Helping Hand" display (197mm by 127mm)

3.8.2 Installation Guidelines

Signs TM6010 and TM6011 are to be installed at all APS button installations. At the approval of Toronto Transportation, signs Type A (semi-actuated) signs and Type B (fixed time) signs are to be installed at fixed time locations and non-actuated crossings at semi-actuated locations. Type C (pedestrian crossover) signs are to be installed at all pedestrian crossovers.

These signs are installed at the preceding location types according to the following guidelines:

1. The bottom of the signs shall be mounted approximately 1.2m above the finished grade.

2. If necessary, signs may be mounted back-to-back on the same pole/post except if they are different signs (see Guideline 5).
3. Pedestrian information signs shall be positioned to face pedestrians as they stand at the corner of the intersection where they should wait to cross.
4. Pedestrian information signs and push buttons shall be installed within 3.0 metres (approximately) of the nearest crosswalk line on either a traffic pole or other utility pole. Additional posts/supports are not to be installed solely for the purpose of mounting these signs (if no suitable pole exists, then no sign shall be installed).
5. The fixed-time and semi-actuated signs shall not be installed on the same pole/post.
6. At semi-actuated intersections, signs shall be installed for the actuated crossing. For the non-actuated crossing, signs shall be installed provided Guidelines 4 and 5 are not violated.

At semi-actuated intersections, pedestrian information signs replace the previously existing "Pedestrian Signal - Push Button" signs. In replacing existing signs that are positioned in manner conflicting with the preceding guidelines, the new pedestrian information signs shall be installed in accordance with the above guidelines.

Figures 15, 16, 17 and 18 are plans showing the typical placement of pedestrian information signs at intersections with semi-actuated and fixed-time control and pedestrian crossovers, respectively.

3.9 Pole Location

- Minimum set back from curb is 1.0 metres, where possible.
- In general, minimize number of poles, maximize arm length.
- Pole use dependent on arm length (see Table 1 and 2).
- Push buttons within 3.0 metre radius of crosswalk (Figures 15 and 16).

Table 1 - Pole Size Selection

Maximum Mast Arm Lengths			
Pole Size (1)	Single Mast Arm Attached	Two Mast Arms Attached (2)	
		Arm #1	Arm #2
6.1 m (20 ft)	3.7 m (12 ft)	3.7 m (12 ft)	3.7 m (12 ft)
7.3 m (24 ft)	3.7 m (12 ft)	3.7 m (12 ft)	3.7 m (12 ft)
9.1 m (30 ft)	7.6 m (25 ft)	4.6 m (15 ft)	4.6 m (15 ft)
10.7 m (35 ft)	4.6 m (15 ft)	4.6 m (15 ft)	4.6 m (15 ft)
6.1 m HD (20 ft)	7.6 m (25 ft)	7.6 m (25 ft)	4.6 m (15 ft)
7.3 m HD (24 ft)	7.6 m (25 Ft)	6.0 m (20 ft)	4.6 m (15 ft)

Notes

(1) For overhead wiring minimum pole size of 7.3 metres to be used.

(2) For two arm attachments

- Mast arms attached at 90 degrees to each other
- Signal head area 11 sq ft (Hwy head)
- 1 1/4 inch Acrow Richmond type anchors
- 3.0 m elliptical street light mast arm where applicable
- applicable to POWCO steel poles only

Table 2 - Traffic Signal Mast Arm

Arm Type	Standard Arm Length (feet/Metres)									
	Single Member	4ft 1.2 m	6 ft 1.8m	8 ft 2.4m	10 ft 3.0m	12 ft 3.7m	15 ft 4.6m	18 ft 5.5m	20 ft 6.1m	22 ft 6.7m