Addendum to

Oregon Department of Transportation, *Traffic Signal Policy and Guidelines* (November 1999) Section IV. A., Left-Turn Signal Phasing

This Addendum updates and expands upon guidance given in Section IV. A., Left Turn Signals. For signals installed and operated on state highways it replaces Section IV.A.

The signal head placement and signing options for left-turn phasing which were illustrated in Appendices C-E have been revised and are incorporated in this Addendum. The option of using a four-section signal head with a flashing yellow arrow is included.

Section IV. Turn Signals

A. Left-Turn Phasing

1. Basis for Installation

In this section, the term *permissive left turn* refers to a vehicular movement made on a circular green or flashing yellow arrow indication after yielding to vehicles or pedestrians. A *protected left turn* is a vehicle movement made in the absence of conflicting vehicular and pedestrian movements and generally during the display of a steady green arrow.

Some kind of left-turn protection should be considered at signalized intersections when any one of the following criteria is satisfied [1]:

a) Left-turn volume routinely exceeds 200 vehicles per hour *or* the product of opposing and left-turn hourly volumes exceeds:
   - 50,000, if there is one opposing lane, or
   - 100,000, if there are two opposing lanes.

   In situations where there is significant lane imbalance, twice the highest single lane volume can be substituted for the total opposing hourly volume when making this calculation.

   Left-turn phasing may be installed initially if projected volumes would warrant it within five years after the traffic signal is placed in service. Design of traffic signals not initially meeting left-turn phasing criteria should provide for their addition in the future.

b) The left-turning movement crosses three or more lanes of opposing through traffic.

c) The posted speed of opposing traffic exceeds 45 mph.

d) Recent crash history indicates three or more left-turning type crashes per approach in a consecutive12-month period within the last three years. Left-turning crashes involving pedestrians should be included.

e) Sight distances to oncoming traffic are less than the minimum distances below:

Speed (MPH)	Minimum Sight Distance in Feet (Meters)
20	200 (60)
25	250 (75)
30	300 (90)
35	350 (105)
40	400 (120)
45	450 (135)

f) An opposing left-turn approach has a left-turn signal or meets one or more of these criteria.

g) An engineering study indicates a need for left-turn phasing. Items that may be considered include, but are not necessarily limited to, pedestrian volumes, traffic signal progression, geometric design, maneuverability of particular classes of vehicles, adequacy of gaps, or operational requirements unique to preemption systems.

2. *Protected Only* Left-Turn Phasing

Protected Only phasing should be considered when an engineering study indicates any of the following conditions is present:

a) Left-turn volume routinely exceeds 300 vehicles per hour or the product of opposing and left-turn hourly volumes exceed 150,000 for one opposing lane or 300,000 for two opposing lanes. In situations where there is significant lane imbalance, twice the highest single lane volume can be substituted for the total opposing hourly volume when making this calculation.

b) The posted speed of opposing traffic exceeds 45 mph.

c) Recent crash history indicates five or more left-turning type crashes per approach in a consecutive 12-month period within the last three years. Left-turning crashes involving pedestrians should be included.

d) The left-turn movement crosses three or more lanes of opposing traffic.

e) Multiple left-turn lanes are provided. (See OAR 734-020-0135 and 0140 which is included as Attachment 1.)

f) Sight distances to oncoming traffic are less than the minimum distances below:

Speed (MPH)	Minimum Sight Distance in Feet (Meters)
20	200 (60)
25	250 (75)
30	300 (90)
35	350 (105)
40	400 (120)
45	450 (135)

g) U-turns are permitted. (*Protected Only* left-turn phasing is required by OAR 734-020-0025 whenever U-turns are permitted at a signalized intersection.)

h) The signal is located in a traffic signal system and lead lag phasing is required for efficient operation. This criterion does not apply if a flashing yellow arrow display can be installed.

i) Additional factors such as high pedestrian volumes, traffic signal progression, geometric design, maneuverability of particular classes of vehicles, adequacy of gaps, or operational requirements unique to preemption systems.

3. *Protected/Permissive* and *Permissive/Protected* Left-Turn Phasing

When the left-turn movement is protected during the first part of the phase and permissive during the second part of the phase, the phasing is referred to as *Protected/Permissive*. If the left turn is permissive during the first part of the phase and protected during the second part it is referred to as *Permissive/Protected*. Both of these are referred to as *PPLT phasing* in these *Guidelines*. *PPLT* phasing should be considered at sites that satisfy criteria for left-turn phasing, but do not meet any of the *Protected Only* left-turn phasing criteria given above.

An engineering study should be performed to assess the conditions at an intersection before determining whether or not *PPLT* phasing is appropriate.

If the Flashing Yellow Arrow display is used, the determination of whether the protected portion of the phase should precede or follow the permissive portion of the phase should be made on the basis of operational requirements and efficiencies.

When the previously standard doghouse type display is used, the protected portion of the cycle should normally precede the permissive part of the cycle. If either of the following situations is present with the doghouse display the protected portion of the cycle can precede or follow the permissive portion of the cycle:

- the intersection is a “T” type with no opposing left turn, or
- the opposing left turn is a prohibited movement or no opposing left turn exists, such as a one-way side street.

4. Modifying Left-Turn Signal Phasing

The removal of *Protected Only* left-turn phasing requires the completion of an engineering study. The engineering study should consider each of the criteria given in IV.A.2.i. as well as the following:

a) The crash history prior to the installation of the protected left turn. If the signal was installed due to left-turn crashes, *Protected Only* phasing should be maintained unless the engineering study indicates a reduction in potential vehicle conflicts.

b) The recent crash history to determine if there is evidence that a reduction in rear-end crashes may be achieved.

c) An estimate of the expected reduction in delay per vehicle entering the intersection if the phasing change were implemented.

If crashes increase significantly after the phasing is modified, *Protected Only* left-turn phasing should be reinstalled.

5. Standard Practices Regarding Left-Turn Signals

a) *Protected Only* Left-Turn Phasing

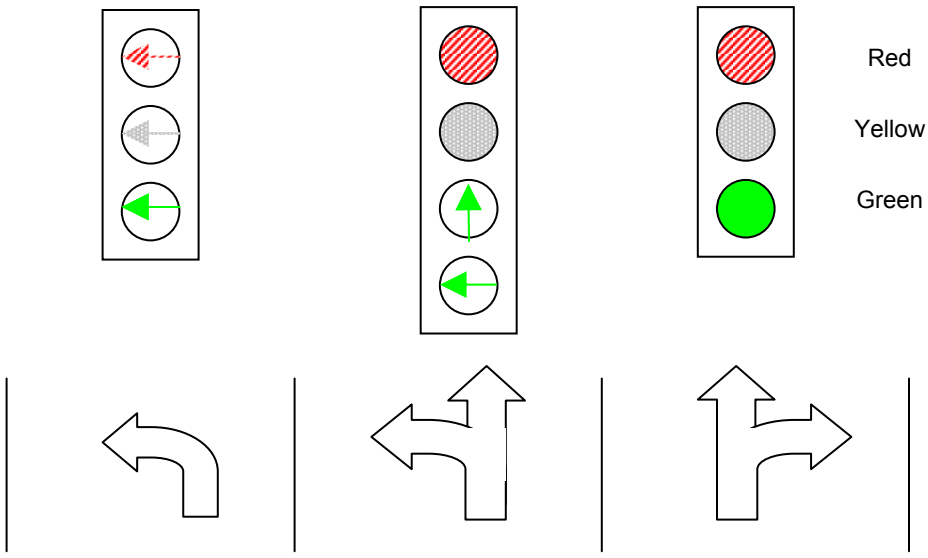
(1) *Protected Only* left-turn phasing using non-programmed visibility signal heads shall have all arrow indications.

(2) *Protected Only* left-turn phasing for a lane sharing left turns with other movements should have a green arrow indication in addition to the circular green indication. If the left turn leads an opposing conflicting phase, a yellow left-turn arrow indication is required.

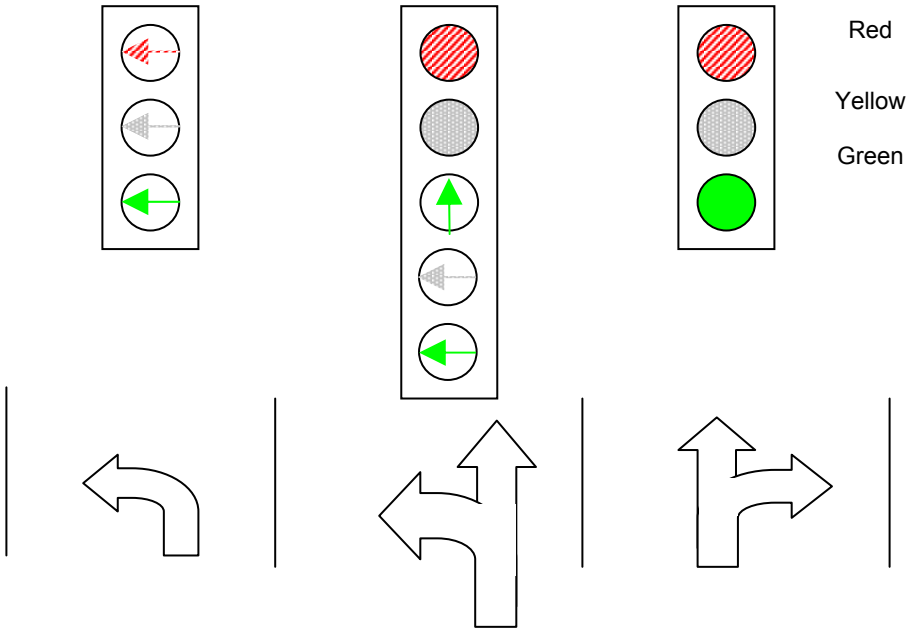
(3) When *Protected Only* left-turn phasing is used for a left-turn lane and the adjacent lane is a “left-through” option lane, the following display should be used:

A three section head with all turn arrow indications over the left-turn lane and either:

- A four section head with circular red, circular yellow, green vertical arrow, and green left-turn arrow when the left turn is lagging, or

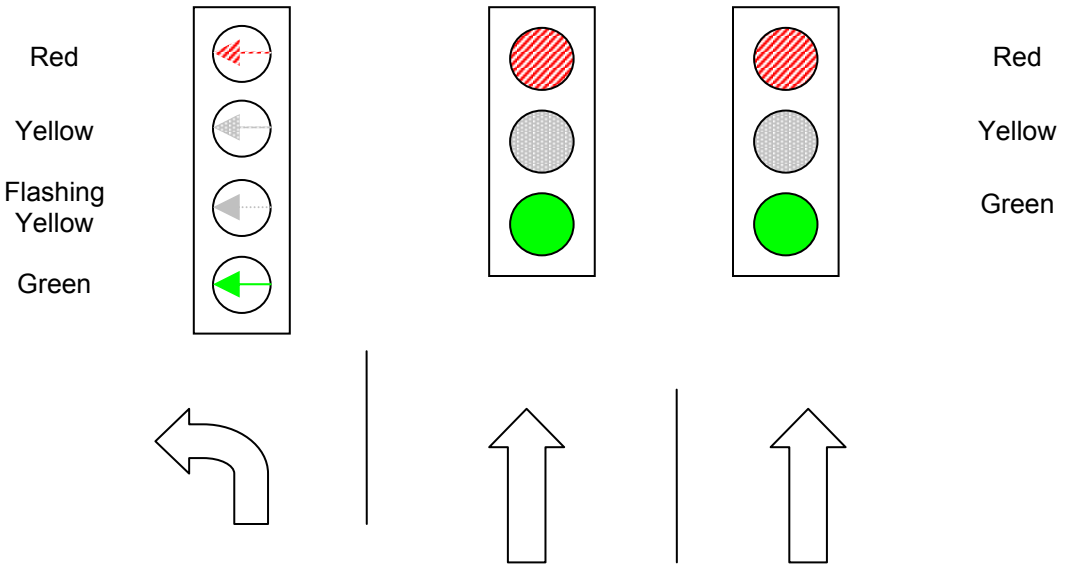


- A five section vertically stacked head with the addition of a yellow left-turn arrow over the option lane when the left turn is leading.



b) *PPLT* Phasing

(1) New installations of *PPLT* phasing should use a four-section vertical head with a flashing yellow arrow.



This display is currently subject to Federal Highway Administration approval as an experimental feature. A request for approval must be prepared and submitted to FHWA through the Traffic Management Section.

(2) A five-section head, known as a doghouse type display, placed over the lane line between the left-turn lane and the through lane may continue to be used. When this display is used a sign is normally placed to the left of the five-section head saying "LEFT TURN YIELD ON GREEN" with a symbolic green ball. (MUTCD R10-12). Figure 1 shows *PPLT* displays that are acceptable for previous installations but not for new designs on state highways unless approved by the State Traffic Engineer.

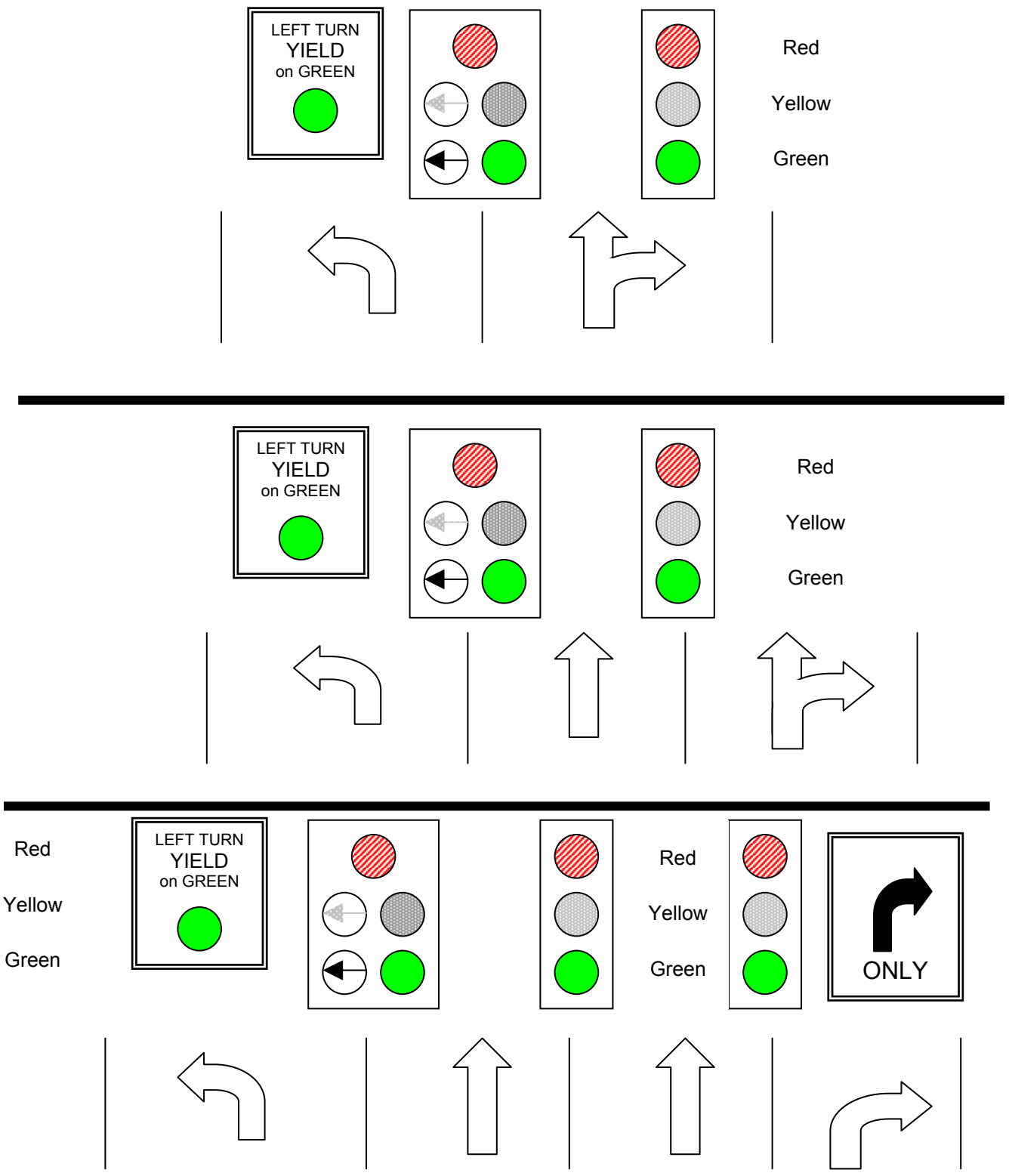
6. Optional Practices Regarding Left-Turn Signals

a) *Permissive* (non-phased) left-turn lanes may have a "LEFT TURN YIELD TO ONCOMING TRAFFIC" (OR 17-1) or a "LEFT TURN YIELD ON GREEN" with a symbolic green ball (MUTCD R10-12) sign over the left-turn lane.

b) *Protected Only* Left-Turn Phasing

(1) *Protected Only* left-turn phasing should use programmed visibility signal heads only when required to prevent driver confusion caused by closely spaced signals that display conflicting indications for a particular vehicle movement.

Figure 1: Standard Signal Head Placement for PPLT Displays
(Not acceptable for new designs on state highways.)



Location of heads may be adjusted based on geometry of specific design.
All vehicle signal heads use 305mm indications.

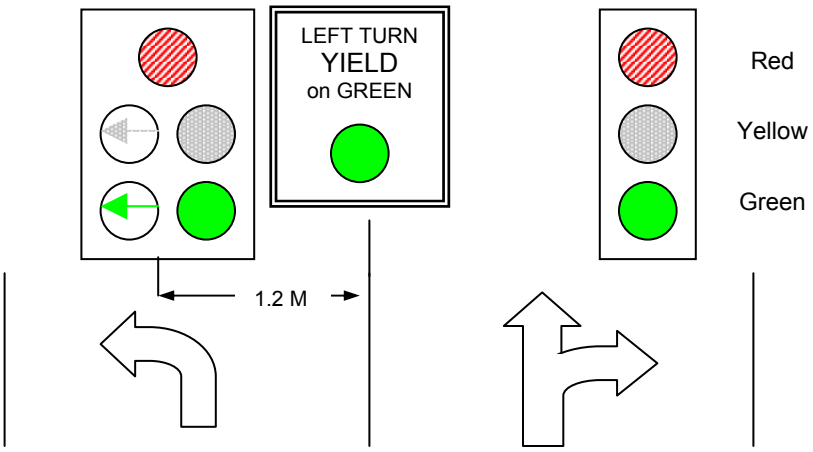
(2) *Protected Only* left-turn phasing may use a "LEFT TURN SIGNAL" sign. (MUTCD R10-10.)

c) *PPLT* Phasing

(1) *PPLT* phasing should use programmed visibility signal heads only when required to prevent driver confusion caused by closely spaced signals that display conflicting indications for a particular vehicle movement.

(2) *PPLT* phasing may have a five section signal head for the left-turn lane with "LEFT TURN YIELD ON GREEN with a symbolic green ball sign (MUTCD R10-12) to the right of the head.

Retrofit Only – Not for new traffic signal designs



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[1]For additional information on the criteria regarding left-turn phasing types refer to the following publications:

Stamatiadis, Nikiforos, Kenneth R. Agent, and Apostolos Bizakis, "Guidelines for Left-Turn Phasing Treatment," Transportation Research Record 1605, TRB, National Resarch Council, Washington D.C., 1997, pp. 1-7.

ITE Committee TENC 4A-30, Recommended Guidelines for Protected/Permissive Left-Turn Phasing, 1999.

Attachment 1

Multiple Right or Left Turns at Highway Intersections

734-020-0135

General Policy

The Oregon Transportation Commission has delegated the authority to the Chief Engineer to designate intersections on the State Highway System to and from which multiple right or left turns may safely be accomplished and where vehicle capacity dictates this traffic engineering feature for the convenience of the motoring public.
Stat. Auth.: ORS 184, ORS 366 & ORS 810
Stats. Implemented: ORS 810.200
Hist.: 2HD 7-1981, f. & ef. 10-2-81; 2HD 7-1984, f. & ef. 4-18-84

734-020-0140

Criteria for Multiple Left or Right Turn Movements

(1) Multiple left or right turns will only be authorized on the basis of an engineering study to review any accident or safety problems that might result. The study may include the following items:
(a) The engineering study may include a capacity analysis. The analysis must clearly demonstrate an improved level of service with multiple turning movements and/or with other considerations not to lower the level of service;
(b) Delay and backup of traffic in the approach under consideration will be a factor in the engineering study to implement the multiple turn treatment;
(c) The multiple-turn engineering study may involve turns from the local agency street or roadway system at the approaches to the State Highway System;
(d) The engineering study will consider truck or other wide turning path vehicles and adequate multiple turning lane widths; and
(e) A part of every study will consider special striping or raised pavement markers to delineate the multiple turning movement and advance signing as required.
(2) The Traffic Engineer will maintain a file on all new approved locations.
(3) Proposed locations involving traffic on side streets at the approach to the State Highway System will have as a part of the file a written notification of intent to the local agency.
Stat. Auth.: ORS 184, ORS 366 & ORS 810
Stats. Implemented: ORS 810.200
Hist.: 2HD 7-1981, f. & ef. 10-2-81; 2HD 7-1984, f. & ef. 4-18-84