

## Part 4 HIGHWAY TRAFFIC SIGNALS May 16, 2011

- Paragraphs are numbered
- *Guidance is italicized*
- No more metric
- Definitions relocated to Part 1

**Standard:**

13 **In cases where irregular street design necessitates placing signal with a comparatively small angle between their respective signal and shall, to the extent practical, be visibility-limited by signal visors, signal an approaching road user's view of the signal indication(s) controlling is minimized.**

14 **Signal visors exceeding 12 inches in length shall not be used on f**  
*Guidance:*

15 *Signal visors should be used on signal faces to aid in directing the s approaching traffic, as well as to reduce "sun phantom," which can res*

16 *The use of signal visors, or the use of signal faces or devices that di intensity, should be considered as an alternative to signal louvers becau by signal louvers.*

**Option:**

17 **Special signal faces, such as visibility-limited signal faces, may be u signal indications intended for other approaches before seeing the signal simultaneous viewing of both signal indications could cause the road use**

- **Standards remain bold**
- Options and support remain unformatted

### Standard:

01 When used in this Manual, the text headings of Standard, Guidance, Option, and Support shall be defined as follows:

- A. **Standard**—a statement of required, mandatory, or specifically prohibitive practice regarding a traffic control device. All Standard statements are labeled, and the text appears in bold type. The verb “shall” is typically used. The verbs “should” and “may” are not used in Standard statements. Standard statements are sometimes modified by Options. Standard statements shall not be modified or compromised based on engineering judgment or engineering study.
- B. **Guidance**—a statement of recommended, but not mandatory, practice in typical situations, with deviations allowed if engineering judgment or engineering study indicates the deviation to be appropriate. All Guidance statements are labeled, and the text appears in unbold type. The verb “should” is typically used. The verbs “shall” and “may” are not used in Guidance statements. Guidance statements are sometimes modified by Options.
- C. **Option**—a statement of practice that is a permissive condition and carries no requirement or recommendation. Option statements sometime contain allowable modifications to a Standard or Guidance statement. All Option statements are labeled, and the text appears in unbold type. The verb “may” is typically used. The verbs “shall” and “should” are not used in Option statements.
- D. **Support**—an informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. Support statements are labeled, and the text appears in unbold type. The verbs “shall,” “should,” and “may” are not used in Support statements.

- **Standards are requirements that SHALL be followed unless there is an Option**
- *Guidance is recommended and SHOULD be followed*
- Options MAY be followed and are sometimes modifications to Standards and Guidance



**Location: Unknown  
(hopefully not in Delaware!)**



- **New Chapters**
  - Pedestrian Hybrid Beacons (Chapter 4F)
  - Highway Traffic Signals at Toll Plazas (Chapter 4K)
- **Many New Sections & Lots of Reorganization within Chapters**
  - Will be discussed throughout presentation
- **Very few Delaware Revisions**

- 4A: General
- 4B: Traffic Control Signals - General
- 4C: Traffic Control Signal Needs Studies
- 4D: Traffic Control Signal Features
- 4E: Pedestrian Control Features
- **4F: Pedestrian Hybrid Beacons (New)**
- 4G: Traffic Control Signals and Hybrid Beacons for Emergency-Vehicle Access
- 4H: Traffic Control Signals for One-Lane, Two-Way Facilities
- 4I: Traffic Control Signals for Freeway Entrance Ramps
- 4J: Traffic Control for Movable Bridges
- **4K: Highway Traffic Signals at Toll Bridges (New)**
- 4L: Flashing Beacons
- 4M: Lane-Use Control Signals
- 4N: In-Roadway Lights



**Location: Melbourne, Australia**

Guidance: **DRAFT**

05 (DE Revision) *If the engineering study indicates that the traffic control signal is no longer justified, and a decision is made to remove the signal, removal should be accomplished using the following steps:*

- A. *Determine the appropriate traffic control to be used after removal of the signal.*
- B. *Remove any sight-distance restrictions as necessary.*
- C. *Inform the public of the removal study. A SIGNAL UNDER STUDY FOR REMOVAL (D12-6-DE) sign (see Figure 2I-8) should be installed at an intersection to inform motorists of the potential removal of an existing traffic signal.*
- D. *Flash or cover the signal heads for a minimum of 90 days, and install the appropriate stop control or other traffic control devices.*
- E. *Remove the signal if the engineering data collected during the removal study period confirms that the signal is no longer needed.*

## Revised Guidance

- *Procedures for removing a traffic signal changed from Option to Guidance*

## DE Revision:

- *A SIGNAL UNDER STUDY FOR REMOVAL (D12-6-DE) sign should be installed*







**INTERSECTION EPIC FAIL**

## Section 4C.04 – Warrant 3, Peak Hour

### Option:

05 If this warrant is the only warrant met and a traffic control signal is justified by an engineering study, the traffic control signal may be operated in the flashing mode during the hours that the volume criteria of this warrant are not met.

### Guidance:

06 *If this warrant is the only warrant met and a traffic control signal is justified by an engineering study, the traffic control signal should be traffic-actuated.*

New Option and Guidance (similar to provisions for Warrants 4 and 5)

- When only Warrant 3 is met:
  - Signal may be operated in flashing mode during off-peak
  - *Signal should be traffic-actuated*

*Note: While not modified in MUTCD, in DE, signals should operate full-time.*



*(DelDOT in the process of converting signal to full-time...)*

**Walther Ave. at Barrett Run**

# Section 4C.05 – Warrant 4, Pedestrian Volume

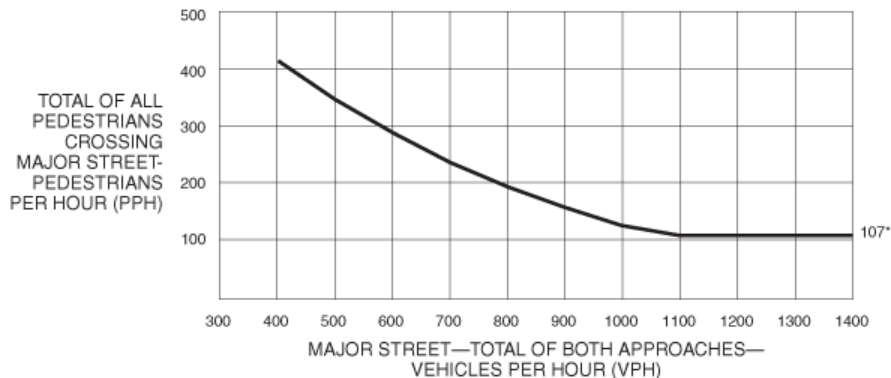
## Standard:

- 02 The need for a traffic control signal at an intersection or midblock crossing shall be considered if an engineering study finds that one of the following criteria is met:
- A. For each of any 4 hours of an average day, the plotted points representing the vehicles per hour on the major street (total of both approaches) and the corresponding pedestrians per hour crossing the major street (total of all crossings) all fall above the curve in Figure 4C-5; or
  - B. For 1 hour (any four consecutive 15-minute periods) of an average day, the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding pedestrians per hour crossing the major street (total of all crossings) falls above the curve in Figure 4C-7.

## Significant Change in Criteria

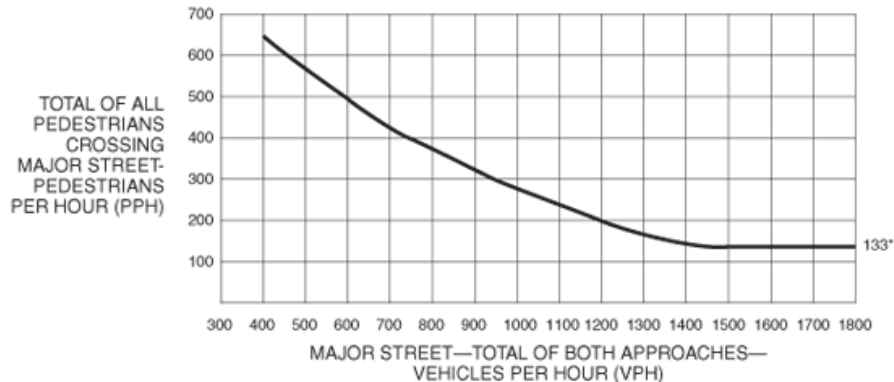
- **Warrant met with plotted points of Four-Hour OR Peak Hour pedestrian and vehicle volumes**
- Previously, both had to be met

Figure 4C-5. Warrant 4, Pedestrian Four-Hour Volume



\*Note: 107 pph applies as the lower threshold volume.

Figure 4C-7. Warrant 4, Pedestrian Peak Hour



\*Note: 133 pph applies as the lower threshold volume.



## Section 4C.05 – Warrant 4, Pedestrian Volume

### Option:

- 03 If the posted or statutory speed limit or the 85th-percentile speed on the major street exceeds 35 mph, or if the intersection lies within the built-up area of an isolated community having a population of less than 10,000, Figure 4C-6 may be used in place of Figure 4C-5 to evaluate Criterion A in Paragraph 2, and Figure 4C-8 may be used in place of Figure 4C-7 to evaluate Criterion B in Paragraph 2.
- 07 The criterion for the pedestrian volume crossing the major street may be reduced as much as 50 percent if the 15th-percentile crossing speed of pedestrians is less than 3.5 feet per second.

### Additional Options

- If speeds exceed 35 mph, a 70% factor reduction of Four-Hour and Peak Hour criteria may be used
- Pedestrian volume criteria may be reduced up to 50% if 15<sup>th</sup>-percentile speed of pedestrians is 3.5 s or less

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### Net Effect of Warrant 4 Changes:

***Warrant 4 is now slightly easier to meet with lower pedestrian volumes but slightly more difficult to meet with low vehicle volumes***



# Section 4C.05 – Warrant 4, Pedestrian Volume

**SR 299 & Middletown H.S.**



Example of a site that did not meet old warrants but did meet the new ped warrant

*Guidance:*

- 06 *If this warrant is met and a traffic control signal is justified by an engineering study, then:*
- A. *If it is installed at an intersection or major driveway location, the traffic control signal should also control the minor-street or driveway traffic, should be traffic-actuated, and should include pedestrian detection.*

## Additional Guidance – Sections 4C.05 & 4C.06

- *Signals installed at intersections based only on Warrants 4 or 5 should also control the minor street or driveway*



**A.I. duPont Middle School @  
Hopeton Rd**

*Guidance:*

- 06 *If this warrant is met and a traffic control signal is justified by an engineering study, then:*
- B. If it is installed at a non-intersection crossing, the traffic control signal should be installed at least 100 feet from side streets or driveways that are controlled by STOP or YIELD signs, and should be pedestrian-actuated. If the traffic control signal is installed at a non-intersection crossing, at least one of the signal faces should be over the traveled way for each approach, parking and other sight obstructions should be prohibited for at least 100 feet in advance of and at least 20 feet beyond the crosswalk or site accommodations should be made through curb extensions or other techniques to provide adequate sight distance, and the installation should include suitable standard signs and pavement markings.*
  - C. Furthermore, if it is installed within a signal system, the traffic control signal should be coordinated.*

## Additional Guidance – Sections 4C.05 & 4C.06

- *Signalized mid-block pedestrian crossings should be:*
  - *>100' from any STOP or YIELD controlled approach*
  - *Pedestrian actuated*
  - *Designed with adequate SD, through curb extensions or other techniques*
  - *Coordinated with adjacent signals if on an actuated corridor*



**Faulk Rd Mid-Block Crossing  
@ Brandywine H.S.**

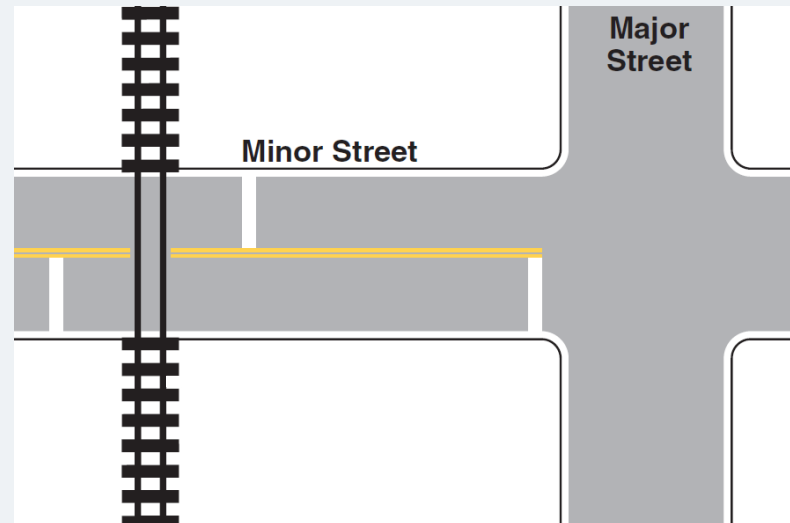


## Support:

- 01 The Intersection Near a Grade Crossing signal warrant is intended for use at a location where none of the conditions described in the other eight traffic signal warrants are met, but the proximity to the intersection of a grade crossing on an intersection approach controlled by a STOP or YIELD sign is the principal reason to consider installing a traffic control signal.

## New Warrant 9 – Intersection Near a Grade Crossing

- Warrant 9 is intended for locations where:
  - No other signal warrants are met
  - Proximity of the intersection to a grade crossing is the principal reason to consider a traffic signal





## Guidance:

02 *This signal warrant should be applied only after adequate consideration has been given to other alternatives or after a trial of an alternative has failed to alleviate the safety concerns associated with the grade crossing. Among the alternatives that should be considered or tried are:*

- A. *Providing additional pavement that would enable vehicles to clear the track or that would provide space for an evasive maneuver, or*
- B. *Reassigning the stop controls at the intersection to make the approach across the track a non-stopping approach.*

## New Warrant 9 – Intersection Near a Grade Crossing

- *Warrant 9 should be applied only after alternatives such as providing additional pavement or re-assigning stop controls at the intersection have been considered*



Front St @ SR 15

## Standard:

03 The need for a traffic control signal shall be considered if an engineering study finds that both of the following criteria are met:

- A. A grade crossing exists on an approach controlled by a STOP or YIELD sign and the center of the track nearest to the intersection is within 140 feet of the stop line or yield line on the approach; and
- B. During the highest traffic volume hour during which rail traffic uses the crossing, the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the minor-street approach that crosses the track (one direction only, approaching the intersection) falls above the applicable curve in Figure 4C-9 or 4C-10 for the existing combination of approach lanes over the track and the distance D, which is the clear storage distance as defined in Section 1A.13.

## New Warrant 9 – Intersection Near a Grade Crossing

- **A traffic signal shall be considered if both of the following conditions are met:**
  - **Grade crossing is within 140 feet of stop or yield line of nearby intersection**
  - **Plotted point is higher than applicable curve in Figure 4C-9 or 4C-10**



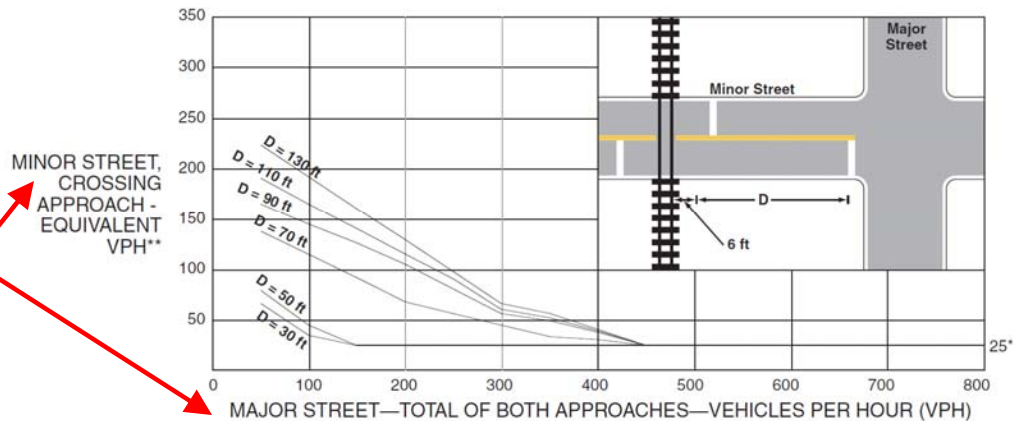
## Considerations for plotting on Figure 4C-9 and 4C-10

- Highest Major and Minor Street traffic volumes when rail traffic uses the crossing

*If rail traffic arrival times are unknown, the highest traffic volume hour of the day should be used*

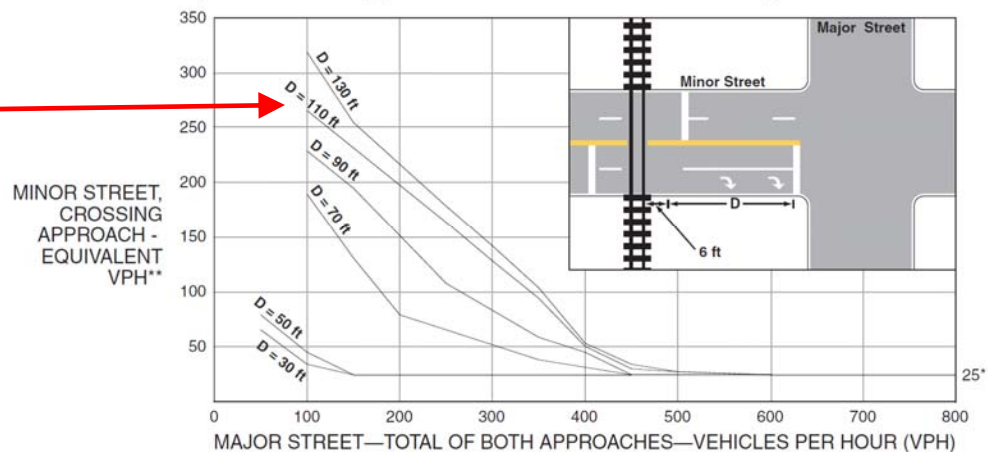
- Clear Storage Distance between track and Major Street

Figure 4C-9. Warrant 9, Intersection Near a Grade Crossing (One Approach Lane at the Track Crossing)



\* 25 vph applies as the lower threshold volume  
 \*\* VPH after applying the adjustment factors in Tables 4C-2, 4C-3, and/or 4C-4, if appropriate

Figure 4C-10. Warrant 9, Intersection Near a Grade Crossing (Two or More Approach Lanes at the Track Crossing)



\* 25 vph applies as the lower threshold volume  
 \*\* VPH after applying the adjustment factors in Tables 4C-2, 4C-3, and/or 4C-4, if appropriate

**Option:**

06 Because the curves are based on an average of four occurrences of rail traffic per day, the vehicles per hour on the minor-street approach may be multiplied by the adjustment factor shown in Table 4C-2 for the appropriate number of occurrences of rail traffic per day.

07 Because the curves are based on typical vehicle occupancy, if at least 2% of the vehicles crossing the track are buses carrying at least 20 people, the vehicles per hour on the minor-street approach may be multiplied by the adjustment factor shown in Table 4C-3 for the appropriate percentage of high-occupancy buses.

08 Because the curves are based on tractor-trailer trucks comprising 10% of the vehicles crossing the track, the vehicles per hour on the minor-street approach may be multiplied by the adjustment factor shown in Table 4C-4 for the appropriate distance and percentage of tractor-trailer trucks.

- Minor-street approach volume may be adjusted by up to 3 factors:

1. Daily frequency of rail traffic
2. Percentage of high-occupancy buses
3. Percentage of tractor-trailer trucks

1.

Rail Traffic per Day	Adjustment Factor
1	0.67
2	0.91
3 to 5	1.00
6 to 8	1.18
9 to 11	1.25
12 or more	1.33

2.

% of High-Occupancy Buses* on Minor-Street Approach	Adjustment Factor
0%	1.00
2%	1.09
4%	1.19
6% or more	1.32

3.

% of Tractor-Trailer Trucks on Minor-Street Approach	Adjustment Factor	
	D less than 70 feet	D of 70 feet or more
0% to 2.5%	0.50	0.50
2.6% to 7.5%	0.75	0.75
7.6% to 12.5%	1.00	1.00
12.6% to 17.5%	2.30	1.15
17.6% to 22.5%	2.70	1.35
22.6% to 27.5%	3.28	1.64
More than 27.5%	4.18	2.09



## Standard:

09 **If this warrant is met and a traffic control signal at the intersection is justified by an engineering study, then:**

- A. **The traffic control signal shall have actuation on the minor street;**
- B. **Preemption control shall be provided in accordance with Sections 4D.27, 8C.09, and 8C.10; and**
- C. **The grade crossing shall have flashing-light signals**  
(see Chapter 8C).

## Guidance:

10 *If this warrant is met and a traffic control signal at the intersection is justified by an engineering study, the grade crossing should have automatic gates (see Chapter 8C).*

- **Traffic signals justified by Warrant 9 shall have:**
  - **Actuation on minor street**
  - **Train preemption control**
  - **Flashing-light signals**
- *Automatic gates should be installed*





# Section 4C.10 – Warrant 9, Intersection Near a Grade Crossing



**Reybold near SR 72**



# Chapter 4D – TRAFFIC CONTROL SIGNAL FEATURES





- **Major Reorganization of Sections in Chapter 4D**
  - **Similar subjects grouped together in adjacent sections or combined in one section**



*Guidance:*

06 *If it is necessary or desirable to prohibit certain pedestrian movements at a traffic control signal location, No Pedestrian Crossing (R9-3) signs (see Section 2B.51) should be used if it is not practical to provide a barrier or other physical feature to physically prevent the pedestrian movements.*

## Upgraded from Option to Guidance

- R9-3 signs should be used to prohibit pedestrian movements at a signal location if it is not practical to provide a barrier or other physical feature*



R9-3



R9-3b



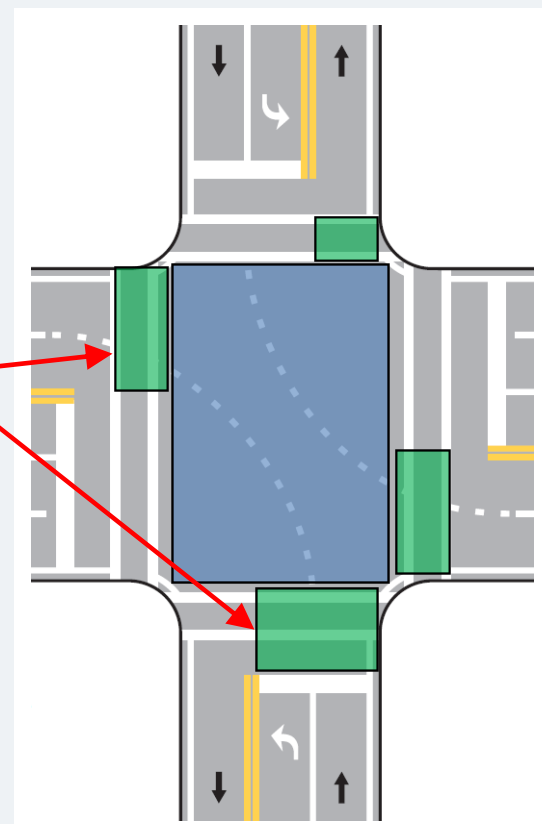
**U of D Football Stadium**

Support:

02 The physical area that is defined as being “within the intersection” is dependent upon the conditions that are described in the definition of intersection in Section 1A.13.

Revised Definition of “Intersection” (reference to Section 1A.13)

- **At a location controlled by a traffic signal, these areas shall also be a part of the intersection:**
  - On approach, the area within crosswalk and/or beyond stop/yield line
  - On departure, area extending to far side of crosswalk
  - At median of divided highway if no stop or yield lines are designated



### Standard: **DRAFT**

03 (DE Revision) The following meanings shall be given to highway traffic signal indications for vehicles and pedestrians:

2. Vehicular traffic facing a steady RED ARROW signal indication shall not enter the intersection to make the movement indicated by the arrow and, unless entering the intersection to make another movement permitted by another signal indication, shall stop at a clearly marked stop line; but if there is no stop line, before entering the crosswalk on the near side of the intersection; or if there is no crosswalk, then before entering the intersection; and shall remain stopped until a signal indication or other traffic control device permitting the movement indicated by such RED ARROW is displayed. When a traffic control device is in place permitting a turn on a steady RED ARROW signal indication, vehicular traffic facing a steady RED ARROW signal indication is permitted to enter the intersection to make the movement indicated by the arrow signal indication, after stopping. The right to proceed with the turn shall be limited to the direction indicated by the arrow and shall be subject to the rules applicable after making a stop at a STOP sign. Pursuant to Delaware Code, Title 21, Chapter 41, Subchapter II, §4108, right turns are not permitted on a steady RED ARROW signal indication. Therefore, traffic control devices permitting turns on a steady RED ARROW shall not be used.

### DE Revision:

- Traffic Control Devices permitting turns on steady red arrow shall not be used



### Standard:

#### E. Flashing yellow signal indications shall have the following meanings:

1. Vehicular traffic, on an approach to an intersection, facing a flashing **CIRCULAR YELLOW** signal indication is permitted to cautiously enter the intersection to proceed straight through or turn right or left or make a U-turn except as such movement is modified by lane-use signs, turn prohibition signs, lane markings, roadway design, separate turn signal indications, or other traffic control devices.

Such vehicular traffic, including vehicles turning right or left or making a U-turn, shall yield the right-of-way to:

- (a) Pedestrians lawfully within an associated crosswalk, and
- (b) Other vehicles lawfully within the intersection.

### Clarification of Standard – Flashing Yellow

- **Vehicles entering intersection on flashing yellow (circular or arrow) shall yield to:**
  - pedestrians lawfully within crosswalk
  - vehicles lawfully within intersection
- Previous standard: vehicles entering intersection on flashing yellow are permitted to proceed with caution



**Walther Ave. at Barrett Run**

**Standard:**

**E. Flashing yellow signal indications shall have the following meanings:**

1. Vehicular traffic, on an approach to an intersection, facing a flashing **CIRCULAR YELLOW** signal indication is permitted to cautiously enter the intersection to proceed straight through or turn right or left or make a U-turn except as such movement is modified by lane-use signs, turn prohibition signs, lane markings, roadway design, separate turn signal indications, or other traffic control devices.

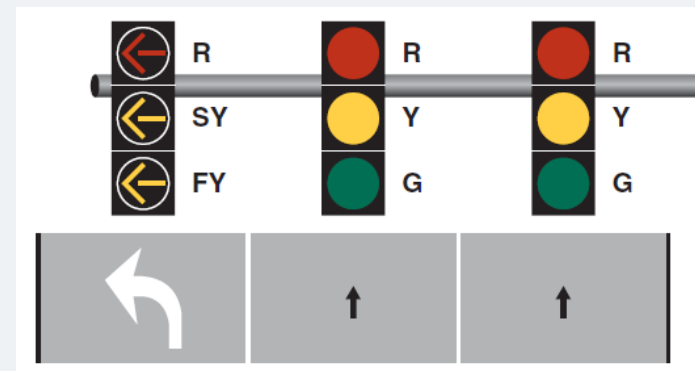
Such vehicular traffic, including vehicles turning right or left or making a U-turn, shall yield the right-of-way to:

- (a) Pedestrians lawfully within an associated crosswalk, and
- (b) Other vehicles lawfully within the intersection.

In addition, vehicular traffic turning left or making a U-turn to the left shall yield the right-of-way to other vehicles approaching from the opposite direction so closely as to constitute an immediate hazard during the time when such turning vehicle is moving across or within the intersection.

## Clarification of Standard – Flashing Yellow (continued)

- **Vehicles turning left or making a U-turn on flashing yellow (circular or arrow) shall yield to other vehicles approaching from the opposite direction**
- Previous standard: vehicles entering intersection on flashing yellow are permitted to proceed with caution



**Standard:**

**E. Flashing yellow signal indications shall have the following meanings:**

- 3. Pedestrians facing any flashing yellow signal indication at an intersection, unless otherwise directed by a pedestrian signal indication or other traffic control device, are permitted to proceed across the roadway within any marked or unmarked associated crosswalk. Pedestrians shall yield the right-of-way to vehicles lawfully within the intersection at the time that the flashing yellow signal indication is first displayed.**

### Clarification of Standard – Flashing Yellow (continued)

- Pedestrians facing a flashing yellow signal are permitted to proceed across the roadway but must yield to vehicles lawfully within intersection**



**Walther at Barrett Run**



## Section 4D.04 – Meaning of Vehicular Signal Indications

### Standard:

E. Flashing yellow signal indications shall have the following meanings:

4. When a flashing **CIRCULAR YELLOW** signal indication(s) is displayed as a beacon (see Chapter 4L) to supplement another traffic control device, road users are notified that there is a need to pay extra attention to the message contained thereon or that the regulatory or warning requirements of the other traffic control device, which might not be applicable at all times, are currently applicable.

### Clarification of Standard – Flashing Yellow (continued)

- A flashing circular yellow indication displayed as a beacon alerts road users of the need to pay extra attention to a traffic control device



Old Capital Trail



Railroad underpass along  
Casho Mill Rd

Note: Here,  
beacons do not  
supplement a  
TCD

## Section 4D.04 – Meaning of Vehicular Signal Indications

### Standard:

#### F. Flashing red signal indications shall have the following meanings:

3. Pedestrians facing any flashing red signal indication at an intersection, unless otherwise directed by a pedestrian signal indication or other traffic control device, are permitted to proceed across the roadway within any marked or unmarked associated crosswalk. Pedestrians shall yield the right-of-way to vehicles lawfully within the intersection at the time that the flashing red signal indication is first displayed.

### Clarified of Standard - Flashing Red

- Pedestrians facing a flashing red signal are permitted to proceed across the roadway but must yield to vehicles lawfully within intersection
- Previously, no discussion of pedestrians at flashing red signals





**Standard:**

**F. Flashing red signal indications shall have the following meanings:**

4. When a flashing CIRCULAR RED signal indication(s) is displayed as a beacon (see Chapter 4L) to supplement another traffic control device, road users are notified that there is a need to pay extra attention to the message contained thereon or that the regulatory requirements of the other traffic control device, which might not be applicable at all times, are currently applicable. Use of this signal indication shall be limited to supplementing STOP (R1-1), DO NOT ENTER (R5-1), or WRONG WAY (R5-1a) signs, and to applications where compliance with the supplemented traffic control device requires a stop at a designated point.

**Clarified of Standard - Flashing Red (continued)**

- **A flashing circular red indication displayed as a beacon shall be limited to use with STOP, DO NOT ENTER, WRONG WAY or other traffic control devices that require a stop**



**Crystal Lake, IL ?**



Alternating beacons not correct. But recently fixed....



**SR 15 at Barratts Chapel Rd**



## Section 4D.04 – Meaning of Vehicular Signal Indications

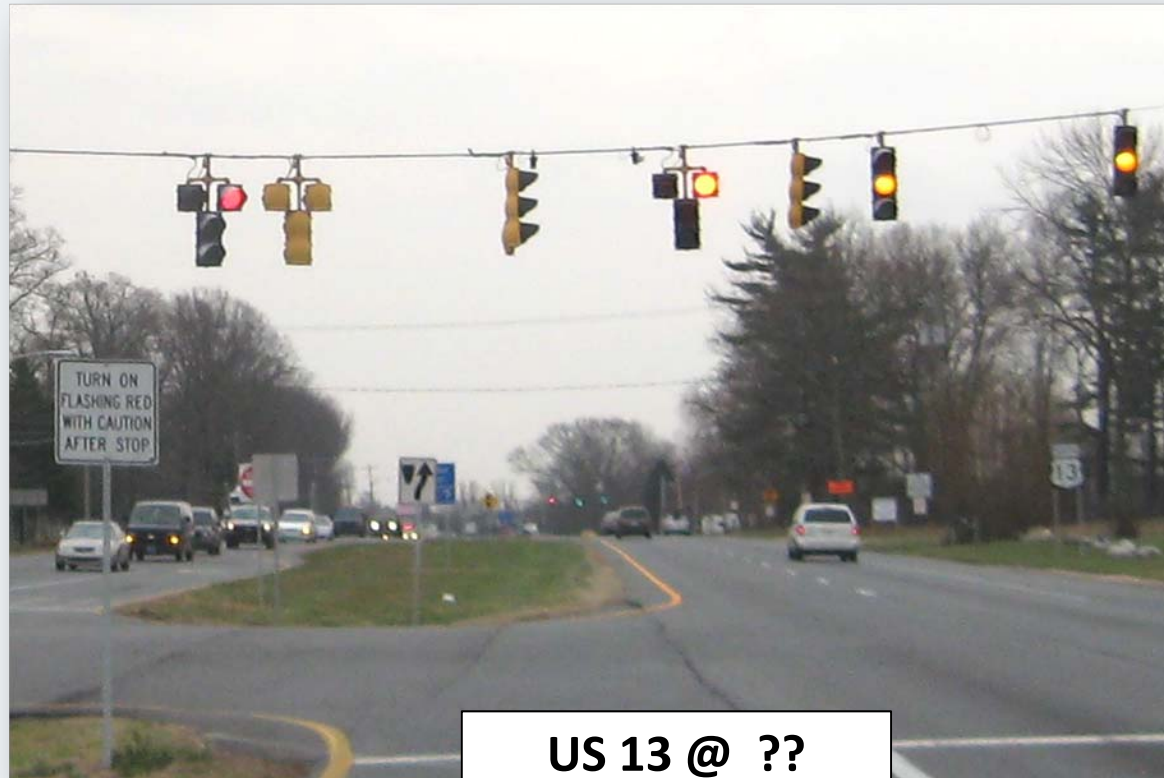
### Standard:

#### F. Flashing red signal indications shall have the following meanings:

2. Vehicular traffic, on an approach to an intersection, facing a flashing RED ARROW signal indication if intending to turn in the direction indicated by the arrow shall stop at a clearly marked stop line; but if there is no stop line, before entering the crosswalk on the near side of the intersection; or if there is no crosswalk, at the point nearest the intersecting roadway where the driver has a view of approaching traffic on the intersecting roadway before entering the intersection. The right to proceed with the turn shall be limited to the direction indicated by the arrow and shall be subject to the rules applicable after making a stop at a STOP sign.

### Clarified of Standard - Flashing Red Signals (continued)

- Note: Flashing Red Arrows (FRA) are still allowed, however, Sections 4D.05 and 4D.17 impact how we can use them in Delaware...

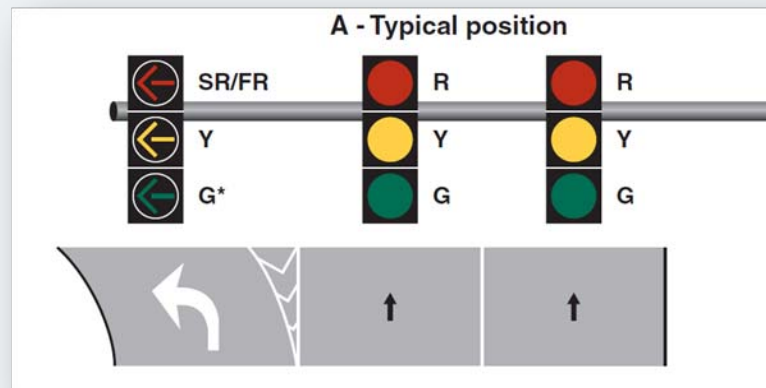
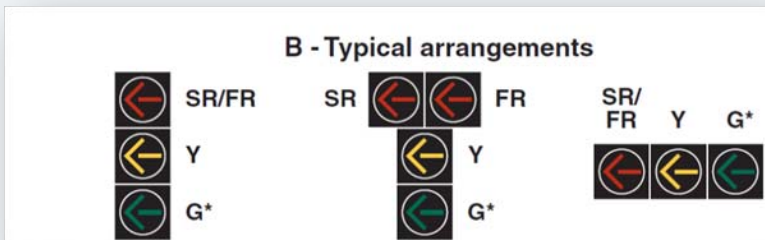


**Standard:**

- E. A steady YELLOW ARROW signal indication:
  - 2. Shall be displayed in the same direction as a flashing YELLOW ARROW signal indication or flashing RED ARROW signal indication following a flashing YELLOW ARROW signal indication or flashing RED ARROW signal indication in the same signal face, when the flashing arrow indication is displayed as part of a steady mode operation, if the signal face will subsequently display a steady red signal indication.

## New Standard for Steady Yellow Arrow Indication

- **A steady yellow arrow indication shall be displayed in the same direction as a flashing yellow or red arrow indication in the same signal face:**
  - When the flashing arrow indication is displayed as part of a steady mode operation, and
  - If the signal face will subsequently display a steady red signal indication



### Standard:

#### E. A steady YELLOW ARROW signal indication:

2. Shall be displayed in the same direction as a flashing YELLOW ARROW signal indication or flashing RED ARROW signal indication following a flashing YELLOW ARROW signal indication or flashing RED ARROW signal indication in the same signal face, when the flashing arrow indication is displayed as part of a steady mode operation, if the signal face will subsequently display a steady red signal indication.

### Implication of New Standard for Steady Yellow Arrow Indication:

- Current FRA signals in DE (<40) no longer compliant with MUTCD
- No decision yet on how to proceed
- Possible actions:
  - Convert some to protected-only (*especially where >45 mph*)
  - Convert some/all to FYA (w/ steady yellow arrow)
  - Convert some/all to FRA (w/ steady yellow arrow)





**Standard:**

03 Steady signal indications shall be applied as follows:

**B. A steady CIRCULAR YELLOW signal indication:**

4. Shall not be displayed to an approach from which drivers are turning left permissively or making a U-turn to the left permissively unless one of the following conditions exists:

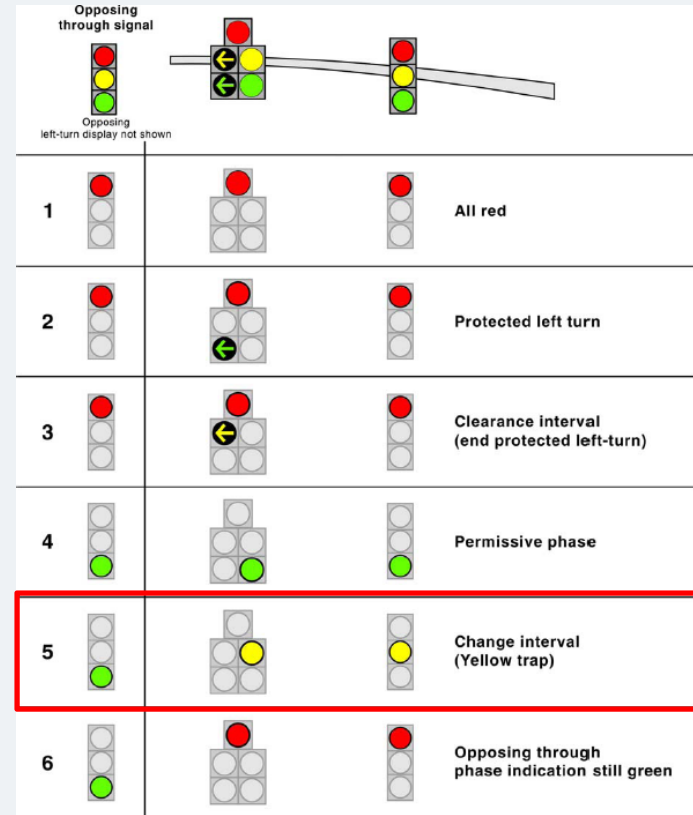
- (c) Drivers are advised of the operation if it occurs only occasionally, such as during a preemption sequence, by the installation near the left-most signal head of a W25-2 sign (see Section 2C.48) with the legend ONCOMING TRAFFIC MAY HAVE EXTENDED GREEN.

New standard for transition out of permissive phase for e/p lefts:

- New language addresses “yellow trap”
  - Caused by lead-lag left turns
  - Also caused by certain preemption sequences
- If conditions are satisfied, a W25-1 or W25-3 sign shall be installed overhead



- Being resolved in DE with new preemption timing

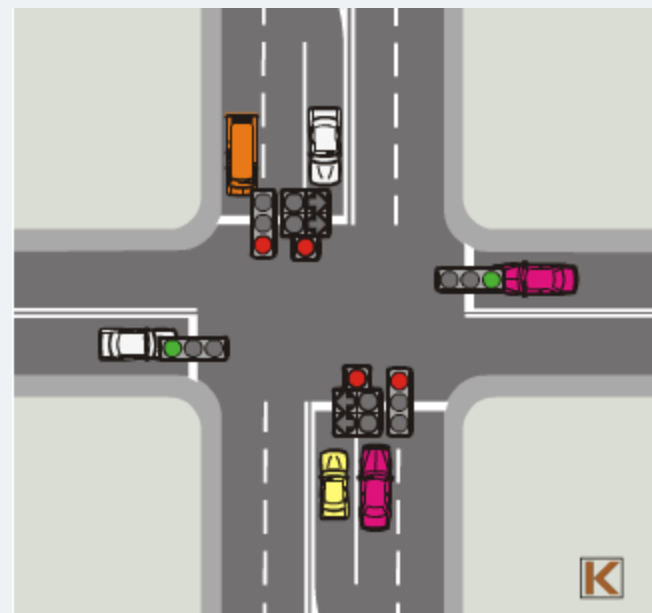


**Standard:**

- 03 **Steady signal indications shall be applied as follows:**
  - B. A steady CIRCULAR YELLOW signal indication:**
    - 4. Shall not be displayed to an approach from which drivers are turning left permissively or making a U-turn to the left permissively unless one of the following conditions exists:**
      - (c) Drivers are advised of the operation if it occurs only occasionally, such as during a preemption sequence, by the installation near the left-most signal head of a W25-2 sign (see Section 2C.48) with the legend ONCOMING TRAFFIC MAY HAVE EXTENDED GREEN.

New standard for transition out of permissive phase for e/p lefts:

- New language addresses “yellow trap”
  - Caused by lead-lag left turns
  - Also caused by certain preemption sequences
- If conditions are satisfied, a W25-1 or W25-3 sign shall be installed overhead



Source: Kittelson Associates, Inc

- Being resolved in DE with new preemption timing

**Standard:**

**D. A flashing green signal indication has no meaning and shall not be used.**

02 **Letters or numbers (including those associated with countdown displays) shall not be displayed as part of a vehicular signal indication.**

03 **Strobes shall not be used within or adjacent to any signal indication.**

04 **Except for the flashing signal indications and the pre-emption confirmation lights that are expressly allowed by the provisions of this Chapter, flashing displays shall not be used within or adjacent to any signal indications.**

## New Standards

- **Specific prohibition of:**
  - **Flashing green signal indications**
  - **Vehicular countdown displays**
  - **Strobes within or adjacent to signal indications**



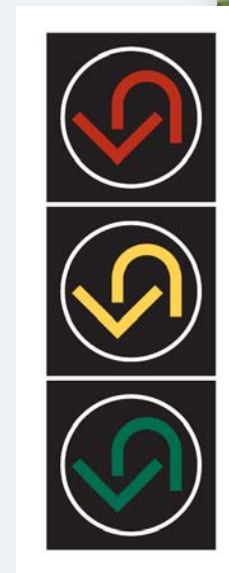
**Standard:****Arrows shall be pointed:**

- A. Vertically upward to indicate a straight-through movement, or
- B. Horizontally in the direction of the turn to indicate a turn at approximately or greater than a right angle, or
- C. Upward with a slope at an angle approximately equal to that of the turn if the angle of the turn is substantially less than a right angle, or
- D. In a manner that directs the driver through the turn if a U-turn arrow is used (see Figure 4D-1).

## New Standard For U-Turn Arrows

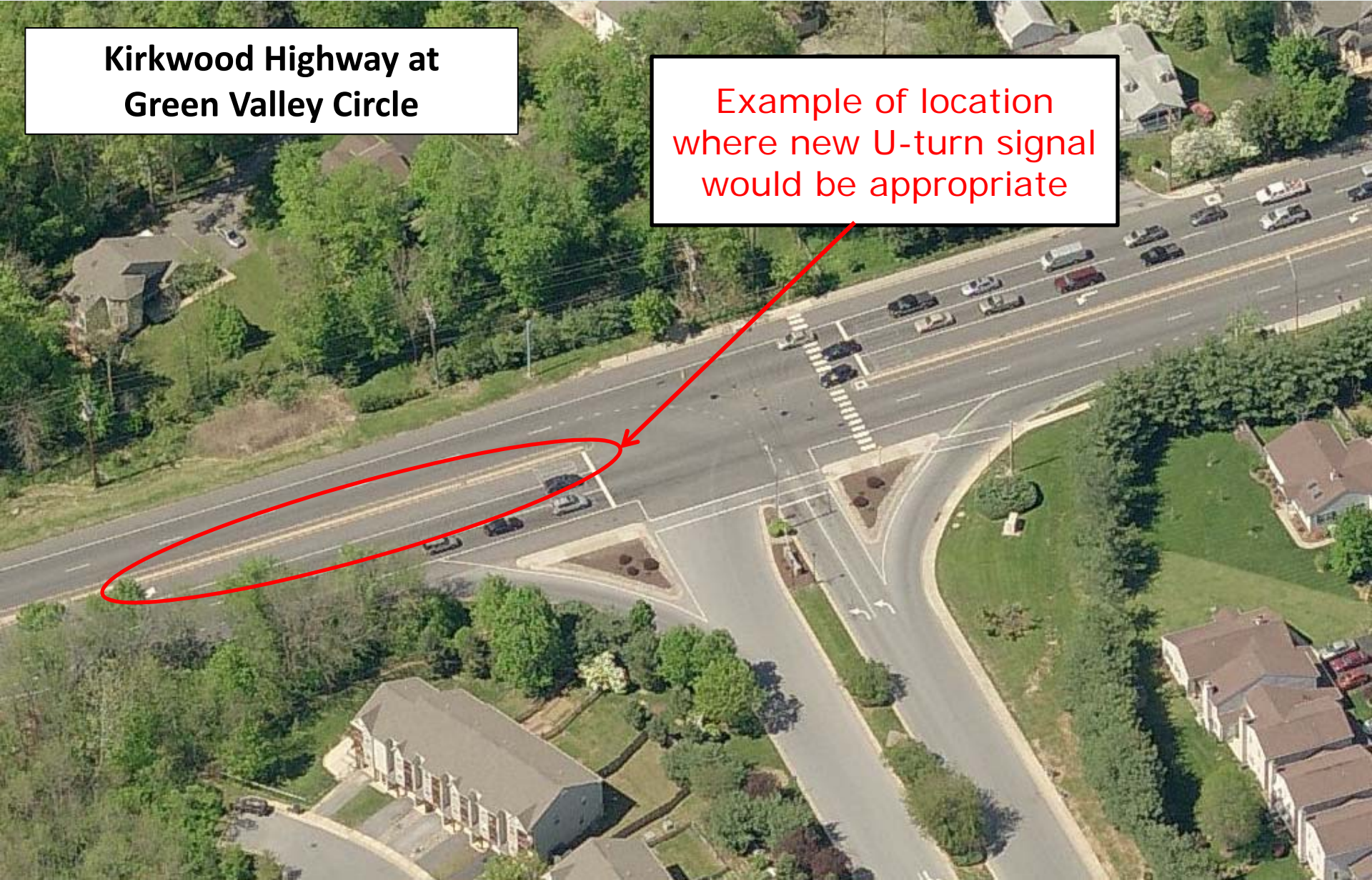
- **Arrows shall be pointed:**

- Vertically, or
- Horizontally, or
- Upward with slope at angle equal to angle of turn, or
- **U-turn**



**Kirkwood Highway at  
Green Valley Circle**

Example of location  
where new U-turn signal  
would be appropriate





## Section 4D.07 – Size of Vehicular Signal Indications

### Standard:

02 Except as provided in Paragraph 3 below, 12-inch signal indications shall be used for all signal sections in all new signal faces.

### Option:

03 Eight-inch circular signal indications may be used in new signal faces only for:

- A. The green or flashing yellow signal indications in an emergency-vehicle traffic control signal (see Section 4G.02);
- B. The circular indications in signal faces controlling the approach to the downstream location where two adjacent signalized locations are close to each other and it is not practical because of factors such as high approach speeds, horizontal or vertical curves, or other geometric factors to install visibility-limited signal faces for the downstream approach;
- C. The circular indications in a signal face that is located less than 120 feet from the stop line on a roadway with a posted or statutory speed limit of 30 mph or less;
- D. The circular indications in a supplemental near-side signal face;
- E. The circular indications in a supplemental signal face installed for the sole purpose of controlling pedestrian movements (see Section 4D.03) rather than vehicular movements; and
- F. The circular indications in a signal face installed for the sole purpose of controlling a bikeway or a bicycle movement.

04 Existing 8-inch circular signal indications that are not included in Items A through F in Paragraph 3 may be retained for the remainder of their useful service life.

### New Standard For 12-inch signal indications

- **12-inch indications shall be used for all new signal faces**
  - 6 exceptions for circular indications
  - Existing 8-inch circular indications are grandfathered for their remaining useful service life





# Section 4D.07 – Size of Vehicular Signal Indications

Example of:  
12" indication (red)  
8" indication (yellow  
and green)



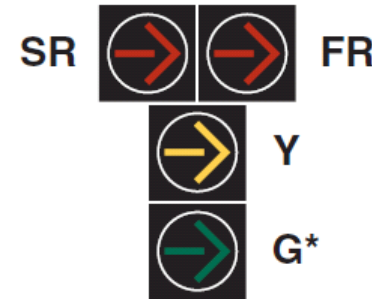
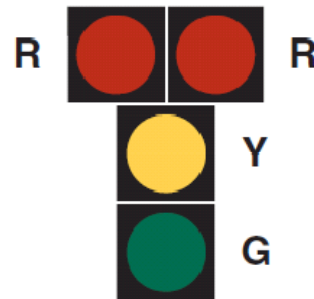
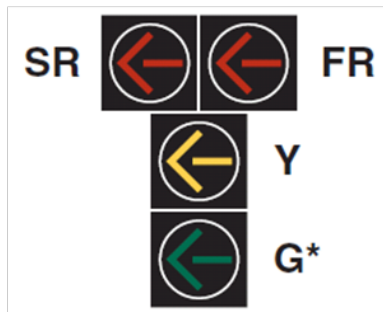
**SR 4 at Stanton Rd**

**Option:**

09 Within a signal face, two identical CIRCULAR RED or RED ARROW signal indications may be displayed immediately horizontally adjacent to each other in a vertical or horizontal signal face (see Figure 4D-2) for emphasis.

## New Option

- Two identical red signal indications may be displayed horizontally for emphasis



## Section 4D.11 – Number of Signal Faces on an Approach

### Standard:

- 01 The signal faces for each approach to an intersection or a midblock location shall be provided as follows:
- A. If a signalized through movement exists on an approach, a minimum of two primary signal faces shall be provided for the through movement. If a signalized through movement does not exist on an approach, a minimum of two primary signal faces shall be provided for the signalized turning movement that is considered to be the major movement from the approach (also see Section 4D.25).

### New Standard

- A minimum of two primary signal faces shall be used for the through movement if it exists, even if it is not the major movement



Additional 3-section signal face  
required for through movement

SR 58 at Continental Dr



## Section 4D.11 – Number of Signal Faces on an Approach

Option:

- 02 Where a movement (or a certain lane or lanes) at the intersection never conflicts with any other signalized vehicular or pedestrian movement, a continuously-displayed single-section GREEN ARROW signal indication may be used to inform road users that the movement is free-flow and does not need to stop.

### New Option

- For movements that never conflict with any other vehicular or pedestrian movement, a continuously-displayed single-section GREEN ARROW signal indication may be used to inform road users that the movement is free flow



SR 2 at Albertson Dr

*Guidance:*

07 *If the posted or statutory speed limit or the 85th-percentile speed on an approach to a signalized location is 45 mph or higher, signal faces should be provided as follows for all new or reconstructed signal installations (see Figure 4D-3):*

A. *The minimum number and location of primary (non-supplemental) signal faces for through traffic should be provided in accordance with Table 4D-1.*

## New Guidance for New or Reconstructed Signals on Approach with Speeds of 45 mph or Higher:

- *Provide one overhead through signal per lane (minimum 2 signals)*
- See Table 4D-1

**Table 4D-1. Recommended Minimum Number of Primary Signal Faces for Through Traffic on Approaches with Posted, Statutory, or 85<sup>th</sup>-Percentile Speed of 45 mph or Higher**

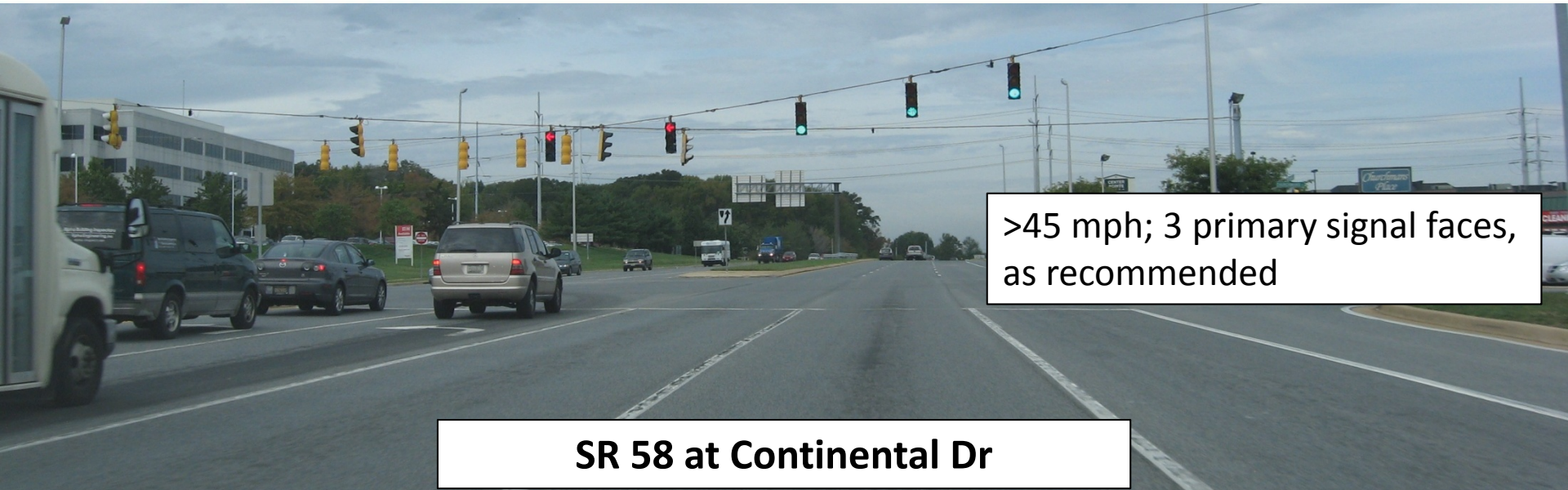
Number of Through Lanes on Approach	Total Number of Primary Through Signal Faces for Approach*	Minimum Number of Overhead-Mounted Primary Through Signal Faces for Approach
1	2	1
2	2	1
3	3	2**
4 or more	4 or more	3**

NOTES: \*A minimum of two through signal faces is always required (See Section 4D.11). These recommended numbers of through signal faces may be exceeded. Also, see cone of vision requirements otherwise indicated in Section 4D.13.

\*\* If practical, all of the recommended number of primary through signal faces should be located overhead.



# Section 4D.11 – Number of Signal Faces on an Approach



>45 mph; 3 primary signal faces, as recommended

**SR 58 at Continental Dr**



<45 mph; minimum of 2 primary signal faces, as recommended

**SR 2 at Linden**



## Section 4D.11 – Number of Signal Faces on an Approach

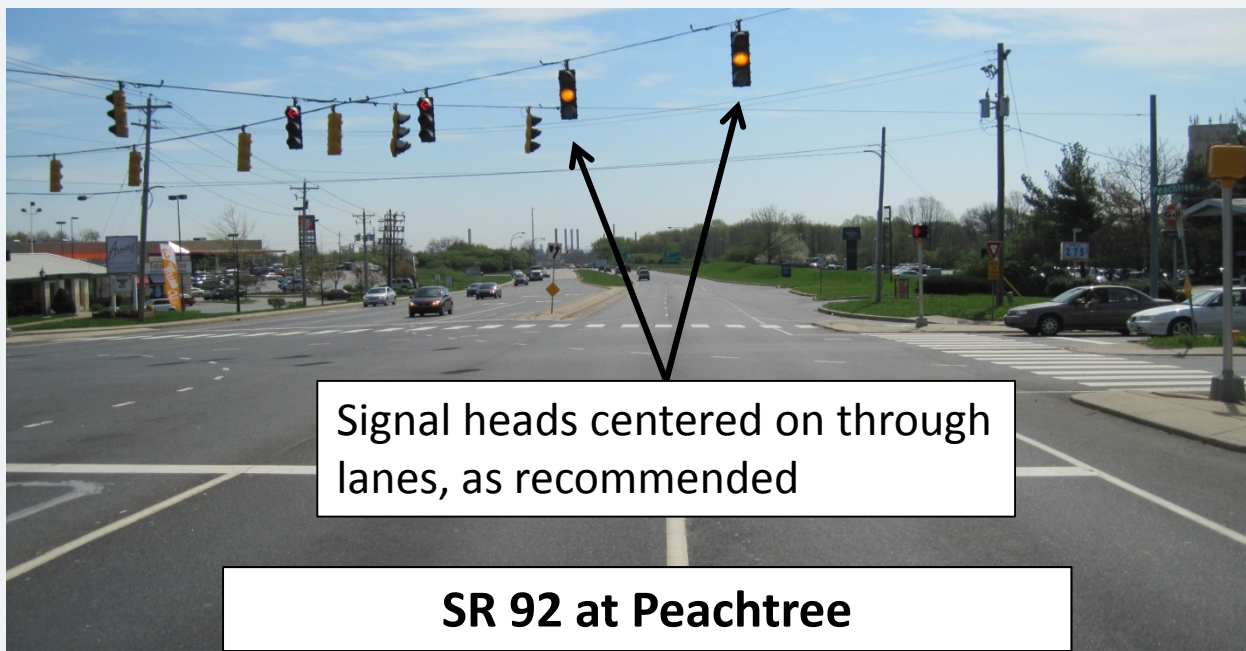
### Guidance:

07 *If the posted or statutory speed limit or the 85th-percentile speed on an approach to a signalized location is 45 mph or higher, signal faces should be provided as follows for all new or reconstructed signal installations (see Figure 4D-3):*

*B. If the number of overhead primary signal faces for through traffic is equal to the number of through lanes on an approach, one overhead signal face should be located approximately over the center of each through lane.*

### New Guidance for New or Reconstructed Signals on Approach with Speeds of 45 mph or Higher (continued):

- *On approaches with two or more through lanes, one signal face per through lane, centered over each through lane*



Guidance: **DRAFT**

07 (DE Revision) *If the posted or statutory speed limit or the 85<sup>th</sup>-percentile speed on an approach to a signalized location is 45 mph or higher, signal faces should be provided as follows for all new or reconstructed signal installations (see Figure 4D-3):*

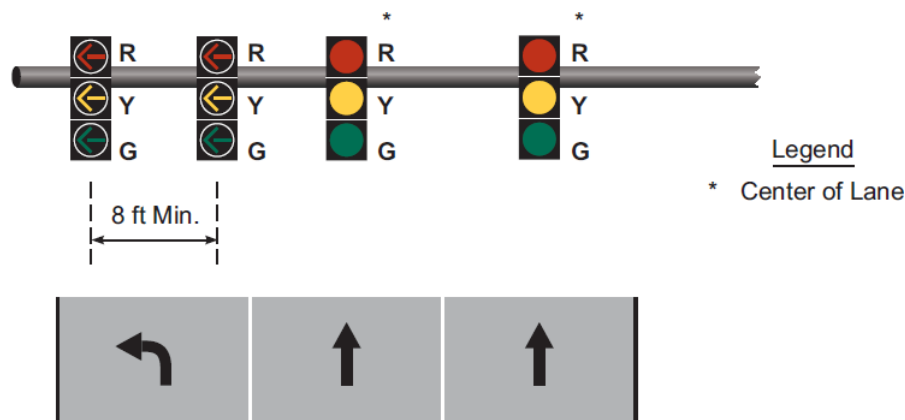
- C. *Except for shared left-turn and right-turn signal faces, any primary signal face required by Sections 4D.17 through 4D.25 for an exclusive turn lane should be located overhead approximately over the center of each exclusive turn lane. When two signal faces are used for a single left-turn lane, they should be positioned a minimum of 8 feet apart (see Section 4D.13) from each other, and both signal faces should be positioned within the extension of the lane lines.*

## New Guidance for New or Reconstructed Signals on Approach with Speeds of 45 mph or Higher (continued):

- *Signal faces for an exclusive turn lane (except for shared turn signal faces) should be located over the center of the turn lane*

### DE Revision:

- *When two signals are used for a single turn lane, they should be 8 feet apart and the pair of signals should be centered over the lane*





# Section 4D.11 – Number of Signal Faces on an Approach

Signal heads approximately 8 feet apart, centered on turn lane



**Elkton at Otts Chapel**



# Section 4D.11 – Number of Signal Faces on an Approach

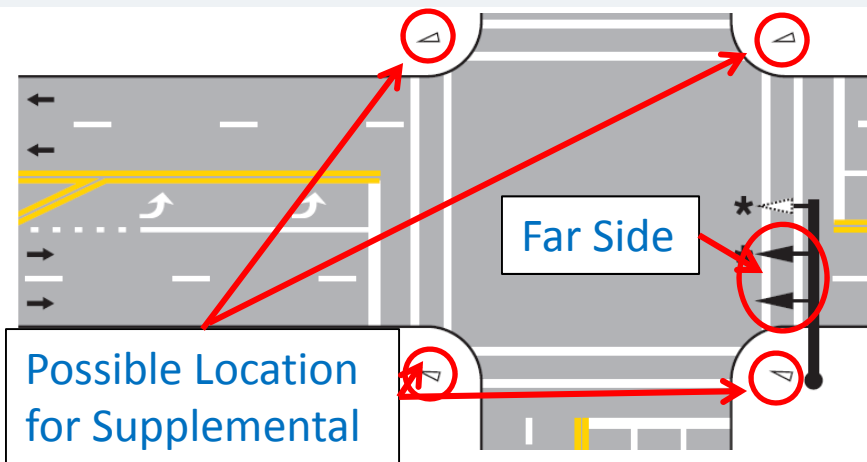
*Guidance:*

07 *If the posted or statutory speed limit or the 85th-percentile speed on an approach to a signalized location is 45 mph or higher, signal faces should be provided as follows for all new or reconstructed signal installations (see Figure 4D-3):*

- D. All primary signal faces should be located on the far side of the intersection.*
- E. In addition to the primary signal faces, one or more supplemental pole-mounted or overhead signal faces should be considered to provide added visibility for approaching traffic that is traveling behind large vehicles.*
- F. All signal faces should have backplates.*

## New Guidance for New or Reconstructed Signals on Approach with Speeds of 45 mph or Higher (continued):

- *All primary signal faces should be at the far side of intersection*
- *One or more supplemental faces should be considered*
- *All signal faces should have backplates*



- Legend**
- Direction of travel
  - ← Recommended location for overhead R-Y-G primary signal face for through or through/right lane
  - △ Overhead primary left-turn signal face as determined by selected mode of left-turn operation
  - ◁ Possible location for a supplemental R-Y-G signal face

Backplate



## Section 4D.11 – Number of Signal Faces on an Approach

### Guidance:

- 07 *If the posted or statutory speed limit or the 85th-percentile speed on an approach to a signalized location is 45 mph or higher, signal faces should be provided as follows for all new or reconstructed signal installations*
- 08 *This layout of signal faces should also be considered for any major urban or suburban arterial street with four or more lanes and for other approaches with speeds of less than 45 mph.*

### New Guidance for New or Reconstructed Signals on Approach with Speeds of 45 mph or Higher (continued):

- *The guidance should also be considered for:*
  - *Major urban or suburban arterial streets with  $\geq 4$  lanes*
  - *Other approaches with speeds of less than 45mph*



SR 4 at Telegraph Rd

## Section 4D.11 – Number of Signal Faces on an Approach

Option: **DRAFT**

07A (DE Revision) Backplates may be considered for use to signal faces in special circumstances, such as a safety countermeasure for specific types of crashes.

Support:

07B (DE Revision) DelDOT conducted a literature review on research that has been performed on the safety effect of adding signal backplates to signal faces. The literature review found a limited pool of data with significant variance in results. Other considerations associated with backplates include the cost of installation and maintenance, including the additional effort required to accommodate oversized vehicles through an intersection equipped with signal backplates.

### DE Revision:

- Backplates may be considered for signal faces in special circumstances
- DelDOT conducted a literature review and found minimal data to support adding backplates to all signals faces especially considering the cost, maintenance, and effort



## Section 4D.12 – Visibility, Aiming, and Shielding of Signal Faces

### Option:

21 A yellow retroreflective strip with a minimum width of 1 inch and a maximum width of 3 inches may be placed along the perimeter of the face of a signal backplate to project a rectangular appearance at night.

### New Option

- *Optional yellow retroreflective strip (1-3 inches) to perimeter of signal backplate*
  - Increases signal conspicuity (especially at night)
  - Helps identify signal locations during power outages



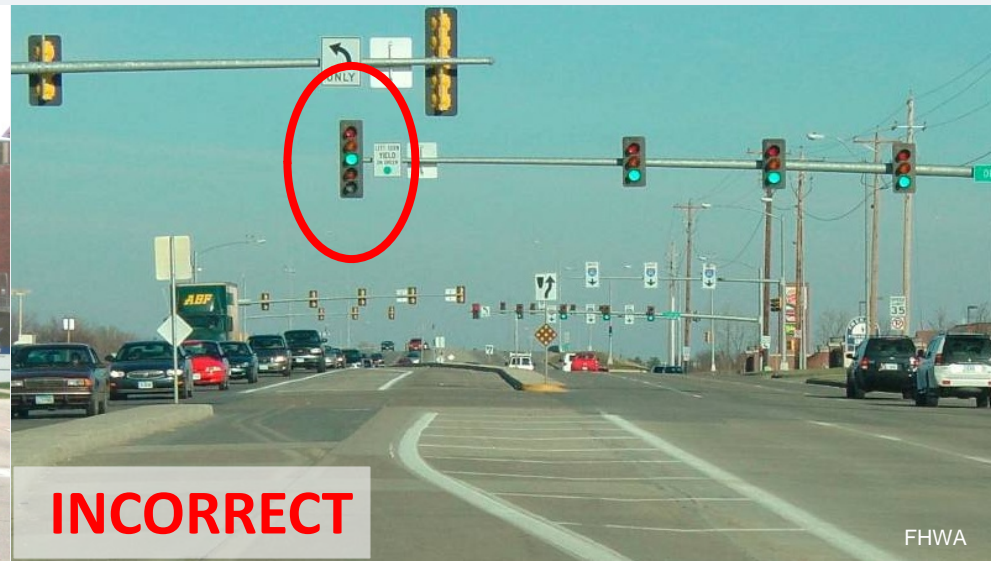
## Section 4D.13 – Lateral Positioning of Signal Faces

### Guidance:

09 For new or reconstructed signal installations, on an approach with an exclusive turn lane(s) for a left-turn (or U-turn to the left) movement and with opposing vehicular traffic, signal faces that display a CIRCULAR GREEN signal indication should not be post-mounted on the far-side median or mounted overhead above the exclusive turn lane(s) or the extension of the lane(s).

### New Guidance for New or Reconstructed Signal Installations

- Signal faces displaying a CIRCULAR GREEN for a permissive left-turn movement should NOT be positioned overhead or post-mounted to the left/front of an exclusive left-turn lane





## Major Reorganization in Sections 4D.17 – 4D.24

### Left-Turn Movements

- 4D.17: General
- 4D.18: Permissive Only Mode
- 4D.19: Protected Only Mode
- 4D.20: Protected/ Permissive Mode

### Right-Turn Movements

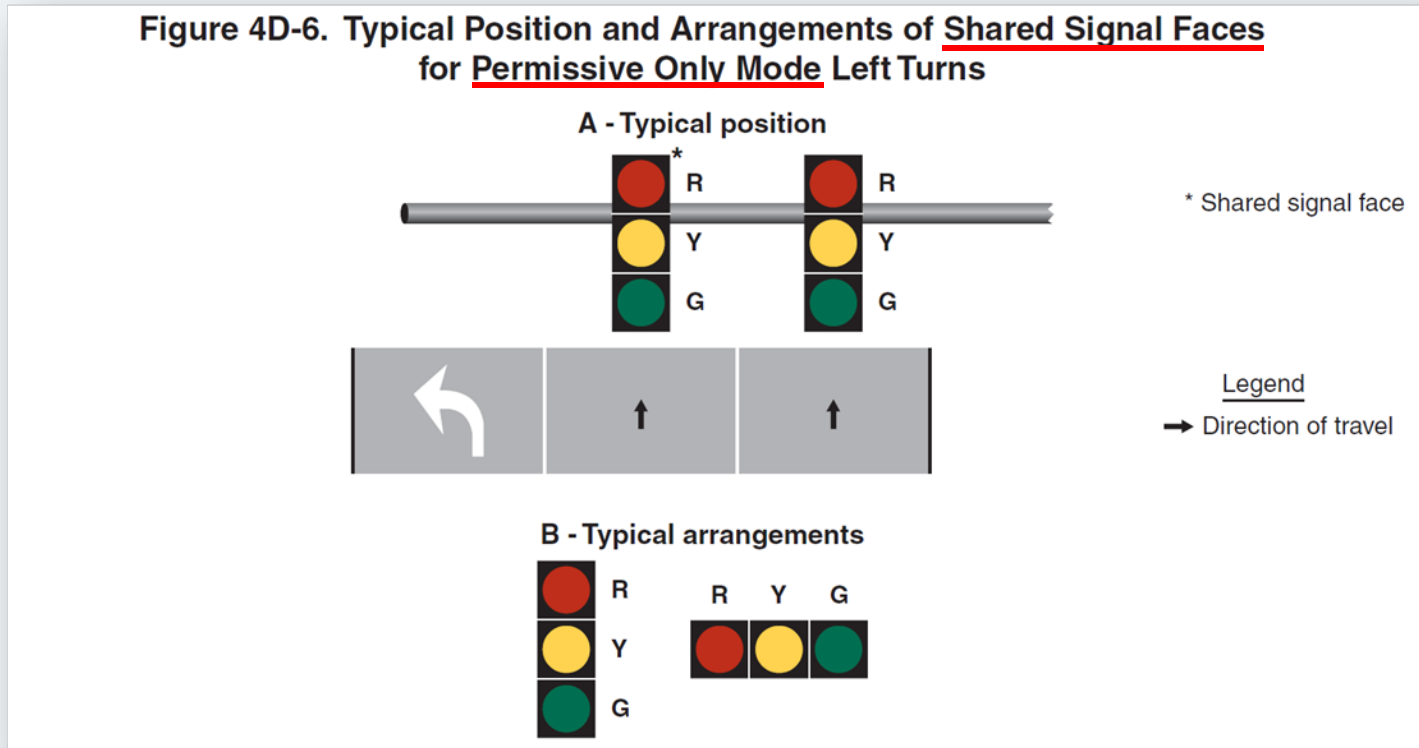
- 4D.21: General
- 4D.22: Permissive Only Mode
- 4D.23: Protected Only Mode
- 4D.24: Protected/ Permissive Mode

**Mostly old information, but many new figures**



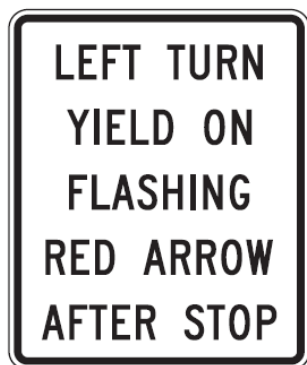
## Permissive-Only Left Turns

- Figure 4D-6 illustrates the optimal signal head positioning for a permissive-only left-turn movement
- *Signals should be centered over through lanes*



## Flashing Arrows for Left Turns

- New Standards and Figures to Clarify Requirements for Flashing Yellow Arrow (FYA) and Flashing Red Arrows (FRA)
- **New Standard: use of Solid Yellow Arrow** (discussed previously)
- **While supplementary signs are not required, if used with a FRA, it shall be a LEFT TURN YIELD ON FLASHING RED ARROW AFTER STOP (R10-27)**

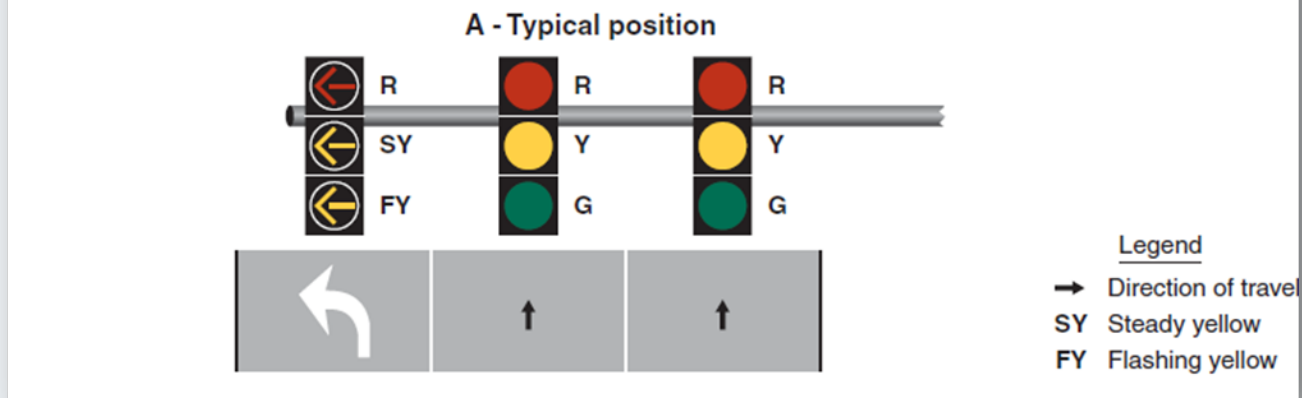


R10-27

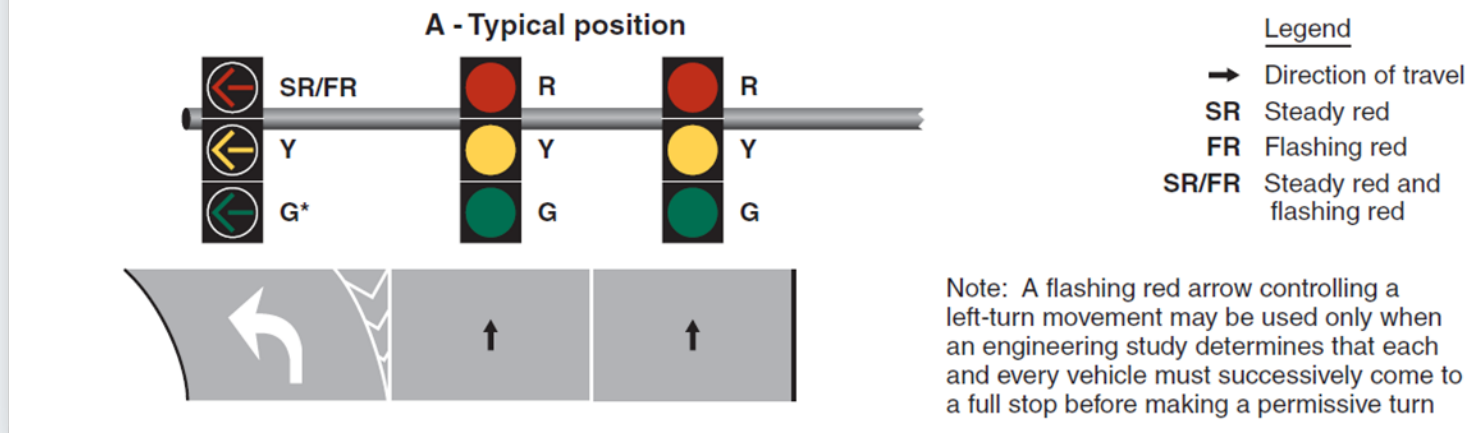


# Flashing Arrows for Left Turns

**Figure 4D-7. Typical Position and Arrangements of Separate Signal Faces with Flashing Yellow Arrow for Permissive Only Mode Left Turns**



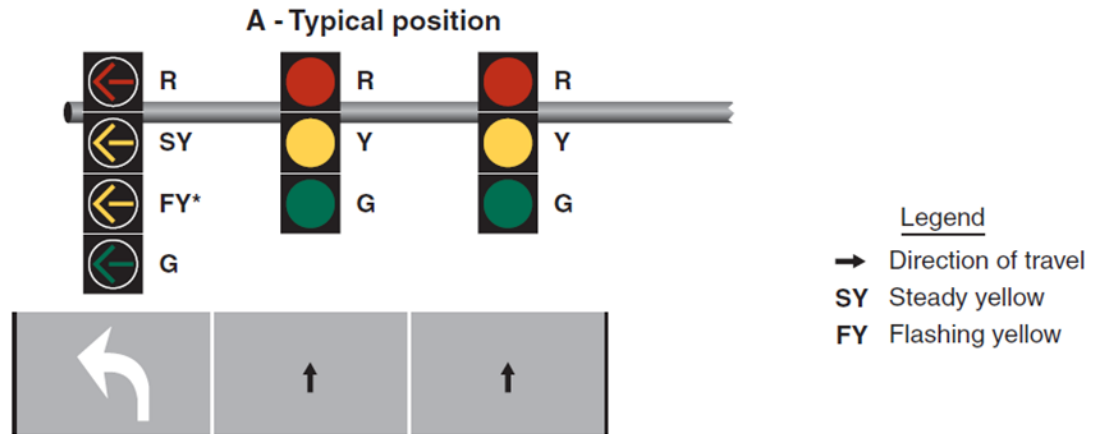
**Figure 4D-8. Typical Position and Arrangements of Separate Signal Faces with Flashing Red Arrow for Permissive Only Mode and Protected/Permissive Mode Left Turns**





# Flashing Arrows for Left Turns

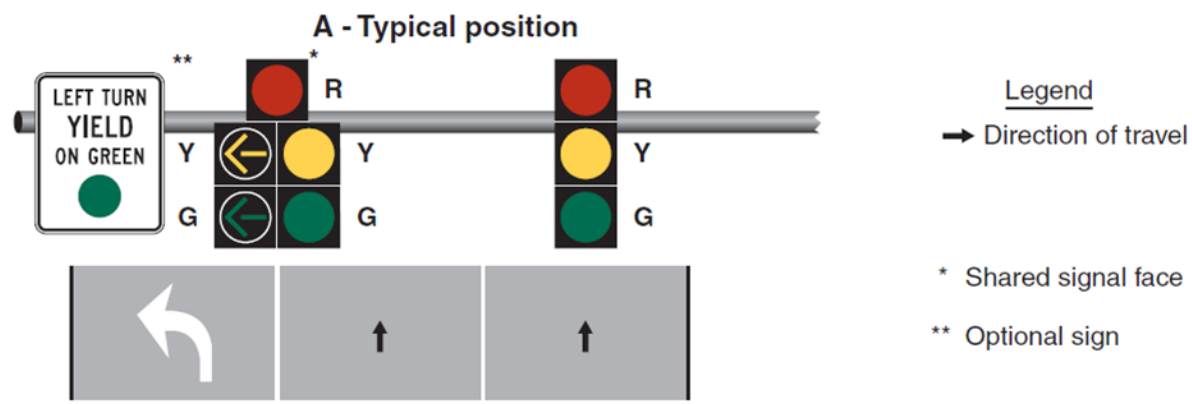
**Figure 4D-12. Typical Position and Arrangements of Separate Signal Faces with Flashing Yellow Arrow for Protected/Permissive Mode and Protected Only Mode Left Turns**



## Protected/Permissive Left Turns

- Figure 4D-11 illustrates the optimal positioning for shared signal faces for Protected/Permissive left-turn
  - *The 5-section signal should be centered between through and left turn lane*
  - *The green ball within the 5-section signal should not be positioned above the exclusive left turn lane*

**Figure 4D-11. Typical Position and Arrangements of Shared Signal Faces for Protected/Permissive Mode Left Turns**



## Protected-Only Left Turns

### Standard:

06 A protected only mode left-turn movement that does not begin and terminate at the same time as the adjacent through movement shall not be provided on an approach unless an exclusive left-turn lane exists.

01 If a shared signal face is provided for a protected/permissive mode left turn, it shall meet the following requirements (see Figure 4D-11):

E. A protected/permissive shared signal face, regardless of where it is positioned and regardless of how many adjacent through signal faces are provided, shall always simultaneously display the same color of circular indication that the adjacent through signal face or faces display.

### New Standards

- Protected-only left turn mode shall not be used without an exclusive left-turn lane unless the approach is split-phased
- Circular indications must always simultaneously display the same color (no Dallas phasing)



SR 92 at Peachtree



## Protected-Only Left Turns

### Standard:

03 If a separate left-turn signal face is provided for a protected only mode left turn, it shall meet the following requirements (see Figure 4D-10):

- A. It shall be capable of displaying, the following signal indications: steady left-turn RED ARROW, steady left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time. A signal instruction sign shall not be required with this set of signal indications. If used, it shall be a LEFT ON GREEN ARROW ONLY (R10-5) sign (see Figure 2B-27).

### New Standard

- **A separate left-turn signal face for protected-only mode must now contain a left-turn RED ARROW**
  - An older option to use CIRCULAR RED for protected left-turns has been deleted



## Protected-Only Left Turns

- Figures 4D-9 and 4D-10 illustrate the optimal positioning for shared and separate signals for protected-only left turns

Figure 4D-9. Typical Positions and Arrangements of Shared Signal Faces for Protected Only Mode Left Turns

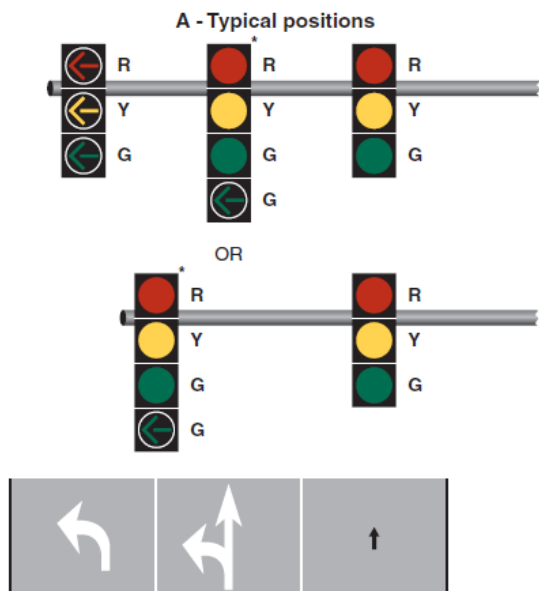
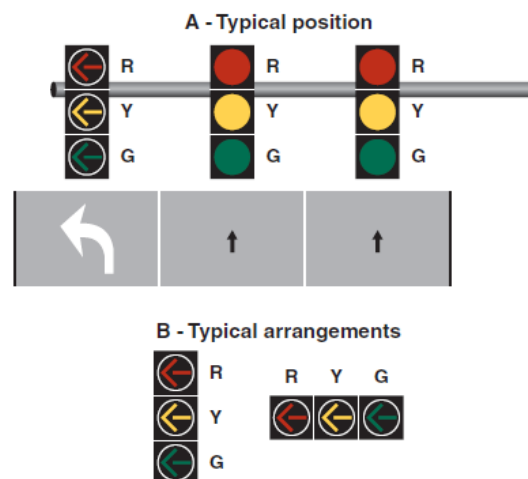


Figure 4D-10. Typical Position and Arrangements of Separate Signal Faces for Protected Only Mode Left Turns



## Right Turns

- New Sections 4D.21 through 4D.24 (right turn signals) very similar to Sections 4D.17 through 4D.20 (left turn signals)



**SR 100 at SR 141**



Standard: **DRAFT**

G. When the separate right-turn signal face is providing a message to stop and remain stopped, a steady right-turn RED ARROW signal indication shall be displayed if it is intended that right turns on red not be permitted (except when a traffic control device is in place permitting a turn on a steady RED ARROW signal indication) or a steady CIRCULAR RED signal indication shall be displayed if it is intended that right turns on red be permitted. Pursuant to Delaware Code, Title 21, Chapter 41, Subchapter II, §4108, right turns are not permitted on a steady RED ARROW signal indication. Therefore, traffic control devices permitting turns on a steady RED ARROW shall not be used.

Option:

01A (DE Revision) On state-maintained roads, in locations where right turns may be prohibited during special circumstances, a shared signal face may be used consisting of the following signal indications: a CIRCULAR GREEN, CIRCULAR YELLOW, CIRCULAR RED and right-turn RED ARROW. For additional emphasis, the NO TURN ON RED ARROW (R10-11-DE) sign may be used.

## *Delaware Revision:*

- Traffic Control Devices permitting turns on steady red arrow shall not be used
- For added emphasis, the NO TURN ON RED ARROW (R10-11-DE) sign may be used



**W. Delaware at Orchard**

## Standard:

02 When a shared left-turn/right-turn lane exists on a signalized approach, the left-turn and right-turn movements shall start and terminate simultaneously and the red signal indication used in each of the signal faces on the approach shall be a CIRCULAR RED.

## New Section and Standard

- For approaches without a through movement, all red signal indications for each signal shall be CIRCULAR RED



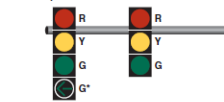
SR 52 at Goodwin Circle

## New Figure 4D-20 (Sheets 1 through 3)

- Three sheets to show indications for approaches with:
  - No conflicting vehicular or pedestrian movements
  - Pedestrian or vehicular conflict with one turn movement
  - Pedestrian or vehicular conflicts with both turn movements

Figure 4D-20. Signal Indications for Approaches with a Shared Left-Turn/Right-Turn Lane and No Through Movement (Sheet 1 of 3)

A - No conflicting vehicular or pedestrian movements



\* Left-turn GREEN ARROW section shall be included if there is an opposing one-way approach and the signal phasing eliminates conflicts.

Notes:

1. Horizontally-aligned signal faces may also be used.
2. Shared signal faces may also be S sections in a vertical straight line instead of a cluster.

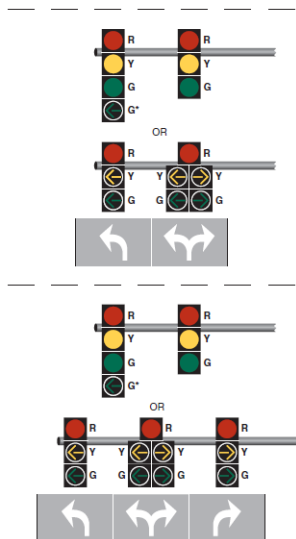
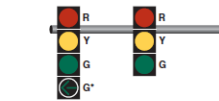


Figure 4D-20. Signal Indications for Approaches with a Shared Left-Turn/Right-Turn Lane and No Through Movement (Sheet 2 of 3)

B - Pedestrian or vehicular conflict with one turn movement



\* Left-turn GREEN ARROW section shall be included if there is an opposing one-way approach and the signal phasing eliminates conflicts.

Notes:

1. A conflict with the right-turn movement is illustrated.
2. Horizontally-aligned signal faces may also be used.
3. Shared signal faces may also be S sections in a vertical straight line instead of a cluster.

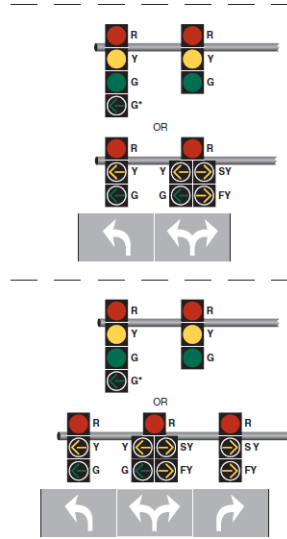
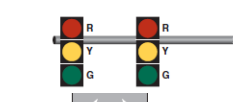


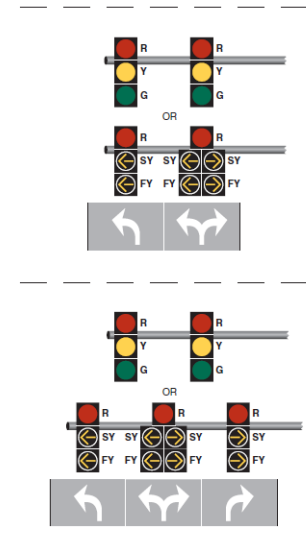
Figure 4D-20. Signal Indications for Approaches with a Shared Left-Turn/Right-Turn Lane and No Through Movement (Sheet 3 of 3)

C - Pedestrian or vehicular conflicts with both turn movements



Notes:

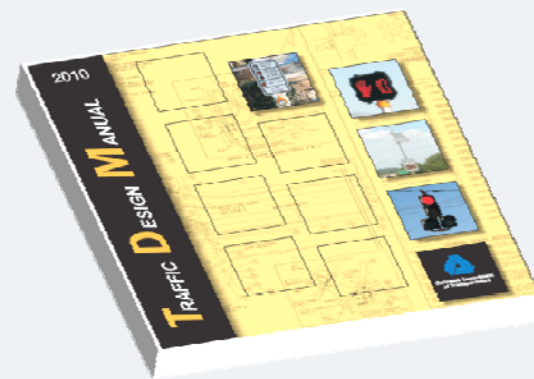
1. Horizontally-aligned signal faces may also be used.
2. Shared signal faces may also be S sections in a vertical straight line instead of a cluster.





## Layout of Signal Heads

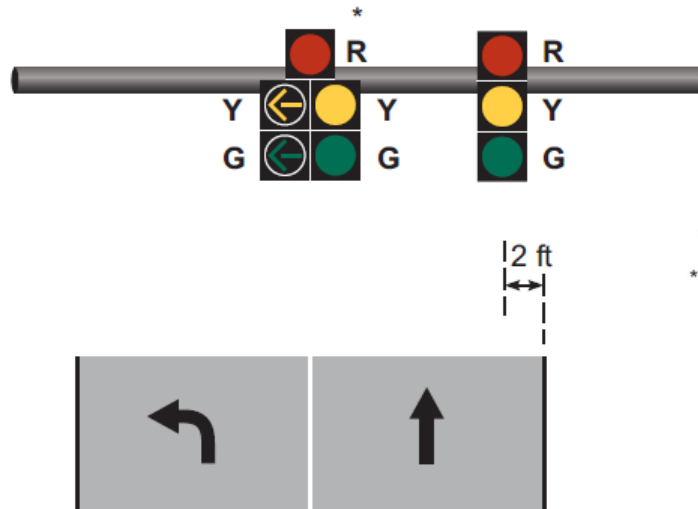
- While the MUTCD provides new, improved figures showing various signal head arrangements, does not cover all situations
- Therefore, future DeIDOT Traffic Design Manual will include:
  - 20 typical applications, covering most intersection configurations in DE
    - o compliant with new MUTCD
    - o consistent with DeIDOT's preferences, **including use of two signal heads per movement**
  - minimum lateral offset dimensions
- DRAFT figures (subject to revision) are shown in following pages



# Layout of Signal Heads

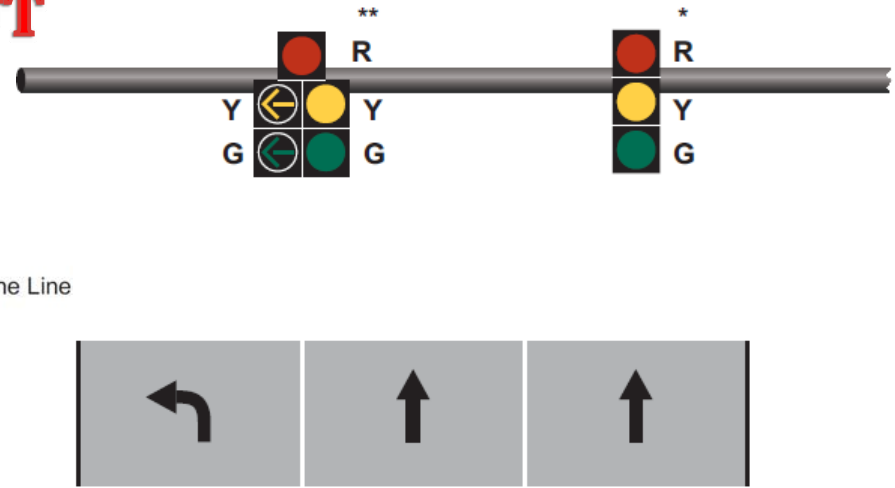
Ex. 1 - Protected / Permissive Left-Turn Phasing

Ex. 2 - Protected / Permissive Left-Turn Phasing



**DRAFT**

- Legend
- \* Center of Lane
  - \*\* Centered on Lane Line



1 Through Lane with 1 Left-Turn Lane

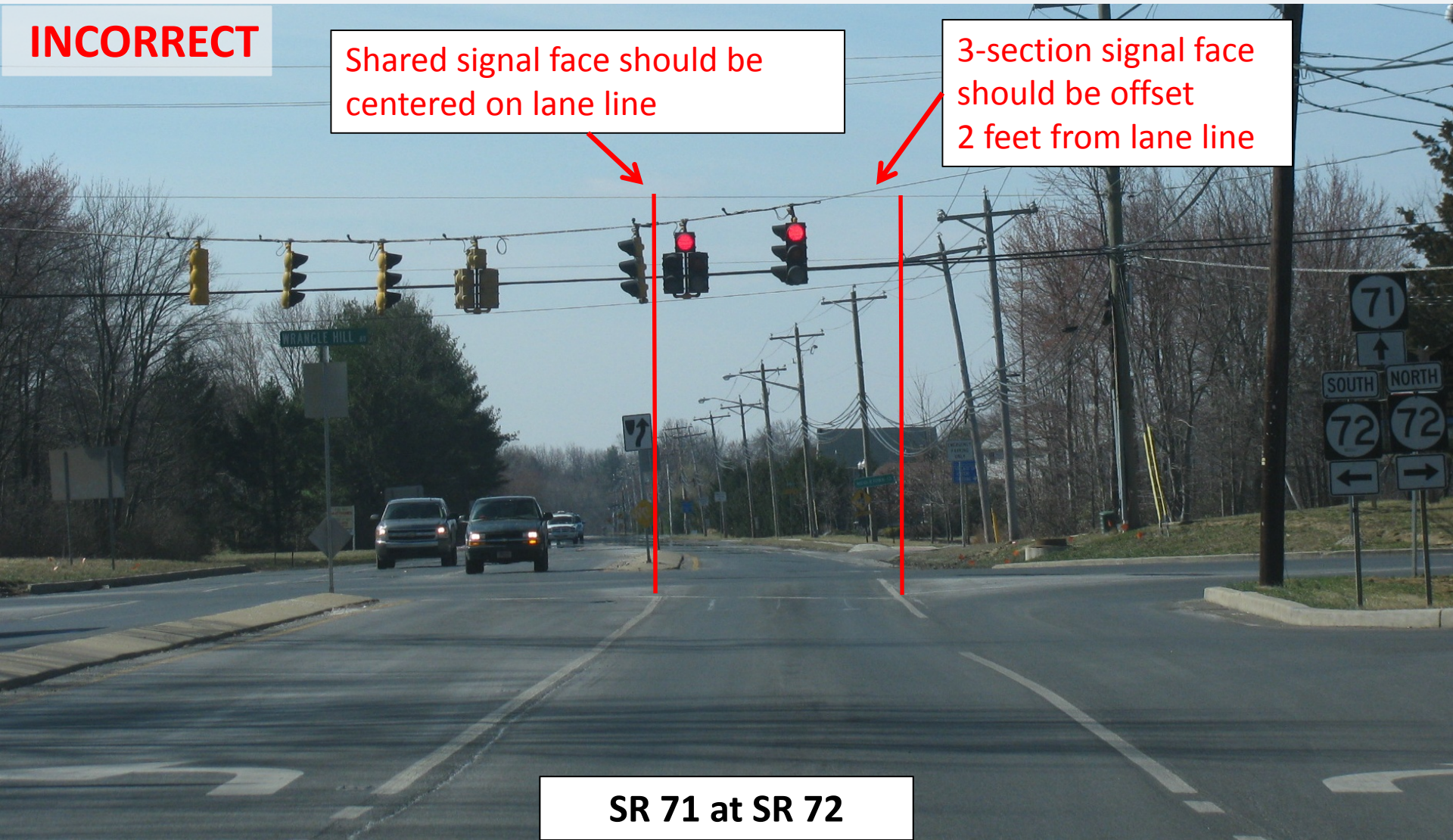
2 Through Lanes with 1 Left-Turn Lane

## Layout of Signal Heads

**INCORRECT**

Shared signal face should be centered on lane line

3-section signal face should be offset 2 feet from lane line



SR 71 at SR 72

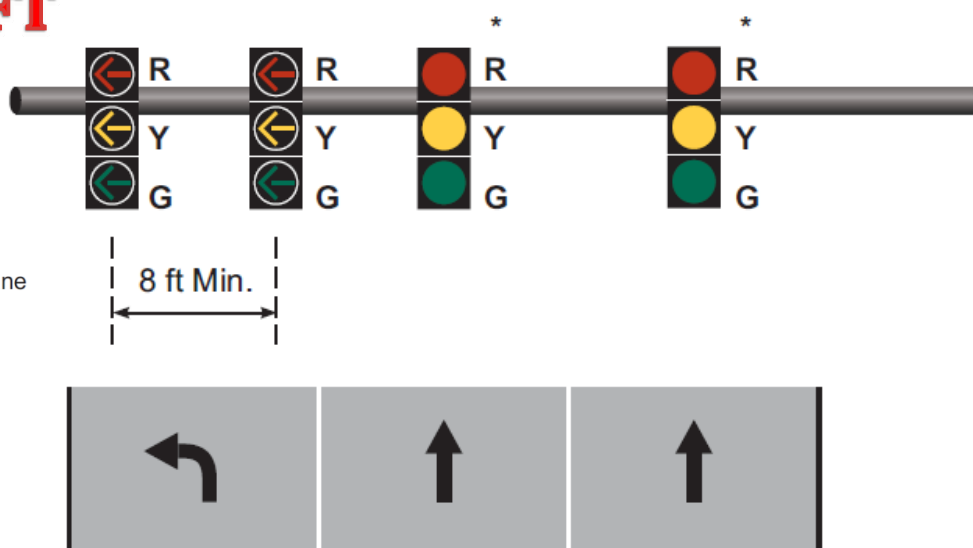
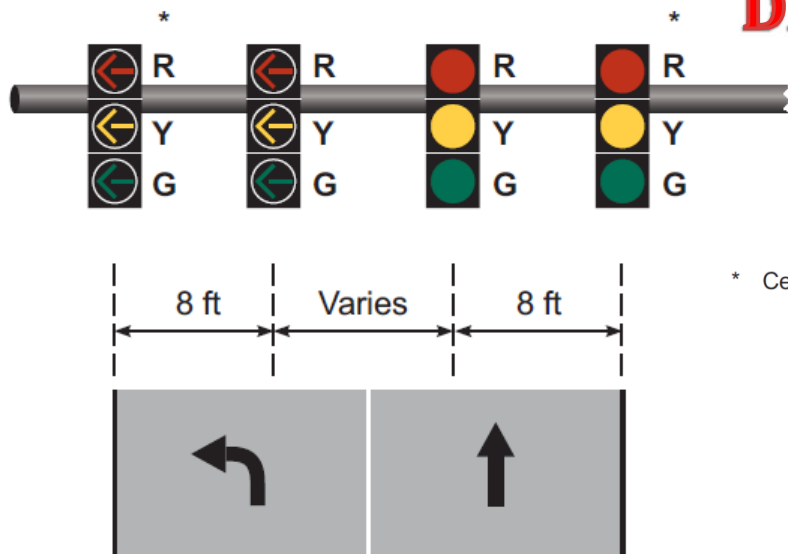


# Layout of Signal Heads

Ex. 3 - Protected Only Left-Turn Phasing

Ex. 4 - Protected Only Left-Turn Phasing

**DRAFT**



Legend  
\* Center of Lane

1 Through Lane with 1 Left-Turn Lane

2 Through Lanes with 1 Left-Turn Lane

## Layout of Signal Heads

signal faces approx  
8 feet apart

signal faces  
centered on  
through lanes

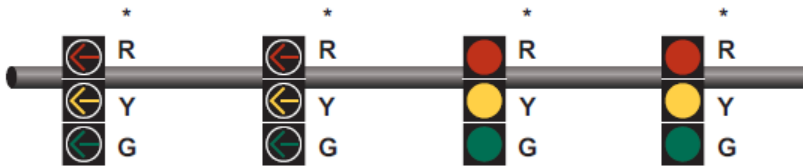


**CORRECT**

**SR 8 at Kenton**

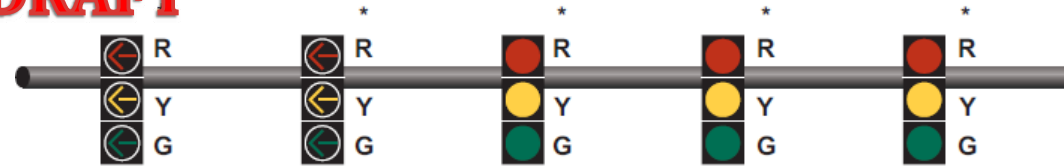
# Layout of Signal Heads

Ex. 5 - Protected Only Left-Turn Phasing



Ex. 6 - Protected Only Left-Turn Phasing

**DRAFT**



Legend

\* Center of Lane



2 Through Lanes with 2 Left-Turn Lanes



3 Through Lanes with 2 Left-Turn Lanes



## Layout of Signal Heads

**CORRECT**

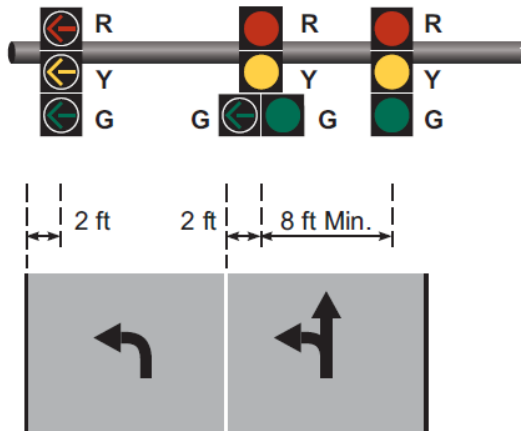
All signal heads  
centered on lanes

**SR 92 at Peachtree**



# Layout of Signal Heads

Ex. 7 - Split Phasing

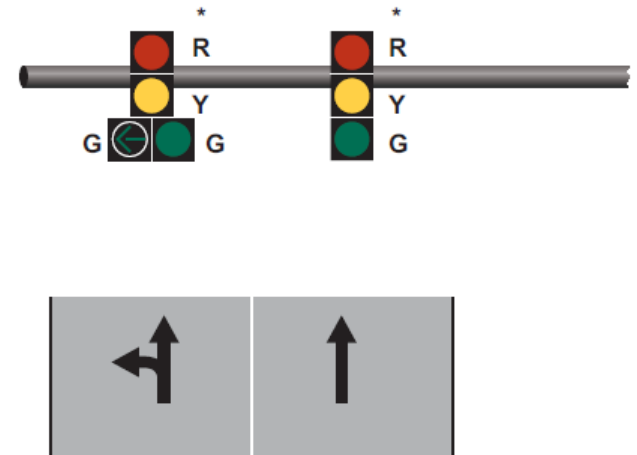


**DRAFT**

Legend

\* Center of Lane

Ex. 8 - Split Phasing



1 Shared Through / Left Lane with 1 Left-Turn Lane

1 Through Lane with 1 Shared Through / Left Lane

## Layout of Signal Heads

Additional 3-section signal face required for through movement

**INCORRECT**

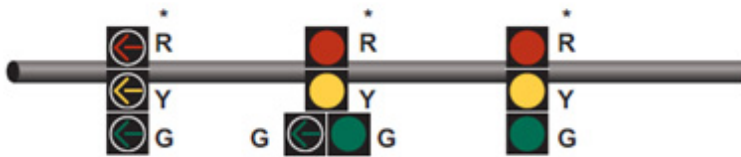


**SR 58 at Continental Dr**



# Layout of Signal Heads

Ex. 9 - Split Phasing



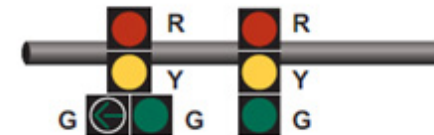
1 Left-Turn Lane, 1 Shared Left / Through Lane, and 1 Through Lane

**DRAFT**

Legend

\* Center of Lane

Ex. 10 - Split Phasing

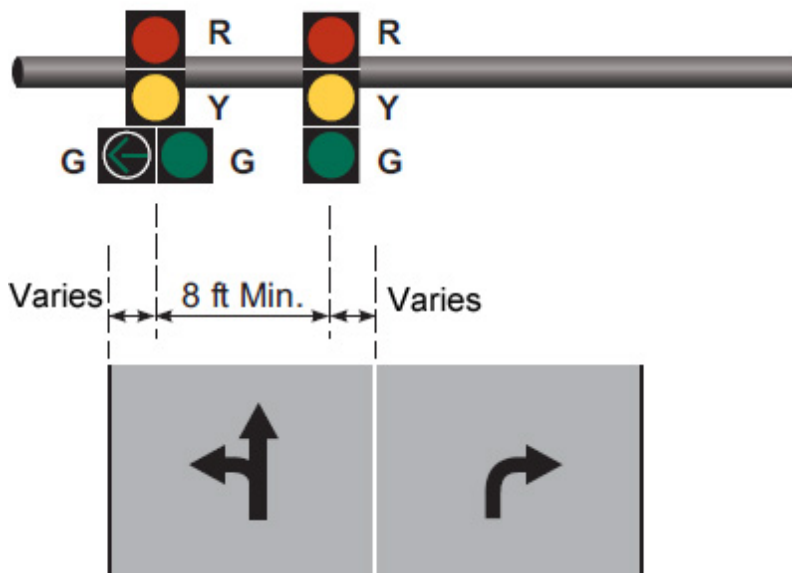


1 Through Lane, and 1 Left-Turn Lane

# Layout of Signal Heads

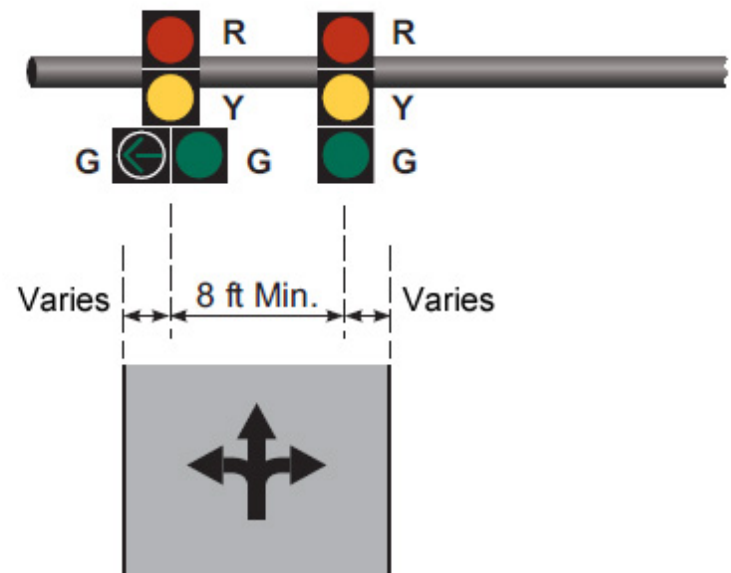
Ex. 11 - Split Phasing

**DRAFT**



1 Shared Through / Left Lane  
with 1 Right-Turn Lane

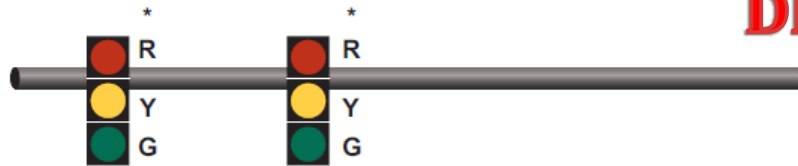
Ex. 12 - Split Phasing



1 Shared Left / Through / Right Lane

# Layout of Signal Heads

Ex. 13 - Permissive Only Right-Turn Phasing



**DRAFT**

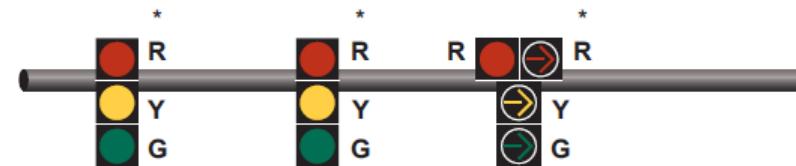
Legend

\* Center of Lane



2 Through Lanes with 1 Right-Turn Lane

Ex. 14 - Protected / Permissive Right-Turn Phasing



2 Through Lanes with 1 Right-Turn Lane



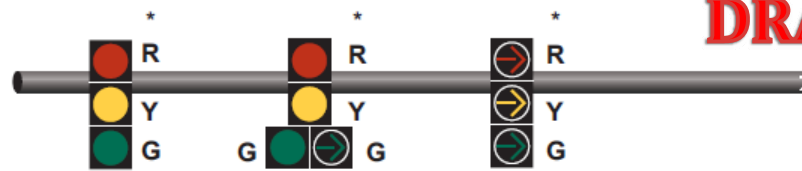
## Layout of Signal Heads



**W. Delaware Ave. at Orchard Rd.**

# Layout of Signal Heads

Ex. 15 - Protected / Permissive Right-Turn Phasing



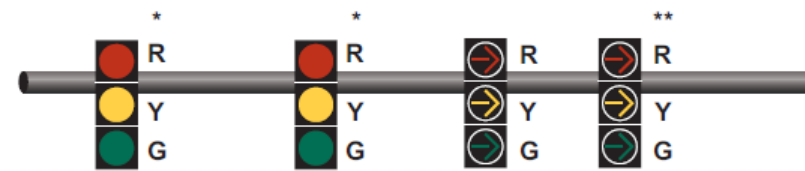
**DRAFT**

- Legend
- \* Center of Lane
  - \*\* Centered on Lane Line



1 Through Lane, 1 Shared Through / Right Lane, and 1 Right-Turn Lane

Ex. 16 - Protected Only Right-Turn Phasing

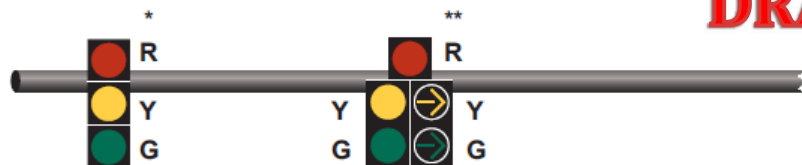


2 Through Lanes with 1 Right-Turn Lane

# Layout of Signal Heads

Ex. 17 - Protected / Permissive Right-Turn Phasing

**DRAFT**

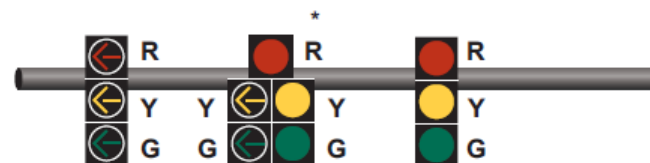


- Legend
- \* Center of Lane
  - \*\* Centered on Lane Line



2 Through Lanes with 1 Right-Turn Lane

Ex. 18 - Protected Left-Turn with Opposing Approach (No Through Movement)

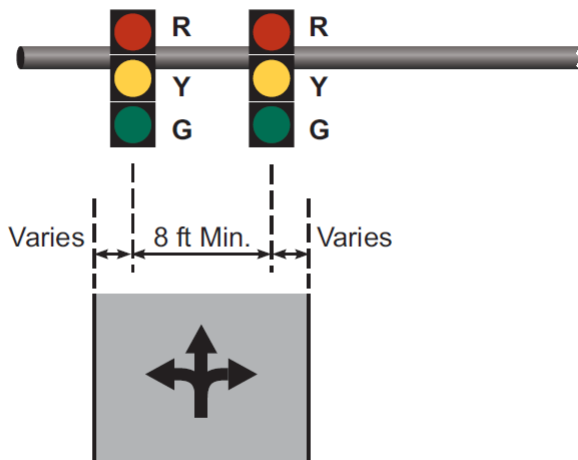


1 Left-Turn Lane with 1 Right-Turn Lane



# Layout of Signal Heads

Ex. 19 - Permissive Left Turn Phasing

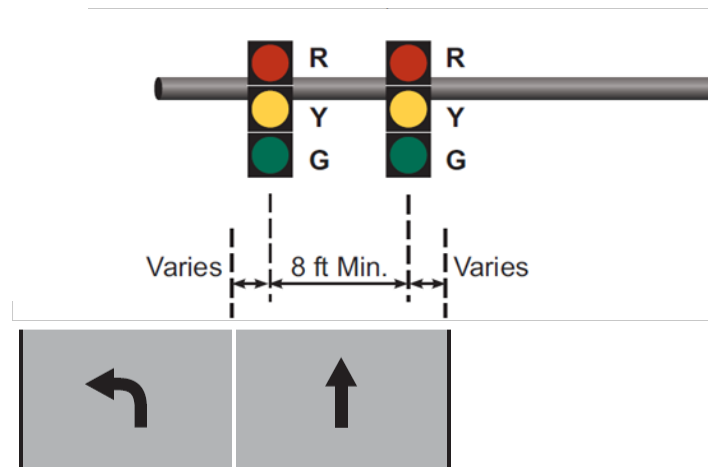


**DRAFT**

Legend  
\* Center of Lane

1 Shared Left / Through / Right Lane

Ex. 20 - Permissive Left-Turn Phasing



1 Through Lane with 1 Left-Turn Lane

## Layout of Signal Heads

**INCORRECT**

signal heads should be separated by 8 feet and the pair should be centered over lane



**SR 24 at SR 5**

## Section 4D.26 – Yellow Change and Red Clearance Intervals

### Standard:

- 03 **The duration of the yellow change interval shall be determined using engineering practices.**
- 06 **When used, the duration of the red clearance interval shall be determined using engineering practices.**

### Guidance:

- 05 *When indicated by the application of engineering practices, the yellow change interval should be followed by a red clearance interval to provide additional time before conflicting traffic movements, including pedestrians, are released.*

- **Durations shall be determined using engineering practices**
  - Compliance date December 31, 2014 or when timing adjustments are made (whichever occurs first)
  - Guidance:
    - Yellow Change Interval: min 3 sec, max 6 sec
    - Red Clearance Interval: max 6 sec
- Current DelDOT practices:
  - Yellow Change Interval: Use ITE formula
  - Red Clearance Interval: typically 2 sec

$$YCI = t + \frac{V}{2a}$$

where:

YCI = yellow change interval (s)  
t = perception-reaction time, 1 s  
V = posted speed limit, ft/s  
a = deceleration rate, 10 ft/s<sup>2</sup>

might change



Guidance: **DRAFT**

11 *Except for traffic control signals interconnected with light rail transit systems, traffic control signals with railroad preemption or coordinated with flashing-light signal systems should be provided with a back-up power supply.*

Guidance:

08A (DE Revision) *During the transition into preemption control:*

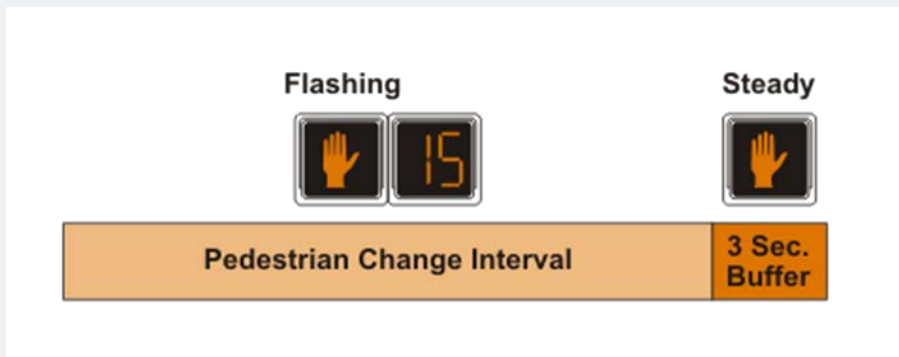
A. *The pedestrian change interval should not be shortened or omitted.*

### New Guidance

- *A back-up power supply should be provided for signals with railroad preemption*

### Delaware Revision

- *Should not omit or shorten ped change interval during preemption*



**SR 52 at Hillside**

## General

Option: **DRAFT**

07 Based on engineering study or engineering judgment, traffic control signals may be operated in the flashing mode on a scheduled basis during one or more periods of the day rather than operated continuously in the steady (stop-and-go) mode.

### *Guidance:*

*06A (DE Revision) Traffic control signals on state-maintained roads should not alternate operations between flashing mode and steady (stop-and-go) mode except in unique circumstances.*

## New Option

- With engineering judgment, traffic signals may be operated in flashing mode for one or more scheduled periods during the day

## Delaware Revision

- *Should not switch between steady and flash mode, except for unique situations*



**Walther at Barrett Run**

Support:

- 04 Section 2B.19 contains information regarding the use of overhead lane control signs on signalized approaches where lane drops, multiple-lane turns involving shared through-and-turn lanes, or other lane-use regulations that would be unexpected by unfamiliar road users are present.

## New Support

- References Section 2B.19 for recommended use of overhead signs at signalized intersections



Although unconventional, lane control signs may be overhead with  $\leq 2$  approach lanes; **prohibited overhead along approaches with  $\geq 3$  lanes**

**SR 2 (Lincoln St) eastbound at SR 52**



R3-5



R3-5a



## Chapter 4E – PEDSTRIAN CONTROL FEATURES



### Standard:

- 01 Pedestrian signal head indications shall have the following meanings:
- B. A flashing UPRAISED HAND (symbolizing DONT WALK) signal indication means that a pedestrian shall not start to cross the roadway in the direction of the signal indication, but that any pedestrian who has already started to cross on a steady WALKING PERSON (symbolizing WALK) signal indication shall proceed to the far side of the traveled way of the street or highway, unless otherwise directed by a traffic control device to proceed only to the median of a divided highway or only to some other island or pedestrian refuge area.

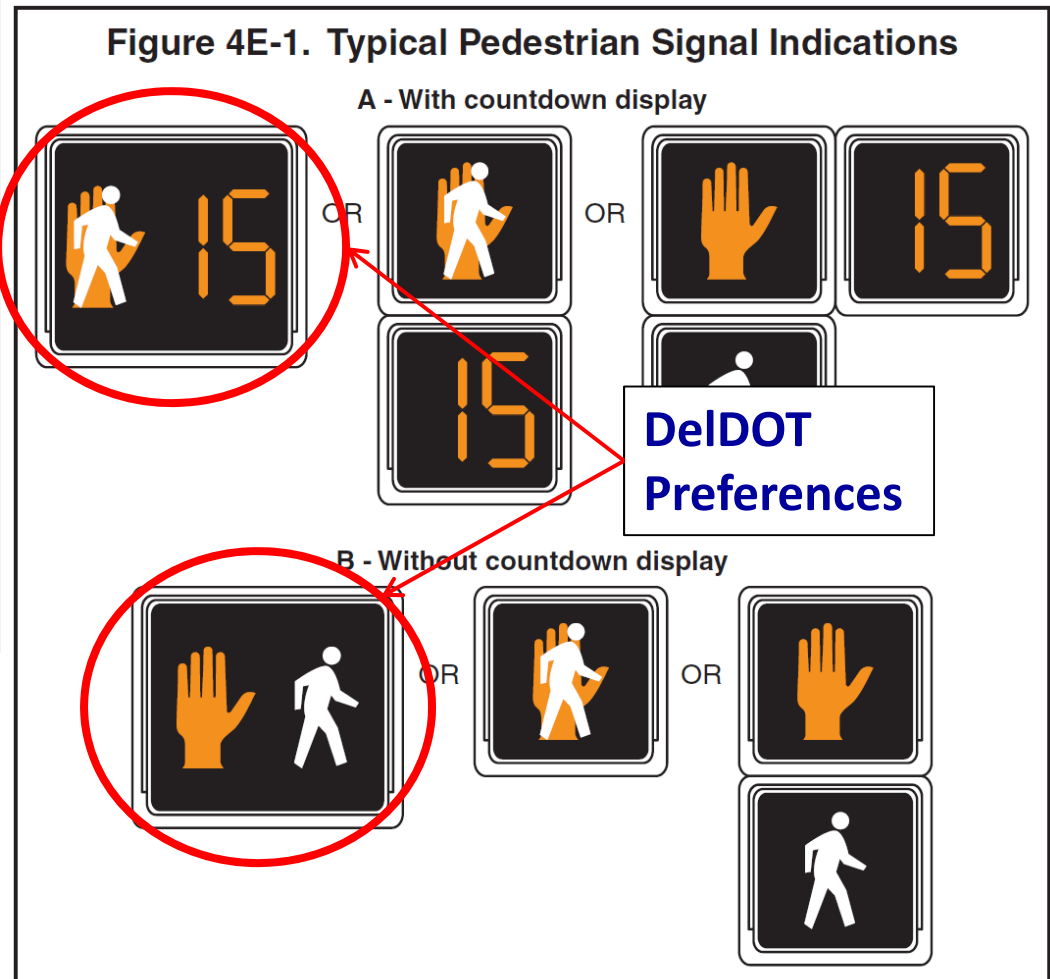
### Revised Definition

- A flashing UPRAISED HAND (DON'T WALK) indication means:
  - a pedestrian who has already started to cross shall proceed to the far curb
  - unless directed to proceed only to the median or pedestrian refuge area
- Signals must be timed so that pedestrians have enough time to cross entire roadway
- If time is only provided to cross to median, you must provide signs or signals to direct them accordingly (see Section 4E.06).



## Revised Standard/Guidance

- **Overlaid pedestrian symbols are allowed**
- *If ped signal causes excessive glare in nighttime conditions, automatic dimming should be used*



**Standard:**

02 If a two-section pedestrian signal head is used, the UPRAISED HAND (symbolizing DONT WALK) signal section shall be mounted directly above the WALKING PERSON (symbolizing WALK) signal section. If a one-section pedestrian signal head is used, the symbols shall be either overlaid upon each other or arranged side-by-side with the UPRAISED HAND symbol to the left of the WALKING PERSON symbol, and a light source that can display each symbol independently shall be used.

*Guidance:*

10 If the pedestrian signal indication is so bright that it causes excessive glare in nighttime conditions, some form of automatic dimming should be used to reduce the brilliance of the signal indication.



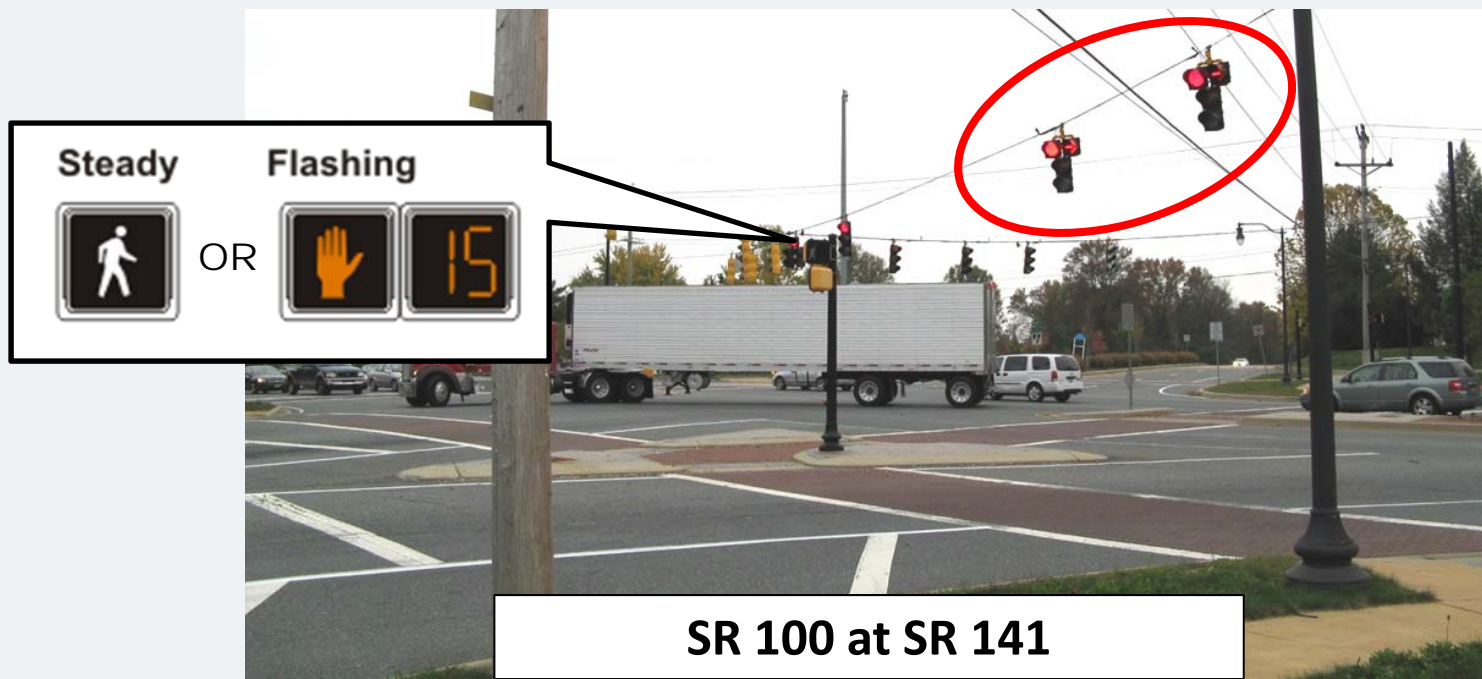
## Section 4E.06 – Pedestrian Intervals and Signal Phases

### Standard:

02 When the pedestrian signal heads associated with a crosswalk are displaying either a steady WALKING PERSON (symbolizing WALK) or a flashing UPRAISED HAND (symbolizing DONT WALK) signal indication, a steady or a flashing red signal indication shall be shown to any conflicting vehicular movement that is approaching the intersection or midblock location perpendicular or nearly perpendicular to the crosswalk.

### Revised Standard

- If a ped signal displays a steady WALKING PERSON or flashing UPRAISED HAND, a steady or flashing red signal indication must be shown to conflicting vehicles



## Section 4E.06 – Pedestrian Intervals and Signal Phases

### Standard:

- 04 A pedestrian change interval consisting of a flashing UPRAISED HAND (symbolizing DONT WALK) signal indication shall begin immediately following the WALKING PERSON (symbolizing WALK) signal indication. Following the pedestrian change interval, a buffer interval consisting of a steady UPRAISED HAND (symbolizing DONT WALK) signal indication shall be displayed for at least 3 seconds prior to the release of any conflicting vehicular movement. The sum of the time of the pedestrian change interval and the buffer interval shall not be less than the calculated pedestrian clearance time (see Paragraphs 7 through 16). The buffer interval shall not begin later than the beginning of the red clearance interval, if used.

### Revised Standard

- **Requires a buffer interval (steady UPRAISED HAND of at least 3 sec) following the FDW prior to the release of the conflicting traffic**
- Previously, you could transition between the FDW and the steady DW at the end of the all red clearance interval
  - This is an issue for DelDOT at intersections w/o countdown pedestrian signals due to DelDOT's typical use of a 2 sec all red.
  - Very difficult to program controllers to change pedestrian timing partially through yellow.
  - DelDOT systematically upgrading signals to include countdown ped signals.
- Buffer interval may be part of calculated ped clearance time

# Section 4E.06 – Pedestrian Intervals and Signal Phases

*Guidance:*

07 Except as provided in Paragraph 8, the pedestrian clearance time should be sufficient to allow a pedestrian crossing in the crosswalk who left the curb or shoulder at the end of the WALKING PERSON (symbolizing WALK) signal indication to travel at a walking speed of 3.5 feet per second to at least the far side of the traveled way or to a median of sufficient width for pedestrians to wait.

*Option:*

08 A walking speed of up to 4 feet per second may be used to evaluate the sufficiency of the pedestrian clearance time at locations where an extended pushbutton press function has been installed to provide slower pedestrians an opportunity to request and receive a longer pedestrian clearance time. Passive pedestrian detection may also be used to automatically adjust the pedestrian clearance time based on the pedestrian's actual walking speed or actual clearance of the crosswalk.

## Revised Guidance/Option for Calculating Various Pedestrian Signal Intervals:

- The pedestrian clearance time should be calculated using a walking speed of 3.5 feet per second. ← was 4.0 fps
- A walking speed of 4.0 fps may still be used if an extended button press feature or passive pedestrian detection is installed





# Section 4E.06 – Pedestrian Intervals and Signal Phases

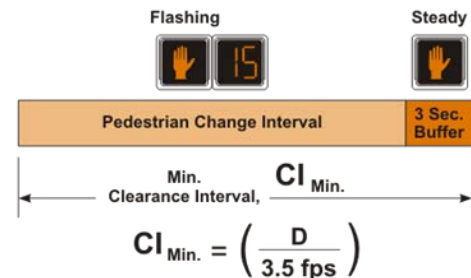
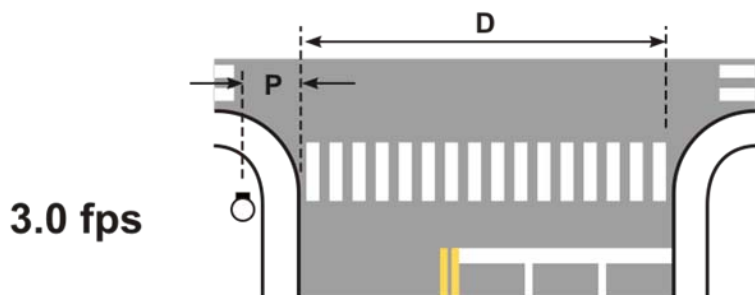
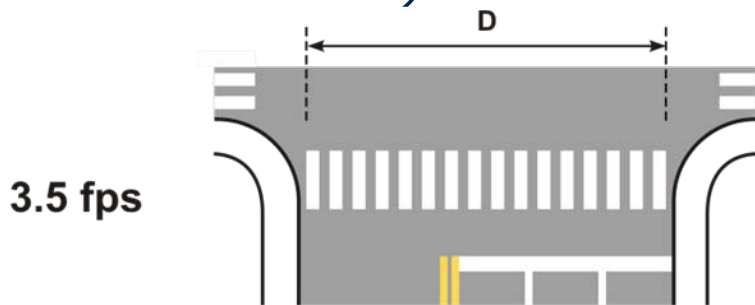
Guidance: **DRAFT**

14 (DE Revision) The total of the walk interval and pedestrian clearance time should be sufficient to allow a pedestrian crossing in the crosswalk who left the pedestrian detector (or, if no pedestrian detector is present, a location 10 feet from the face of the curb or from the edge of the pavement) at the beginning of the WALKING PERSON (symbolizing WALK) signal indication to travel at a walking speed of 3 feet per second to the far edge of roadway (typically the face of curb, if one exists) or to the median if a two-stage pedestrian crossing sequence is used. Any additional time that is required to satisfy the conditions of this paragraph should be added to the walk interval.

**DE Revision:**  
Changed 6' to 10'

## New Guidance for Calculating Pedestrian Signal Intervals:

- The sum of the walk interval and ped clearance time should allow a pedestrian walking at 3.0 fps to travel from ped detector (typically <10 ft in advance of curb) to far face of the curb

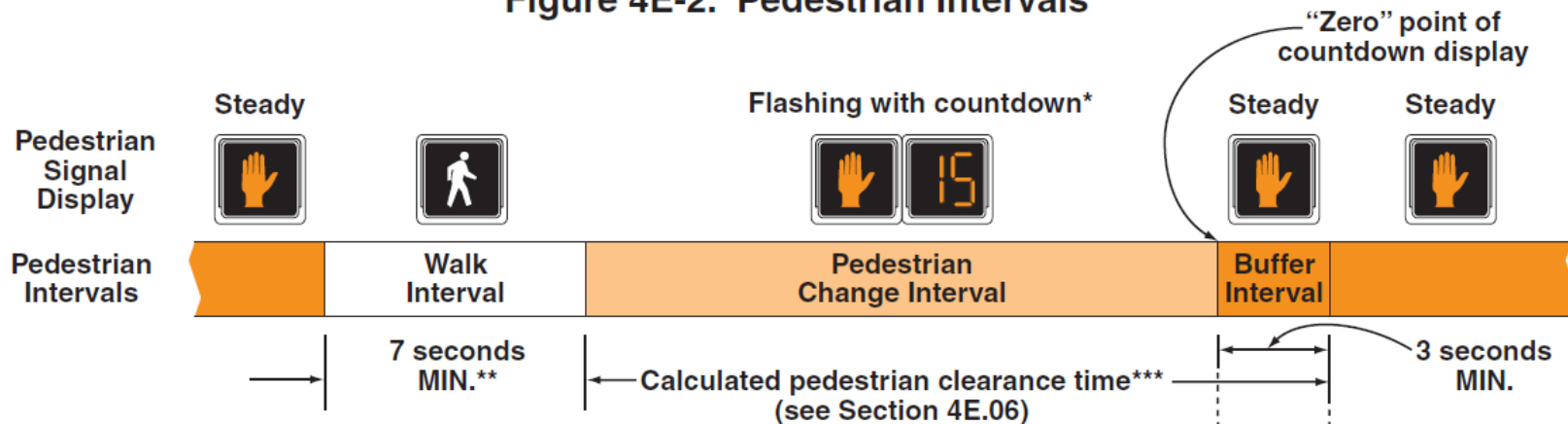


$$WCI_{Min.} = \left( \frac{D + P}{3.0 \text{ fps}} \right)$$

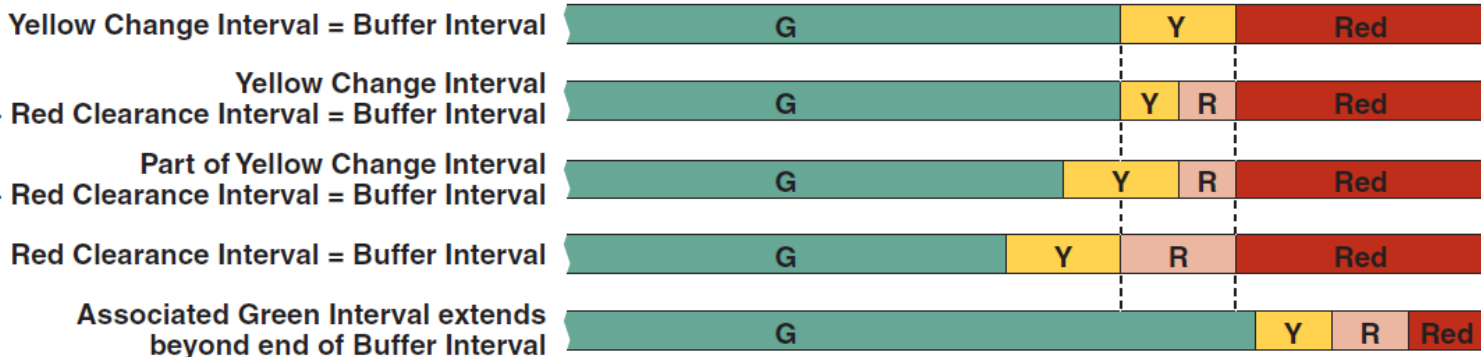
Where  $D$  = Crossing Distance  
 $P$  = Distance from curb to pedestrian pushbutton, typically 10' or less

# Section 4E.06 – Pedestrian Intervals and Signal Phases

Figure 4E-2. Pedestrian Intervals



Relationship to associated vehicular phase intervals:



Legend

- G** = Green Interval
- Y** = Yellow Change Interval (of at least 3 seconds)
- R** = Red Clearance Interval
- Red** = Red because conflicting traffic has been released

\* The countdown display is optional for Pedestrian Change Intervals of 7 seconds or less.

\*\* The Walk Interval may be reduced under some conditions (see Section 4E.06).

\*\*\* The Buffer Interval, which shall always be provided and displayed, may be used to help satisfy the calculated pedestrian clearance time, or may begin after the calculated pedestrian clearance time has ended.

Current DelDOT Practice (w/o countdown)



## Section 4E.06 – Pedestrian Intervals and Signal Phases

### Option:

19 At intersections with high pedestrian volumes and high conflicting turning vehicle volumes, a brief leading pedestrian interval, during which an advance WALKING PERSON (symbolizing WALK) indication is displayed for the crosswalk while red indications continue to be displayed to parallel through and/or turning traffic, may be used to reduce conflicts between pedestrians and turning vehicles.

### Guidance:

22 *If a leading pedestrian interval is used, it should be at least 3 seconds in duration and should be timed to allow pedestrians to cross at least one lane of traffic or, in the case of a large corner radius, to travel far enough for pedestrians to establish their position ahead of the turning traffic before the turning traffic is released.*

23 *If a leading pedestrian interval is used, consideration should be given to prohibiting turns across the crosswalk during the leading pedestrian interval.*

### Support:

24 At intersections with pedestrian volumes that are so high that drivers have difficulty finding an opportunity to turn across the crosswalk, the duration of the green interval for a parallel concurrent vehicular movement is sometimes intentionally set to extend beyond the pedestrian clearance time to provide turning drivers additional green time to make their turns while the pedestrian signal head is displaying a steady UPRAISED HAND (symbolizing DONT WALK) signal indication after pedestrians have had time to complete their crossings.

## New Option for Leading Ped Intervals

- A WALKING PERSON indication may be displayed for peds while red indications continue to be displayed for parallel and/or turning traffic
- *The leading ped interval should be at least 3 seconds to allow pedestrians to cross one lane of traffic and establish position in crosswalk*

Steady





# Section 4E.06 – Pedestrian Intervals and Signal Phases



**Notice leading WALK indication while corresponding traffic signal remains on red**

**Most appropriate for locations with high pedestrian volumes (examples: Beaches, Wilmington, Newark)**

## Section 4E.07 – Countdown Pedestrian Signals

### Standard:

01 All pedestrian signal heads used at crosswalks where the pedestrian change interval is more than 7 seconds shall include a pedestrian change interval countdown display in order to inform pedestrians of the number of seconds remaining in the pedestrian change interval.

### New Standard

- **If the pedestrian change interval is more than 7 seconds, a countdown display must be used**
- No compliance date
- Can remain w/o countdown heads until ped heads replaced

i.e., the flashing  
Don't Walk

i.e., almost  
everywhere



SR 2 at Linden

## Section 4E.07 – Countdown Pedestrian Signals

### Standard:

- 03 Where countdown pedestrian signals are used, the countdown shall always be displayed simultaneously with the flashing UPRAISED HAND (symbolizing DONT WALK) signal indication displayed for that crosswalk.
- 06 The countdown pedestrian signal shall display the number of seconds remaining until the termination of the pedestrian change interval (flashing UPRAISED HAND). Countdown displays shall not be used during the walk interval or during the red clearance interval of a concurrent vehicular phase.

### New Standards

- **The countdown shall be displayed simultaneously with a flashing UPRAISED HAND**
- **The countdown shall display “Zero” at the end of the pedestrian change interval**
- **The countdown display shall not be used during the all red phase**

Flashing with countdown

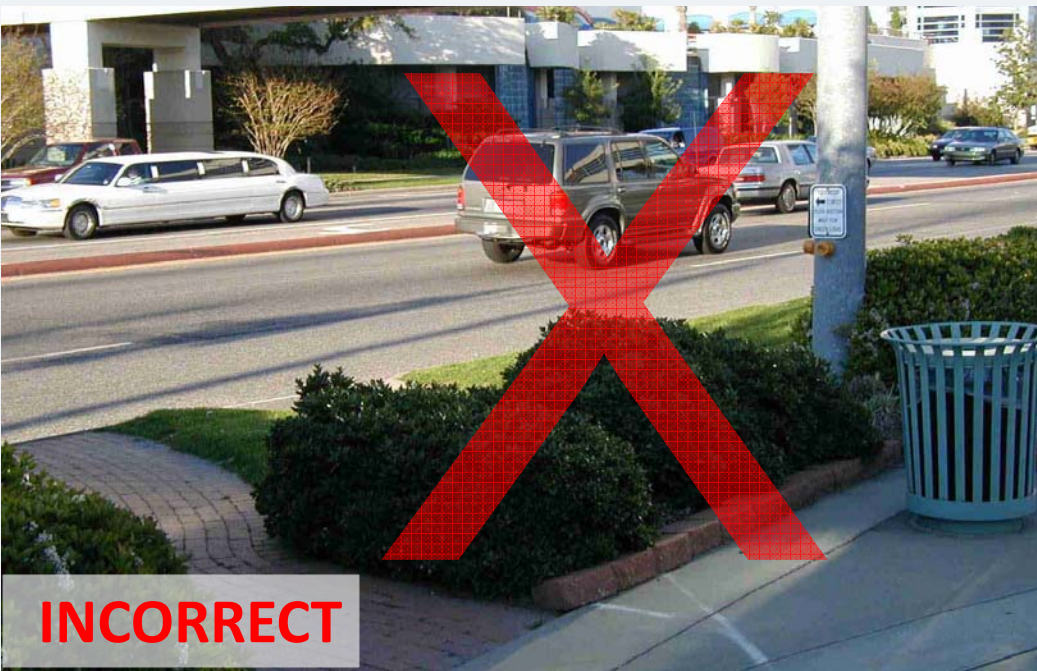




## Section 4E.08 – Pedestrian Detectors

### New Guidance on Location of Pedestrian Pushbuttons

- Easier to reach
- Placed more consistently
- More obvious which crosswalk it applies to
- Consistent with potential APS upgrades



# Section 4E.08 – Pedestrian Detectors

Option: **DRAFT**

01 Pedestrian detectors may be pushbuttons or passive detection devices.

Guidance:

04 (DE Revision) If pedestrian pushbuttons are used, they should be capable of easy activation and conveniently located near each end of the crosswalks. Except as provided in Paragraphs 5 and 6, pedestrian pushbuttons should be located to meet all of the following criteria (see Figure 4E-3):

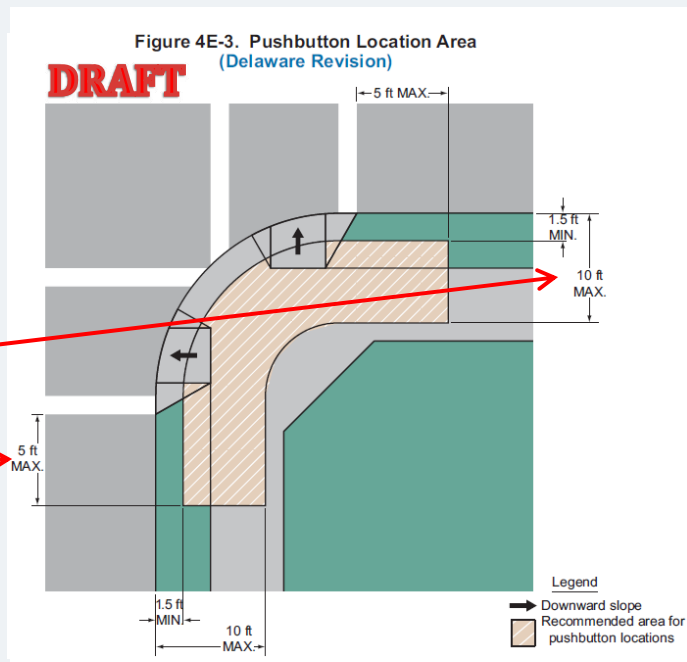
- A. Unobstructed and adjacent to a level all-weather surface to provide access from a wheelchair;
- B. Where there is an all-weather surface, a wheelchair accessible route from the pushbutton to the ramp;
- C. Between the edge of the crosswalk line (extended) farthest from the center of the intersection and the side of a curb ramp (if present), but not greater than 5 feet from said crosswalk line;
- D. Between 1.5 and 10 feet from the edge of the curb, shoulder, or pavement;
- E. With the face of the pushbutton parallel to the crosswalk to be used; and
- F. At a mounting height of approximately 3.5 feet, but no more than 4 feet, above the sidewalk.

**DE Revision:**  
Changed 6' to 10'

## New Guidance on Location of Pedestrian Pushbuttons

- *Pedestrian pushbuttons should be:*

- *Unobstructed, adjacent to a level surface, with accessible route to curb ramp*
- *Min 1.5', 10' max from curb*
- *< 5' from the crosswalk line farthest from the center of the intersection*
- *Mounted 42" to 48" above sidewalk, parallel to crosswalk*



# Section 4E.08 – Pedestrian Detectors

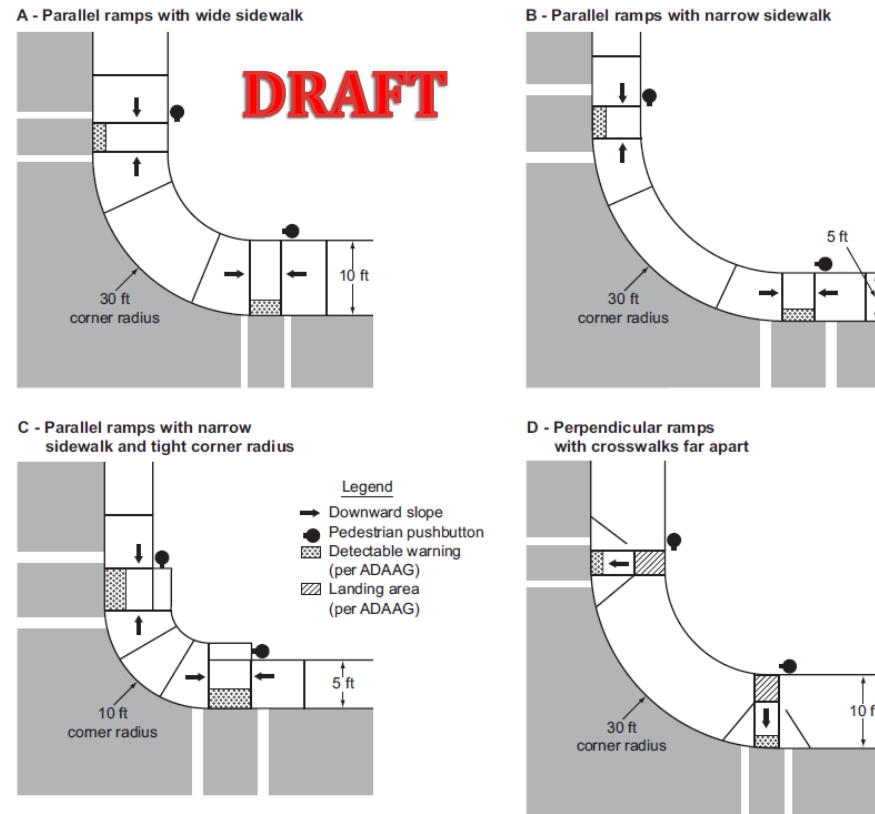
Guidance: **DRAFT**

06A (DE Revision) In locations where there is an increased likelihood of the pedestrian pushbutton pole being struck, the pole should be placed as far as possible from the edge of traveled way, but not farther than 10 feet from the edge of curb, shoulder, or pavement.

## DE Revision:

- Where there is a high probability of pushbutton pole being struck:
  - Should be placed as far as possible from road
  - Still within 10' of curb/shoulder/pavement
  - Figure 4E-4 revised accordingly

Figure 4E-4. Typical Pushbutton Locations (Sheet 1 of 2)  
(Delaware Revision)



Notes:

1. This figure is not drawn to scale.
2. These drawings are intended to describe the typical locations for pedestrian pushbutton installations. They are not intended to be a guide for the design of curb cut ramps.
3. Figure 4E-3 shows the recommended area for pushbutton locations.



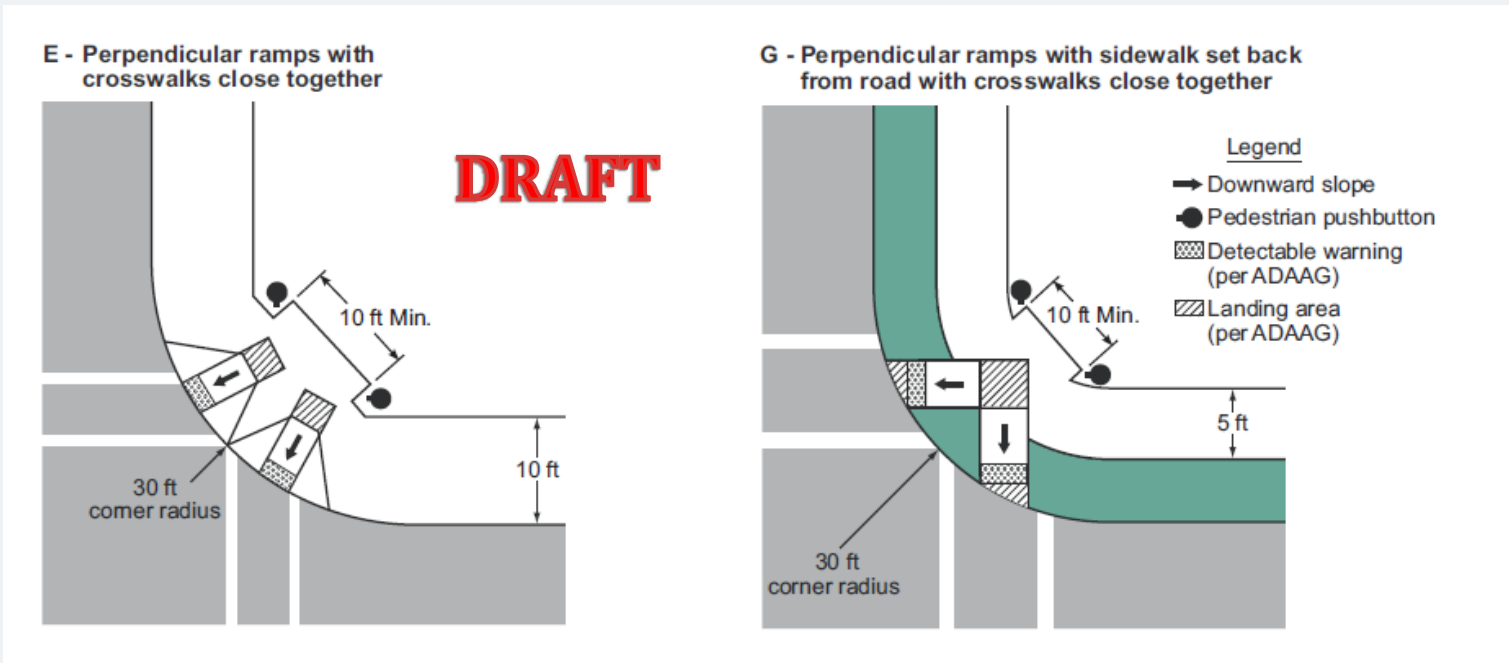
# Section 4E.08 – Pedestrian Detectors

*Guidance:*

- 07 Except as provided in Paragraph 8, where two pedestrian pushbuttons are provided on the same corner of a signalized location, the pushbuttons should be separated by a distance of at least 10 feet.
- Option:
- 08 Where there are physical constraints on a particular corner that make it impractical to provide the 10-foot separation between the two pedestrian pushbuttons, the pushbuttons may be placed closer together or on the same pole.

## New Guidance on Location of Ped Pushbuttons

- *Two pushbuttons on same corner should be min. 10' apart or can be co-mounted on the same pole*



## Section 4E.08 – Pedestrian Detectors

### Standard:

12 The positioning of pedestrian pushbuttons and the legends on the pedestrian pushbutton signs shall clearly indicate which crosswalk signal is actuated by each pedestrian pushbutton.

### New Standard for Location of Ped Pushbuttons

- **Signs and Pushbutton location must make it obvious which crosswalk it applies to**



Educational sign

Arrow may be used to make it more obvious which crosswalk it applies to

Arrowhead should not be covered for this type of installation

## Section 4E.08 – Pedestrian Detectors

Option: **DRAFT**

12A (DE Revision) At intersections on state-maintained roads where pedestrian pushbuttons are co-mounted on poles, physical arrows on the pushbuttons may be used instead of arrows on pedestrian pushbutton signs to indicate which crosswalk is actuated by each pedestrian pushbutton.

### ***DE Revision:***

- If pushbuttons are co-mounted on the same pole, use arrows on the pushbuttons not signs*

Single Educational Sign used for both pushbuttons (w/o arrow)

Arrow stickers Required



Walker at Saulsbury



## Guidance on Accessible Pedestrian Signals (APS) and Detectors Combined and Reorganized:

- 4E.09 – General
- 4E.10 – Location
- 4E.11 – Walk Indications
- 4E.12 – Tactile Arrows and Locator Tones
- 4E.13 – Extended Pushbutton Press Features

**No Compliance Dates**



Support:

02 The primary technique that pedestrians who have visual disabilities use to cross streets at signalized locations is to initiate their crossing when they hear the traffic in front of them stop and the traffic alongside them begin to move, which often corresponds to the onset of the green interval. The existing environment is often not sufficient to provide the information that pedestrians who have visual disabilities need to cross a roadway at a signalized location.

- The MUTCD now acknowledges that “the existing environment is often not sufficient” to provide adequate info for pedestrians with visual disabilities

**Complete reversal from old MUTCD!**

## Section 4E.10 – APS and Detectors - Location

### Standard:

03 If two accessible pedestrian pushbuttons are placed less than 10 feet apart or on the same pole, each accessible pedestrian pushbutton shall be provided with the following features (see Sections 4E.11 through 4E.13):

- A. A pushbutton locator tone,
- B. A tactile arrow,
- C. A speech walk message for the WALKING PERSON (symbolizing WALK) indication, and
- D. A speech pushbutton information message.

### New Standard

- If 2 accessible ped pushbuttons are <10' apart or on same pole, must have:
  - Locator tone
  - Tactile arrow
  - Speech walk message for the WALKING PERSON indication
  - Speech pushbutton information message



SR 92 at Peachtree



## Section 4E.11 – APS and Detectors - Walk Indications

### Standard:

- 02 Accessible pedestrian signals shall have both audible and vibrotactile walk indications.
- 03 Vibrotactile walk indications shall be provided by a tactile arrow on the pushbutton (see Section 4E.12) that vibrates during the walk interval.
- 04 Accessible pedestrian signals shall have an audible walk indication during the walk interval only. The audible walk indication shall be audible from the beginning of the associated crosswalk.
- 05 The accessible walk indication shall have the same duration as the pedestrian walk signal except when the pedestrian signal rests in walk.
- 07 Where two accessible pedestrian signals are separated by a distance of at least 10 feet, the audible walk indication shall be a percussive tone. Where two accessible pedestrian signals on one corner are not separated by a distance of at least 10 feet, the audible walk indication shall be a speech walk message.
- 10 Automatic volume adjustment in response to ambient traffic sound level shall be provided up to a maximum volume of 100 dBA.
- 17 If speech walk messages are used to communicate the walk interval, they shall provide a clear message that the walk interval is in effect, as well as to which crossing it applies. Speech walk messages shall be used only at intersections where it is technically infeasible to install two accessible pedestrian signals at one corner separated by a distance of at least 10 feet.



### New Standard

- **APS must have both audible and vibrotactile walk indications**
- **During the walk interval:**
  - **Audible**
    - percussive or speech walk message (only if two APS <10' apart)
    - max volume of 100 dBA
  - **Vibrotactile - arrow on pushbutton vibrates**





## Section 4E.08 – Pedestrian Detectors

Example of Accessible Pedestrian Signal (APS) Detector



**Elkton Road at Apple**

## Standard:

- 01 To enable pedestrians who have visual disabilities to distinguish and locate the appropriate pushbutton at an accessible pedestrian signal location, pushbuttons shall clearly indicate by means of tactile arrows which crosswalk signal is actuated by each pushbutton. Tactile arrows shall be located on the pushbutton, have high visual contrast (light on dark or dark on light), and shall be aligned parallel to the direction of travel on the associated crosswalk.
- 02 An accessible pedestrian pushbutton shall incorporate a locator tone.
- 05 Pushbutton locator tones shall be deactivated when the traffic control signal is operating in a flashing mode. This requirement shall not apply to traffic control signals or pedestrian hybrid beacons that are activated from a flashing or dark mode to a stop-and-go mode by pedestrian actuations.



## New Standard

- **APS pushbuttons shall have tactile arrows on pushbutton and a locator tone**
- **Locator tones must be deactivated when traffic signal is in flashing mode**
  - **except signals activated from flashing mode by pushbutton (incl. HAWKS – see Chapter 4F)**



## Section 4E.11 – Extended Pushbutton Press Features

Option:

01 Pedestrians may be provided with additional features such as increased crossing time, audible beaoning, or a speech pushbutton information message as a result of an extended pushbutton press.

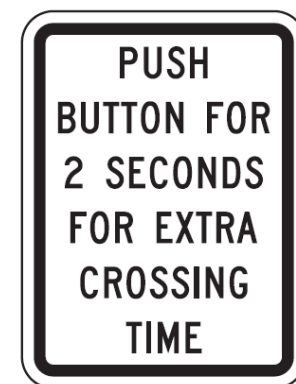
**Standard:**

02 **If an extended pushbutton press is used to provide any additional feature(s), a pushbutton press of less than one second shall actuate only the pedestrian timing and any associated accessible walk indication, and a pushbutton press of one second or more shall actuate the pedestrian timing, any associated accessible walk indication, and any additional feature(s).**

03 **If additional crossing time is provided by means of an extended pushbutton press, a PUSH BUTTON FOR 2 SECONDS FOR EXTRA CROSSING TIME (R10-32P) plaque (see Figure 2B-26) shall be mounted adjacent to or integral with the pedestrian pushbutton.**

### New Option and Standards

- An extended pushbutton press may be used to activate increased crossing time, audible beacon, or speech message
  - **<1 sec press: activates normal walk time + walk indication**
  - **>1 sec press: activates additional crossing time**
- **Shall use the R10-32P plaque wherever extended pushbuttons are used**



R10-32P



**NEW CHAPTER ON HYBRID BEACONS**  
**Better known as...”HAWKS”**



## Section 4F.01– Application of Pedestrian Hybrid Beacons

### Standard:

- 03 If used, pedestrian hybrid beacons shall be used in conjunction with signs and pavement markings to warn and control traffic at locations where pedestrians enter or cross a street or highway. A pedestrian hybrid beacon shall only be installed at a marked crosswalk.

### New Chapter on Hybrid Beacons (“HAWKS”)

- **Shall only be used:**
  - at marked crosswalks
  - with signs and pavement markings



SR 72 at Farm



## Section 4F.01– Application of Pedestrian Hybrid Beacons

### Guidance:

05 *If a traffic control signal is not justified under the signal warrants of Chapter 4C and if gaps in traffic are not adequate to permit pedestrians to cross, or if the speed for vehicles approaching on the major street is too high to permit pedestrians to cross, or if pedestrian delay is excessive, the need for a pedestrian hybrid beacon should be considered on the basis of an engineering study that considers major-street volumes, speeds, widths, and gaps in conjunction with pedestrian volumes, walking speeds, and delay.*

- *HAWKS should be considered when:*
  - *Signal Warrants not met (Chapter 4C)*
  - *Gaps in traffic are not adequate,*
  - *Speed of vehicles approaching is too high,*
  - *or, Pedestrian delay is excessive*
- *New curves provided, similar to volume warrant curves in Chapter 4C (see Figures 4F-1 and 4F-2 next Slide)*

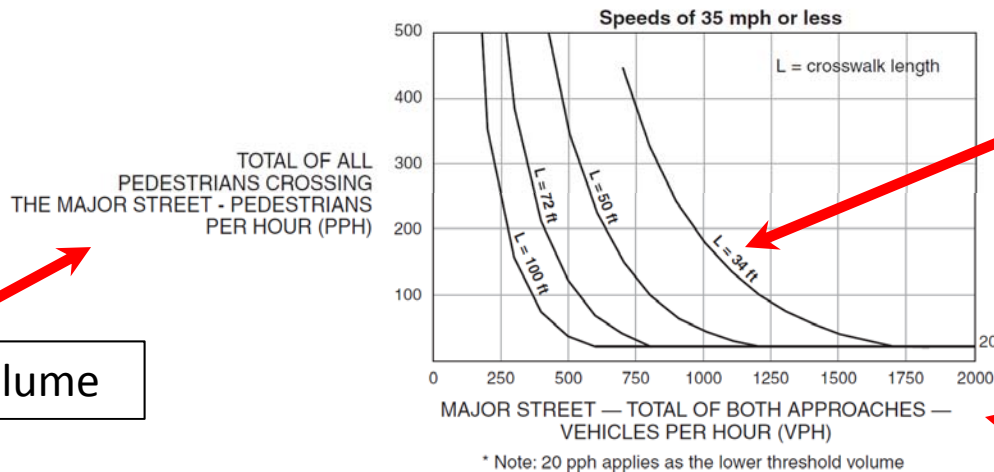


**SR 72 at Farm**



# Section 4F.01– Application of Pedestrian Hybrid Beacons

**Figure 4F-1. Guidelines for the Installation of Pedestrian Hybrid Beacons on Low-Speed Roadways**

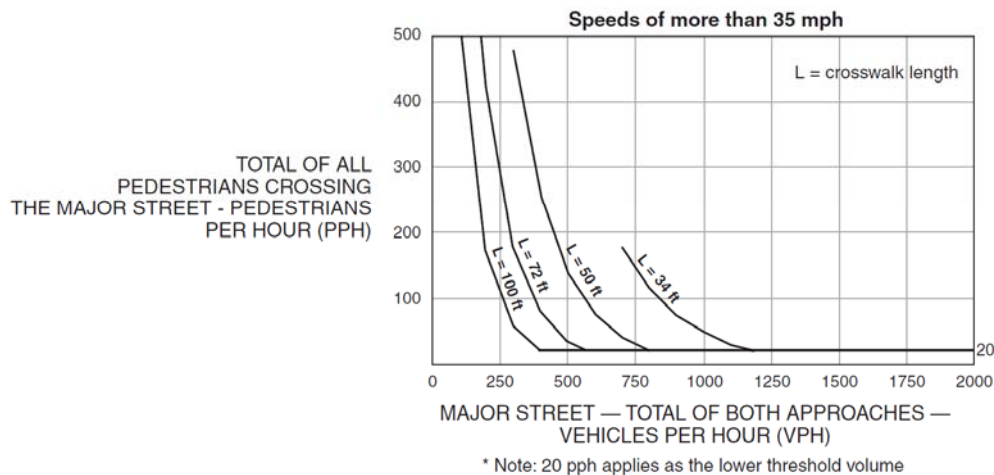


Crosswalk Length

Pedestrian Volume

Major Street Volume

**Figure 4F-2. Guidelines for the Installation of Pedestrian Hybrid Beacons on High-Speed Roadways**



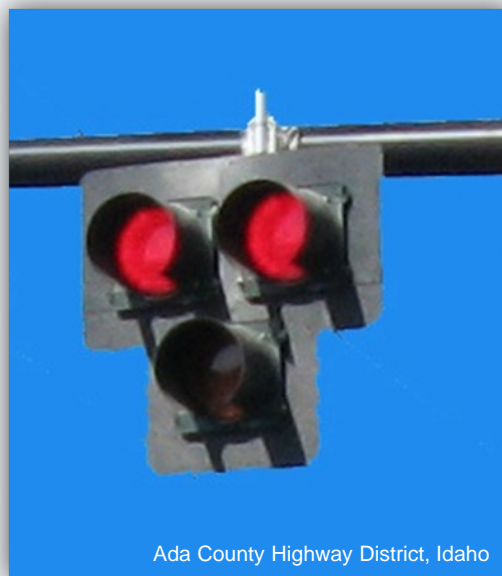
## Section 4F.02– Design of Pedestrian Hybrid Beacons

### Standard:

01 Except as otherwise provided in this Section, a pedestrian hybrid beacon shall meet the provisions of Chapters 4D and 4E.

02 A pedestrian hybrid beacon face shall consist of three signal sections, with a CIRCULAR YELLOW signal indication centered below two horizontally aligned CIRCULAR RED signal indications (see Figure 4F-3).

- A pedestrian hybrid beacon face shall consist of two CIRCULAR RED signal indications above a CIRCULAR YELLOW signal indication



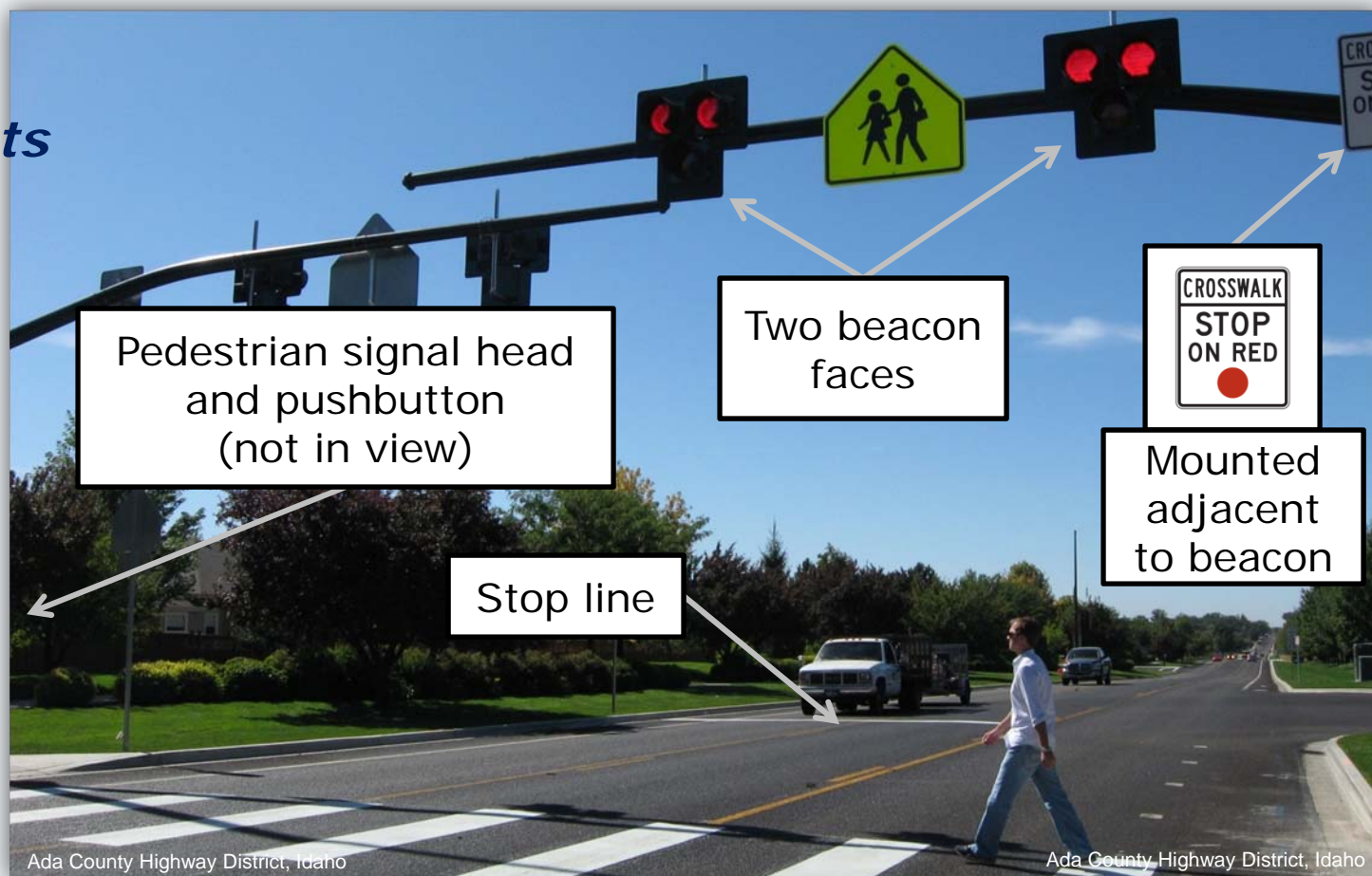
Ada County Highway District, Idaho

## Section 4F.02– Design of Pedestrian Hybrid Beacons

### Standard:

- 03 When an engineering study finds that installation of a pedestrian hybrid beacon is justified, then:
- A. At least two pedestrian hybrid beacon faces shall be installed for each approach of the major street,
  - B. A stop line shall be installed for each approach to the crosswalk,
  - C. A pedestrian signal head conforming to the provisions set forth in Chapter 4E shall be installed at each end of the marked crosswalk, and
  - D. The pedestrian hybrid beacon shall be pedestrian actuated.

### *Minimum Requirements*





## Section 4F.02– Design of Pedestrian Hybrid Beacons

### *Guidance:*

- 04 *When an engineering study finds that installation of a pedestrian hybrid beacon is justified, then:*
- A. *The pedestrian hybrid beacon should be installed at least 100 feet from side streets or driveways that are controlled by STOP or YIELD signs,*
  - B. *Parking and other sight obstructions should be prohibited for at least 100 feet in advance of and at least 20 feet beyond the marked crosswalk, or site accommodations should be made through curb extensions or other techniques to provide adequate sight distance,*
  - C. *The installation should include suitable standard signs and pavement markings, and*
  - D. *If installed within a signal system, the pedestrian hybrid beacon should be coordinated.*
- 05 *On approaches having posted or statutory speed limits or 85th-percentile speeds in excess of 35 mph and on approaches having traffic or operating conditions that would tend to obscure visibility of roadside hybrid beacon face locations, both of the minimum of two pedestrian hybrid beacon faces should be installed over the roadway.*
- 06 *On multi-lane approaches having a posted or statutory speed limits or 85th-percentile speeds of 35 mph or less, either a pedestrian hybrid beacon face should be installed on each side of the approach (if a median of sufficient width exists) or at least one of the pedestrian hybrid beacon faces should be installed over the roadway.*

### ***Additional Guidance:***

- *Speed > 35 mph: should be mounted overhead*
- *Speed < 35 mph: should either be mounted on both sides of approach (if median present) or at least one mounted overhead*
- *should be installed at least 100 feet from side streets or driveways controlled by STOP or YIELD signs (similar to guidance in Chapters 4C and 4D)*
- *Should include suitable signs and markings*
- *If part of coordinated system, should be coordinated*

## Section 4F.03– Operation of Pedestrian Hybrid Beacons

### Standard:

01 **Pedestrian hybrid beacon indications shall be dark (not illuminated) during periods between actuations.**

02 **Upon actuation by a pedestrian, a pedestrian hybrid beacon face shall display a flashing CIRCULAR yellow signal indication, followed by a steady CIRCULAR yellow signal indication, followed by both steady CIRCULAR RED signal indications during the pedestrian walk interval, followed by alternating flashing CIRCULAR RED signal indications during the pedestrian clearance interval (see Figure 4F-3). Upon termination of the pedestrian clearance interval, the pedestrian hybrid beacon faces shall revert to a dark (not illuminated) condition.**

03 **Except as provided in Paragraph 4, the pedestrian signal heads shall continue to display a steady UPRAISED HAND (symbolizing DONT WALK) signal indication when the pedestrian hybrid beacon faces are either dark or displaying flashing or steady CIRCULAR yellow signal indications. The pedestrian signal heads shall display a WALKING PERSON (symbolizing WALK) signal indication when the pedestrian hybrid beacon faces are displaying steady CIRCULAR RED signal indications. The pedestrian signal heads shall display a flashing UPRAISED HAND (symbolizing DONT WALK) signal indication when the pedestrian hybrid beacon faces are displaying alternating flashing CIRCULAR RED signal indications. Upon termination of the pedestrian clearance interval, the pedestrian signal heads shall revert to a steady UPRAISED HAND (symbolizing DONT WALK) signal indication.**

### Option:

04 **Where the pedestrian hybrid beacon is installed adjacent to a roundabout to facilitate crossings by pedestrians with visual disabilities and an engineering study determines that pedestrians without visual disabilities can be allowed to cross the roadway without actuating the pedestrian hybrid beacon, the pedestrian signal heads may be dark (not illuminated) when the pedestrian hybrid beacon faces are dark.**

### Guidance:

05 *The duration of the flashing yellow interval should be determined by engineering judgment.*

### Standard:

06 **The duration of the steady yellow change interval shall be determined using engineering practices.**

### Guidance:

07 *The steady yellow interval should have a minimum duration of 3 seconds and a maximum duration of 6 seconds (see Section 4D.26). The longer intervals should be reserved for use on approaches with higher speeds.*

***See next slides for graphics 😊***

# Section 4F.03– Operation of Pedestrian Hybrid Beacons

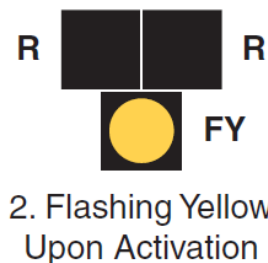
**1. Until activated, the hybrid beacons remain dark and ped signals display steady DON'T WALK**



**Steady**



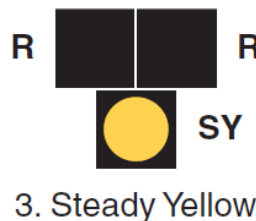
**2. When activated, beacons display a flashing yellow, while ped signals remain steady DON'T WALK**



**Steady**



**3. Beacons display a steady yellow while ped signals remain steady DON'T WALK**



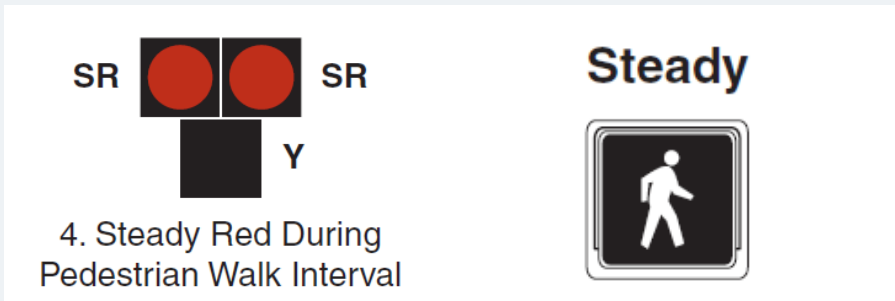
**Steady**



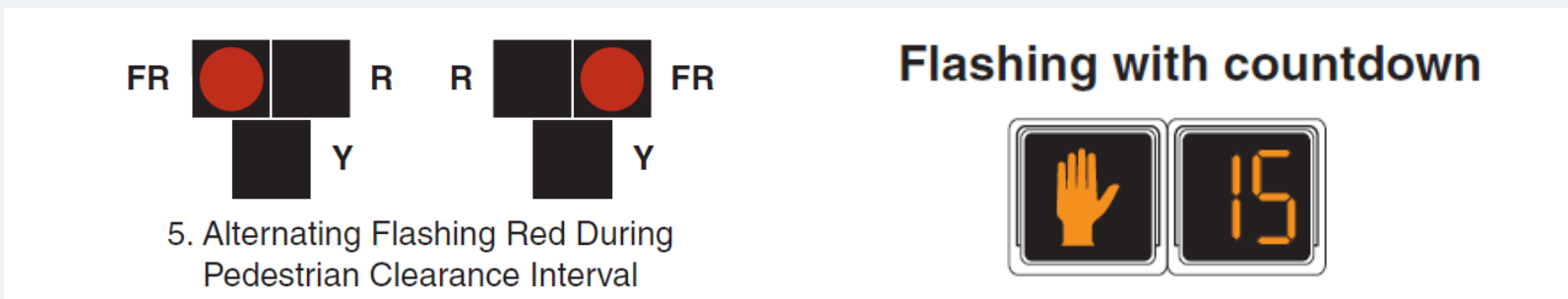


# Section 4F.03– Operation of Pedestrian Hybrid Beacons

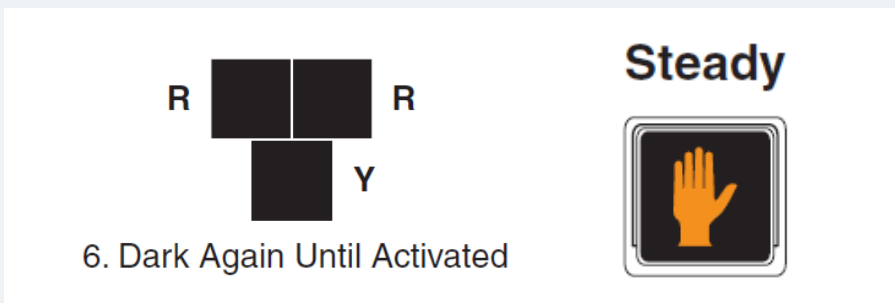
4. During ped walk interval, beacons display both steady red and ped signal displays steady WALK



5. During ped clearance interval, beacons alternate flashing red and ped signal flashes DON'T WALK



6. Upon termination of ped clearance interval, beacons revert to dark and ped signals display steady DON'T WALK



## Section 4G.01 Application of Emergency-Vehicle Traffic Control Signals and Hybrid Beacons

Option:

03 An emergency-vehicle hybrid beacon may be installed instead of an emergency-vehicle traffic control signal under conditions described in Section 4G.04.

## Section 4G.04 Emergency-Vehicle Hybrid Beacons

Standard:

01 Emergency-vehicle hybrid beacons shall be used only in conjunction with signs to warn and control traffic at an unsignalized location where emergency vehicles enter or cross a street or highway. Emergency-vehicle hybrid beacons shall be actuated only by authorized emergency or maintenance personnel.

14 At least two emergency-vehicle hybrid beacon faces shall be installed for each approach of the major street and a stop line shall be installed for each approach of the major street.

## New Option

- Hybrid beacons may be installed instead of an emergency-vehicle traffic control signal
- **shall only be used where emergency vehicles enter or cross roadway**
- **At least 2 hybrid beacon faces shall be installed on each approach**

**Could be replaced with HAWK**



**Aetna Fire Station along Old County Rd**



## DE Guidance:

- Existing signals OK until the end of useful life
- Anything more than routine maintenance → upgrade

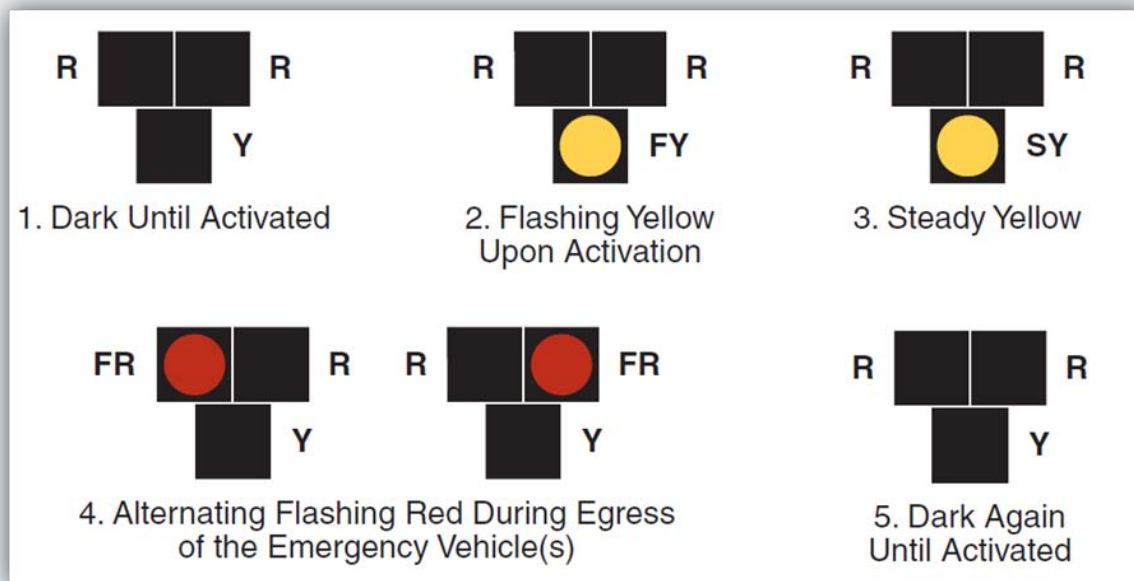
# Section 4G.04– Emergency-Vehicle Hybrid Beacons

**Standard:**

06 Upon actuation by authorized emergency personnel, the emergency-vehicle hybrid beacon faces shall each display a flashing yellow signal indication, followed by a steady yellow change interval, prior to displaying two CIRCULAR RED signal indications in an alternating flashing array for a duration of time adequate for egress of the emergency vehicles. The alternating flashing red signal indications shall only be displayed when it is required that drivers on the major street stop and then proceed subject to the rules applicable after making a stop at a STOP sign. Upon termination of the flashing red signal indications, the emergency-vehicle hybrid beacons shall revert to a dark mode (no indications displayed) condition.

## New Standard for Operation of Emergency-Vehicle Hybrid Beacons

- Similar to pedestrian HAWK
- Solid red phase optional (not shown in figure)



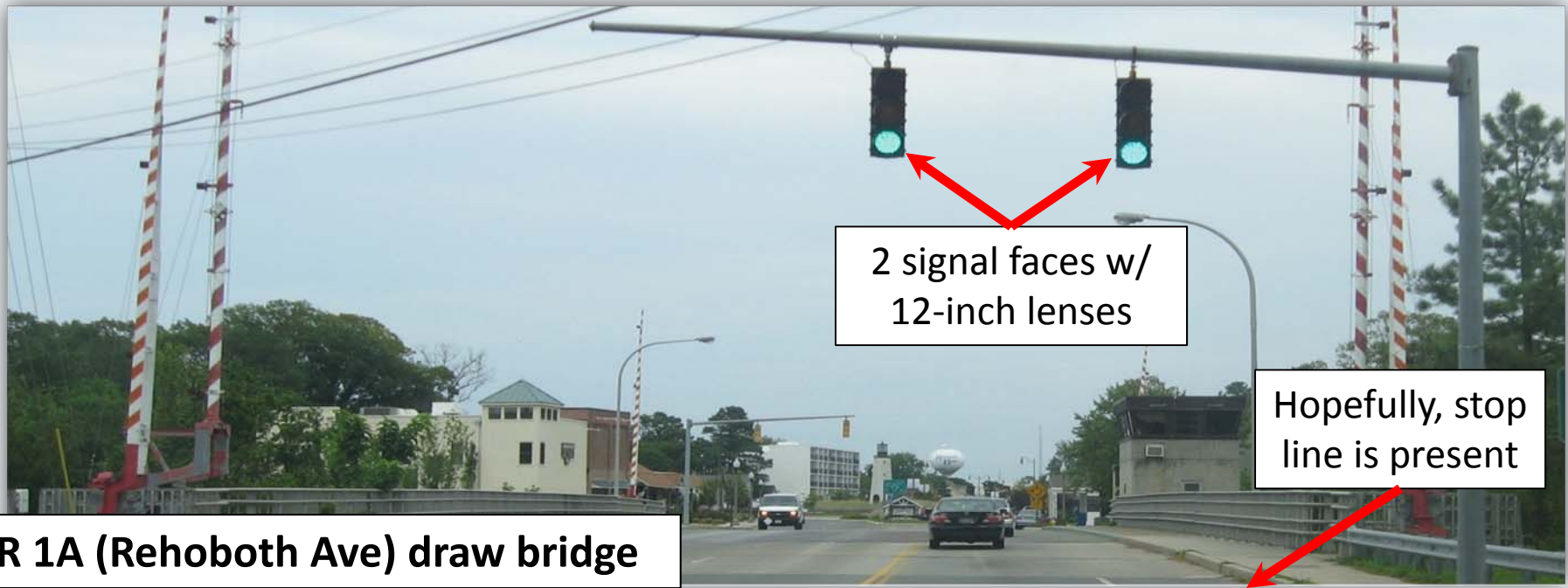


## Standard:

- 02 Signal faces with 12-inch diameter signal indications shall be used for all new movable bridge signals.
- 05 Regardless of which signal type is selected, at least two signal faces shall be provided for each approach to the movable span and a stop line (see Section 3B.16) shall be installed to indicate the point behind which vehicles are required to stop.

## Revised Standards

- 12-inch signal indications now required
- At least two signal faces required
- A stop line is required for vehicles



## Chapter 4K– HIGHWAY TRAFFIC SIGNALS AT TOLL PLAZAS

### Section 4K.01 Traffic Signals at Toll Plazas

#### Standard:

- 01 Traffic control signals or devices that closely resemble traffic control signals that use red or green circular indications shall not be used at toll plazas to indicate the open or closed status of the toll plaza lanes.

### Section 4K.02 Lane-Use Control Signals at or Near Toll Plazas

#### Standard:

- 01 Lane-use control signals used at toll plazas shall comply with the provisions of Chapter 4M except as otherwise provided in this Section.
- 02 At toll plazas with multiple lanes where one or more lanes is sometimes closed to traffic, a lane-use control signal shall be installed above the center of each toll plaza lane to indicate the open or closed status of the controlled lane.

## New Chapter

- Red or green circular indications shall not be used to indicate open or closed status of toll lane
- Lane-use control signals shall be used to indicate open or closed status of toll lane



*Note: I-95 Toll Plaza currently being upgraded*

# Chapter 4K– HIGHWAY TRAFFIC SIGNALS AT TOLL PLAZAS

**INCORRECT**



**SR 1 – N. Dover Plaza**

**CORRECT**



**NJ Turnpike?**



## Section 4K.03– Warning Beacons at Toll Plazas

### Standard:

01 **Warning Beacons used at toll plazas shall comply with the provisions of Chapter 4L except as otherwise provided in this Section.**

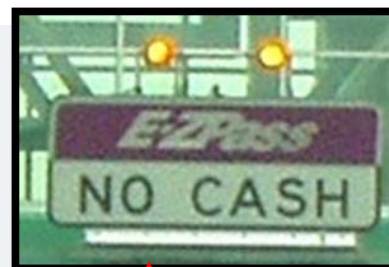
### Guidance:

02 *Warning Beacons, if used with a toll plaza canopy sign (see Section 2F.16) to assist drivers of such vehicles in locating the dedicated ETC Account-Only lane(s), should be installed in a manner such that the beacons are distinctly separate from the lane-use control signals (see Section 4M.01) for the toll plaza lane.*

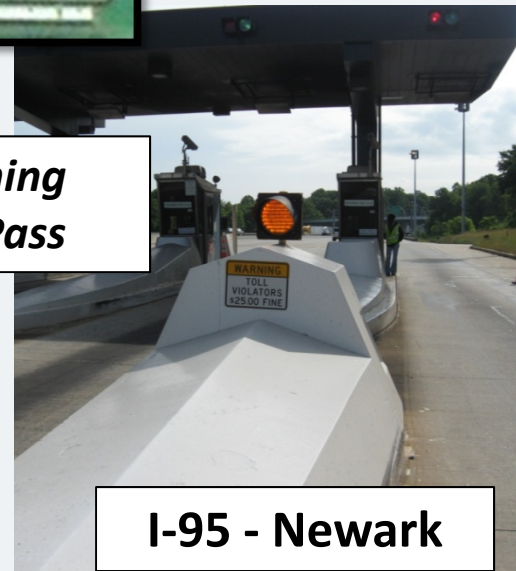
### Option:

03 Warning Beacons that are mounted on toll plaza islands, behind impact attenuators in front of toll plaza islands, and/or on toll booth pylons (ramparts) to identify them as objects in the roadway may be mounted at a height that is appropriate for viewing in a toll plaza context, even if that height is lower than the normal minimum of 8 feet above the pavement.

- **Use of Warning Beacons shall comply with Chapter 4L**
- Warning Beacons mounted on toll plaza islands may be mounted at a height below the normal minimum of 8 feet above the pavement
- *Warning Beacons used with toll plaza canopy signs should be distinctly separate from lane-use control signals*



**OK to use flashing yellow for E-ZPass**



**I-95 - Newark**

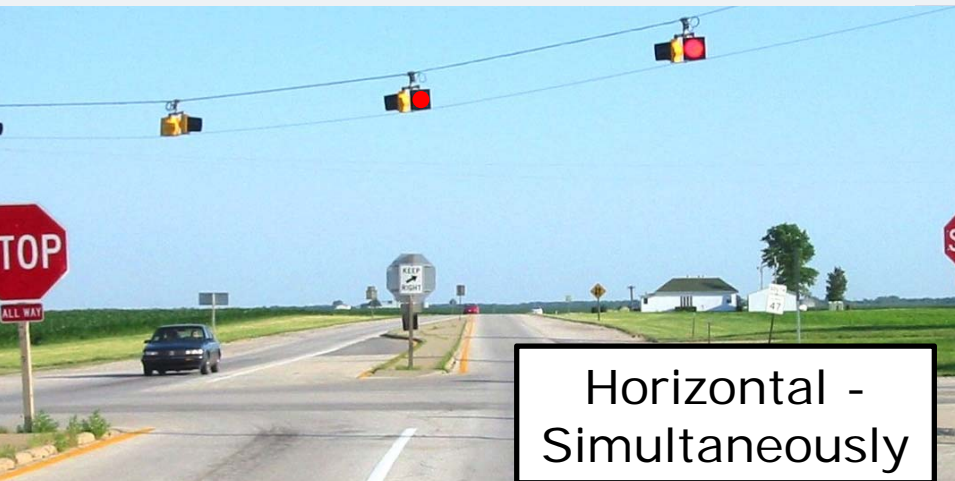
# Section 4L.02 – Intersection Control Beacon

**Standard:**

05 If two horizontally aligned red signal indications are used on an approach for an Intersection Control Beacon, they shall be flashed simultaneously to avoid being confused with grade crossing flashing-light signals. If two vertically aligned red signal indications are used on an approach for an Intersection Control Beacon, they shall be flashed alternately.

**Revised Standard**

- If two red signal beacons are aligned horizontally, they shall be flashed simultaneously
- If two red signal beacons are aligned vertically, they shall be flashed alternately



## Section 4N – In-Roadway Lights

### Standard:

02A (DE Revision) Due to prior poor performance of in-roadway lighting within Delaware, in-roadway lighting on state-maintained roads shall only be permitted with DelDOT Traffic approval.

### DE Revision

- In-roadway lights only permitted on state maintained roads with DelDOT Traffic approval

