

**Policy:** 6785-2- Left Turn Phasing

**Section:** Traffic Signals

**Office/Department:** Office of Traffic Operations

**Reports To:** Division of Permits & Ops

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The purpose of this policy is to provide guidance concerning the use of permissive-only, protected-only and protected/permissive turn phases at signalized intersections.

### **I. LEFT TURN PHASING**

Protected left turn phases for signals at intersections are often overused or misused and can cause an intersection to function with less capacity than is desirable. Typically, left turn phases are not to be used at new or upgraded traffic signal installations unless justified based on the criteria below. Left turn phases should typically not be used at intersection approaches where a left turn lane has not been provided. A new traffic signal permit (new signals) or a permit revision (existing signals) shall be approved by the State Traffic Engineer before the addition or modification of any left turn phases.

#### **A. Protected –Permissive Left Turn Phasing**

Left turn phasing will typically be installed as a protected/permissive left turn movement (assuming some form of protection is needed). This will keep the intersection capacity and efficiency at the highest possible operation level. Protected-permissive phasing can be used for left turn phases if conditions meet any of the criteria below:

1. The cross-product is greater than 50,000 for a leading left turn phase or greater than 30,000 for a lagging left turn phase.\*

$$\text{Cross Product} = \text{left turn volume} \left( \frac{\text{opposing through volume}}{\text{number of opposing through lanes}} \right)$$

2. The left turn volume is 125 vehicles or greater per hour for a leading left turn phase or is 75 vehicles or greater per hour for a lagging left turn phase.\*
3. The number of left turn crashes under permissive operation is 4 or more in a 12 month period; or 6 or more in a 24 month period.
4. Additional criteria can also be taken into consideration when evaluating requests for left turn phases. These include but are not limited to:
  - insufficient left turn lane storage
  - delay
  - the angle of the left turn
  - number of opposing through lane
  - speed of opposing traffic
  - the signal is included in a coordinated signal system

\*Note: If a left turn phase only meets the lagging thresholds, then it must operate as a lagging only phase and must be shown in the phasing diagram as such. Any lagging left turn phases shall also require a 3-section permissive-only FYA signal head for the opposing left turning movement if the opposing left turn movement does not have a left turn phase.

## B. Protected-Only Left Turn Phasing

A protected-only left turn phase will only be allowed when conditions satisfy one or more of the following criteria:

1. Limited sight distance due to a permanent obstruction that will not allow permissive turns (See Table 1)
2. Conflicting left turn paths (may require lead/lag protected-only operation)
3. Additional criteria such as unusual intersection geometrics or a high volume of pedestrians
4. Within a 24 month period, five (5) or more left-turn, angle crashes with the opposing on-coming traffic having occurred under protected-permissive phasing

Decisions on the use of left turn phases will be approved by the State Traffic Engineer. Request for left turn phase approvals should be accompanied by supporting documentation as outlined above. In some cases, PO/PP-TOD may be appropriate (See [Section D](#))

## C. Converting Single Lane Left Turn From Protected-Only to Protected/Permissive

An existing single lane, protected-only left turn phase may be changed to a protected/permissive left turn operation if the following documentation is submitted to and approved by the State Traffic Engineer:

1. Table with the minimum required sight distance (calculated) and the field measured maximum sight distance for the movement being considered. The minimum sight distance required should be based off the calculated red clearance interval for the left turn movement and the speed of opposing vehicles (See Table 1).

$$\text{Red Clearance Interval} = \frac{W + L}{V_{LT}}$$

W Distance from stop bar to outside edge of the travel lane of the farthest conflicting movement along the vehicle's travel path

L Length of vehicle (ft) - 20 ft typical

V<sub>LT</sub> 85<sup>th</sup> percentile speed of left turning vehicle (ft/sec) - 25 mph typical

Minimum Left Turn Sight Distance for Permissive Operation									
Design Speed (mph)	Red Clearance Interval (sec)								
	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
25	150	165	185	205	220	240	260	275	295
30	180	200	220	245	265	290	310	330	355
35	205	235	260	285	310	335	360	385	415
40	235	265	295	325	355	385	415	440	470
45	265	300	330	365	400	430	465	495	530
50	295	330	370	405	440	480	515	550	590
55	325	365	405	445	485	525	565	605	645

$$LTSD = V_{major} \left( 2 + \frac{W + L}{V_{LT}} \right)$$

LTSD Minimum Left Turn Sight Distance

$V_{major}$  Design speed of oncoming through traffic (ft/sec)

2. Confirmation that all files for the subject intersection have been reviewed and that no documentation exists indicating that the Protected-Only left turn operation was installed to mitigate crashes. A protected/permissive phase may still be considered if geometric improvements that improve sight distance have been made since the crash history was documented.

#### **D. Protected-Only/Protected-Permissive by Time-of-Day (PO/PP-TOD)**

In cases where sight distance constraints are temporary (i.e.: a vehicle in the opposing left turn lane is constraining sight distance, but if no vehicle is present, sight distance is acceptable) protected-only/protected-permissive by time-of-day operation should be considered. PO/PP-TOD operation may be used (for example: between the hours of 10 pm and 5 am) when traffic volumes are much lower. The District Traffic Engineer will determine when the left turn phase operates as protected-only and when it operates as protected-permissive. A note should be placed under the phasing diagram that states which left turn phases will operate as PO/PP-OD.

The left turn sight distance should be measured with and without temporary obstructions, compared with the calculated minimum from Table 1, and submitted to the State Traffic Engineer. It may be also be appropriate to use PO/PP-TOD based on engineering judgment (i.e. difficulty getting acceptable gaps due to saturated opposing flow; crashes during certain times of the day).

#### **E. Permissive-Only Left Turn Phasing**

In cases where a left turn phase is not warranted it may be appropriate to use a 3-section permissive-only FYA signal head (i.e. offset left turn lanes or opposing a lagging left turn phase).

## **II. FLASHING YELLOW LEFT TURN ARROWS**

A flashing yellow arrow (FYA) left turn signal head should be installed where protected/permissive as well as PO/PP-TOD and permissive-only left turn operation is warranted. FYA is the required alternative over the five-section “dog-house” signal head configuration when new signals are installed or signals are upgraded.

The regulatory sign R10-5a, explaining the flashing yellow arrow operation to approaching motorist, should be placed on the mast arm or span wire adjacent to the flashing yellow arrow signal head to coincide with the public outreach. The installing agency should conduct public outreach prior to the installation of FYAs in a new area, which should include media segments (radio and television), pamphlets, mailings addressed to the surrounding public and/or portable message signs.



A five-section (dog-house) left turn signal head should not be used as a protected/permissive left turn treatment at the same intersection that a FYA signal head has been installed. When the intersection is in flash, due to a malfunction, the FYA head shall flash the red arrow.

A four-section FYA head cannot be used as protected-only head full time at an intersection; if a FYA signal becomes protected-only full time, the FYA signal head must be replaced with the appropriate protected-only left turn signal head as defined in the GDOT signal design manual.

### **III. RIGHT TURNING PHASING**

Right turn phasing and overlaps can provide an operational benefit to a signalized intersection. A protected right turn phase should only be installed if an exclusive right turn lane exists. Any protected right turn phase, including overlaps, should be shown in the phasing diagram and/or noted below the phasing diagram. Single signal indication of an overlap is recommended with a single right turn lane.

For dual right turn lanes, permissive operation (including right turn on red) should be used if adequate sight distance is provided. The red right arrow should only be installed where right-turn-on-red is prohibited.

### **IV. SPLIT PHASING**

Split phasing at a signalized intersection can significantly impede the capacity of the intersection and should only be implemented after documentation has been submitted and the permit has been approved by the State Traffic Engineer. Documentation should satisfy one or more of the following criteria:

1. Side street has a left turn lane and a shared through/left lane
2. Crash history associated with the side street having a shared through/left lane
3. Unbalanced opposing traffic volumes, where opposing movement does not need to be served each cycle, thus resulting in reduced intersection delay
4. Unusual intersection geometrics (offset side streets)
5. Paths of opposing left turn movements conflict but the preferred lead/lag operation is not desirable
6. Limited sight distance but protected-only left turns on the side street is not desirable

Although the left turn movements of split-phased approaches operate as protected-only, if the intersection is ever converted from split phased to concurrent phasing, all left turn phases should meet the appropriate criteria before approval.

## **References:**

None.

## **History:**

I.B.4. revised to incorporate language proposed by AG: 08/13/2020;

updated logo: 11/09/18;

added to TOPPS: 04/10/96;

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