



# Traffic Signal Design Manual

ORIGINATOR Director, Bureau of Traffic Operations		3-4-1
CHAPTER 3	Project Scoping Process & Geometric Design Considerations	
SECTION 4	Operational Considerations	
SUBJECT 1	Left Turn Phasing	

The number of phases at signalized intersections *should* be kept to a minimum.

Left turn phases **shall** be installed on approaches with:

- Multiple left turn lanes (see below)

Left turn phases *should* be considered on approaches when:

- Visibility is limited. Queue spillback occurs into adjacent through lane
- Left turn queue does not consistently clear during permissive green.
- There exists a left turn delay of 2.0 vehicle hours or more in a peak hour on a critical approach.
- The left turn crash experience meets or exceeds: for one approach, four left turn crashes in one year or six in two years; or for opposing approaches, six left turn crashes in one year or ten in two years. Analysis **shall** include review of past 5 years of crash records. This will allow the engineer to determine if crash patterns exist, and what circumstances *may* be involved.
- The product of a left turning volume and its opposing through and right-turn volume meet or exceed the minimum requirements given in the table below during the peak hour. All opposing through traffic including right turns *should* be considered unless the right turns are well removed from the intersection.

### Minimum Vehicular Volumes For Left Turn Analysis

Number of left turn lanes	Number of opposing through lanes	Product of peak hour left turning vehicles and opposing plus right-turn vehicles
1	1	50,000
1	2	100,000

In any case, left turn phasing **shall** be approved by the Regional Traffic Engineer.

Adding phases leads to an increase in cycle length and delay and decreases intersection efficiency, especially at pre-timed signals. In addition, adding non-warranted left turn phases *may* impact driver perception and lead to requests for left turn phases at other non-warranted locations. Left turn phasing *should* be determined

early in the design process, prior to completing the capacity analysis and starting geometric design.

Typically separate opposing or positively offset left turn lanes *should* be provided on all approaches in order to allow for simultaneous leading left turn phases at the present time and in the future. If the geometrics cannot be improved to allow simultaneous leading left turn phases then split phasing on the side street is an alternative, although not desired. Split phasing shall only be considered as last resort in extreme cases. Split phasing is inefficient, especially if there are pedestrian phases on both approaches of a street. Geometric improvements **shall** always be explored first.

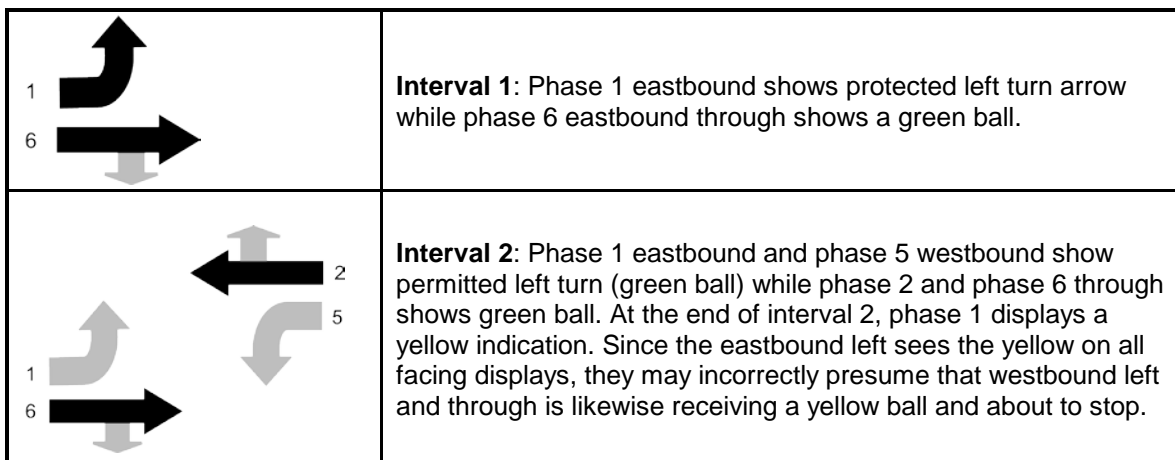
In most cases protected/permitted left turn phasing *should* be tried prior to installing protected only phasing. Installing protected/permitted phasing rather than protected only phasing typically results in increased intersection capacity and decreased intersection delay and driver frustration.

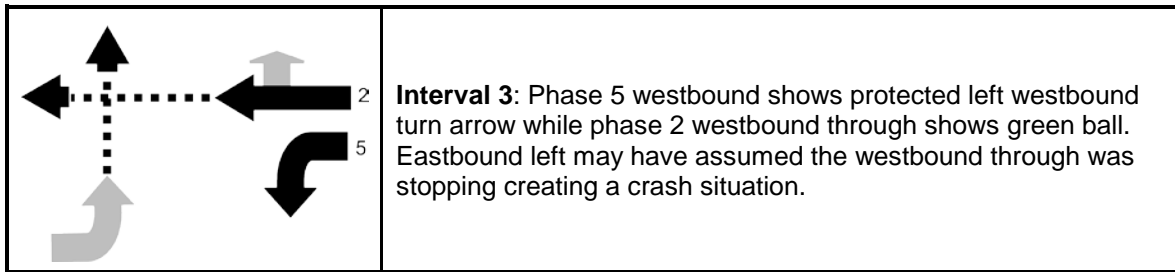
Protected only phasing **shall** be used to control dual and triple left turn lanes. In addition, protected only phasing *should* be considered in cases where visibility of opposing thru traffic to left turning vehicles is not sufficient to allow for a safe movement and improving the geometrics is not feasible. This typically occurs with wide medians where left turn lanes are not opposing or positively offset. When protected only phasing is installed on one approach the opposing approach **shall** have protected only phasing **or** a flashing yellow arrow due to driver perception and safety.

Protected only left turn phasing *should* also be considered at locations with higher operating speeds (greater than 45 mph), when left-turn movements need to cross more than two opposing through lanes and when crash trends dictate.

Typically, left-turn phases are leading.

Lagging protected/permitted left turn phasing **shall not** be utilized as it creates a dangerous situation often referred to as a “left turn trap” or “yellow trap”. Figure 1 shows the phase intervals for this situation. Three exceptions are as follows; at T-intersections, at interchange ramp terminals where no opposing left turn movements exist, and when flashing yellow arrows are utilized for the protected/permitted left turn.





**Figure 1**  
Left turn trap diagram

Lead-lag left turn phasing *may* be utilized only when there is protected only phasing on both approaches of a street. This phasing sequence can be advantageous when used on a coordinated street as it has the potential to maximize two way progression. An example of this sequence is: NB leading protected left phase and NB through phase followed by the NB and SB through phases, followed by the SB lagging left phase and SB through phase.

### TEMPORARY SIGNALS

Refer to TSDM 3-4-10, Temporary Signals for left turn phasing for temporary signals.