612 LEFT TURN SIGNAL PHASING

The need for left turn traffic signal phasing should be evaluated on the basis of the following guidelines and engineering judgment:

A. <u>Traffic Volumes</u>

Left turn phasing may be considered when the cross-product during the peak hour exceeds the following values:

CROSS-PRODUCT (left turn volume x opposing through volume)

	2-LANE STREET	4-LANE STREET	6-LANE STREET
RURAL	50,000	100,000	150,000
URBAN	75,000	150,000	225,000

Also, the left turn volume should be greater than two vehicles per cycle during the peak hour. Cross-products meeting these levels indicate that further study of the intersection is required.

It is important to use engineering judgment to consider what portion, if any, of right-turning traffic would be considered as opposing traffic. A portion of the right-turning traffic may conflict or impede left turn movements due to intersection geometric features, for example.

B. <u>Stopped-time Delay</u>

Left turn phasing may be considered if the left turn delay is 2.0 vehicle-hours or more during a peak hour on an approach. Also, the left turn volume should be greater than two vehicles per cycle during the peak hour, and the average delay per left-turning vehicle should equal or exceed 35 seconds.

C. <u>Crash Experience</u>

Left turn phasing may be considered when the number of reported left turn crashes meets the following values:

LEFT TURN CRASH EXPERIENCE

	ONE-YEAR PERIOD	TWO-YEAR PERIOD
ONE APPROACH	4	6
TWO OPPOSING APPROACHES	6	10

Where left turn phasing has been determined to be justified on the basis of traffic volumes, consider the option of protected/permissive left turn phasing over protected-only left turn phasing. Where protected/permissive left turn phasing is implemented, the operation of the left turn controls should be monitored to determine if motorists are safely negotiating left turns during the permissive portion of the left turn phase.

Protected-only left turn phasing may be considered if any of the following conditions exist:

a. Three or more through lanes of traffic on the opposing leg, or
b. Posted speed limit of opposing traffic is greater than 45 mph, or
c. Dual left turn only lanes, or
d. Sight distance restrictions to opposing traffic due to geometry or opposing left turn vehicles, or
e. Use of protected/permissive phasing has resulted in left turn crash experience which meets the values in the Left Turn Crash Experience table on the preceding page.

Split phasing may be considered if any of the following conditions exist:

a. Geometric offset of opposing approaches makes simultaneous left turns impracticable, or
b. Left turn volumes of opposing approaches are heavy and nearly equal to adjacent through movement critical lane volumes, or
c. Heavy left turn volume on an approach without a separate left turn lane, or
d. More than one left turn lane, but one of the lanes permits both left turn and through movements.

Flashing yellow arrow (FYA) operation may be used for protected/permissive left turn phasing in accordance with Part 4 of the MUTCD.

FIELD PROCEDURE

Cross-product and stopped-time delay values require the sampling of traffic data from the field. Cross-product values can be extracted from a turning movement volume survey. The following procedure should be used to measure stopped-time delay for left-turning vehicles:

A. Planning

1) Select approach(es) to be studied

2) Select time period:
   Peak season - winter vs. summer
   Peak hour - AM vs. PM

3) Select length of study period:
   30 minutes, 15 second intervals
   60 minutes, 15 second intervals

B. Field Measurement

1) The sampling procedure consists of recording the number of stopped vehicles on the approach being studied at 15 second intervals throughout the study period. A stopped vehicle is a vehicle that is not in motion or a vehicle that had previously come to a stop or near stop and is creeping forward in a queue.

2) After waiting 15 seconds the data counter again records the number of stopped vehicles.

3) The sampling continues for the duration of the study, either 30 or 60 minutes.

4) During the entire study period a volume count is maintained, counting left-turning vehicles as they complete their turning maneuver and clear the intersection.

The total stopped-time delay figure can then be calculated from this field technique and applied to the guidelines. The form in Exhibit 612-A is used to record stopped-time delay data.

Left turn signal phasing shall be approved by the State Traffic Engineer or the Regional Traffic Engineer.

Exhibit 612-A. Left Turn Delay Form

ARIZONA DEPARTMENT OF TRANSPORTATION

LEFT-TURN DELAY

Location: ______________________________

Time: ____________ **Date:** ____________ **Recorder:** ____________

TIME	Observations/15 sec				Approach	Time	Observations/15 sec				Approach
	0	15	30	45			0	15	30	45	
:00						:30					
:01						:31					
:02						:32					
:03						:33					
:04						:34					
:05						:35					
:06						:36					
:07						:37					
:08						:38					
:09						:39					
:10						:40					
:11						:41					
:12						:42					
:13						:43					
:14						:44					
:15						:45					
:16						:46					
:17						:47					
:18						:48					
:19						:49					
:20						:50					
:21						:51					
:22						:52					
:23						:53					
:24						:54					
:25						:55					
:26						:56					
:27						:57					
:28						:58					
:29						:59					
Total:	0	0	0	0	0	**Total:**	0	0	0	0	0

AVERAGE DELAY = ____________ **Sec/Veh** **TOTAL DELAY =** ____________ **Veh/Hr**

Average Delay $= \dfrac{\text{Total Obs} \times 15}{\text{Approach Vol.}}$ **Total Delay** $= \dfrac{\text{Total Obs} \times 15}{3600}$ or $\dfrac{\text{Total Obs}}{240}$