

Mn/DOT Traffic Signal Timing and Coordination Manual

Guidelines for Consideration and Timing of Advanced Warning Flashers

The following guidelines indicate when the installation of AWF for signal change interval may be considered. Due to the complex nature of traffic flow characteristics, these guidelines should be applied along with engineering judgment. Guidelines should be reviewed for each prospective installation.

AWF should only be installed in response to a specifically correctable problem, not in anticipation of a future problem. Generally, AWF implementation is appropriate only at high speed locations. Before an AWF is installed, other remedial action should be considered.

The following guidelines generally apply only where posted speed is 55 mph or higher.

<u>CATEGORY</u>	<u>CRITERIA</u>	<u>COMMENT</u>
1. Isolated or Unexpected signalized intersection	Where there is a long distance from the last intersection at which the mainline is controlled, or the intersection is otherwise unexpected.	This guideline may be applicable where the distance from the last intersection is greater than 10 miles, or at a freeway terminus, or at other locations where the intersection is unexpected.
2. Limited sight distance	Where the distance to the stop bar, D, with two signal heads visible is insufficient: $D \leq 1.467vt + \frac{v^2}{0.93(a + 32.2s)}$ <p>Where: D = distance to stop bar feet v= posted speed in mph t= reaction time, 2.5 seconds a= deceleration rate 8 ft/s² (trucks) 10 ft/s² (all traffic) s= decimal gradient</p>	See Graphs of Limited Sight Distance, Exhibit 4-6 & Exhibit 4-7. A sight distance falling below the lines for the given speed and grade indicates the possible need for AWF.

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<u>CATEGORY</u>	<u>CRITERIA</u>	<u>COMMENT</u>
3. Dilemma Zone	<p>Where a dilemma zone exists for all traffic or for heavy vehicles. A dilemma zone exists if:</p> $Y \leq t + \frac{1.467v}{2(a + 32.2s)}$ <p>Where:</p> <p>Y = yellow interval in seconds</p> <p>v = Posted speed in mph</p> <p>t = 1 second</p> <p>a = deceleration rate</p> <p>8 ft/s² (trucks)</p> <p>10 ft/s² (all traffic)</p> <p>s = decimal gradient</p>	<p>See Graphs on Minimum Yellow Intervals, Exhibit 4-8 & Exhibit 4-9.</p> <p>If the yellow interval is less than indicated, AWF may be considered (longer yellow should be considered first).</p>
4. Accidents	<p>If an approach has an accident problem, the intersection should be examined for existence of dilemma zone or sight distance restriction.</p>	<p>If no sight distance or dilemma zone problems exist, AWF may not be an appropriate countermeasure to accident problems.</p>
5. Heavy Truck Volume	<p>Where the roadway has a grade of 3% or greater and truck volume exceeds 15%.</p>	
6. Engineering Judgment		

Combinations of above guidelines or other considerations may justify the installation of AWF.

Engineering judgment should be based on additional data such as complaints, violations, conformity of practice, and traffic conflicts. Prior to installing AWF, consideration should be given to other countermeasures including but not limited to: adjustment of timing parameters which may include increasing yellow and/or all red intervals, improving detection, or modification of the signal system as by adding signal heads, adjusting speed limits.

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GUIDELINES FOR INSTALLATION

1. **Advanced Warning Flasher** - The Advanced Warning Flasher design details are shown on the web: www.dot.state.mn.us/trafficeng/signals/signaldetails.html. The flasher shall flash yellow in a (inside-outside) wig-wag manner prior to the termination of the green (See number 3, below), and during the yellow and red periods of the signal. The flasher will also flash if the signal goes into flashing operation. Power shall be supplied to the AWF from the signal control cabinet.
2. **Advanced Warning Flasher Sign Placement** - The AWF should be set back from the intersection in accordance with the table shown below. At locations on four lane divided roadway, the AWF shall be placed on both sides of the approach.

<u>Posted Speeds (mph)</u>	<u>AWF Placement</u>	<u>Leading Flash (seconds)</u>
40	560 ft	8.0
45	560 ft	7.0
50	700 ft	8.0
55	700 ft	7.0
60	850 ft	8.0
65	850 ft	7.5

3. **Leading Flash** - The Leading Flash is the amount of time, prior to the signal turning yellow, that the AWF flashes. The AWF shall flash during the Leading Flash Period and continue flashing through the signal's yellow clearance interval and the red. The Leading Flash time is shown in the table above.

For existing systems where the placement is other than what is listed in the table above, the Leading Flash Time can be computed by the following formula:

Where:

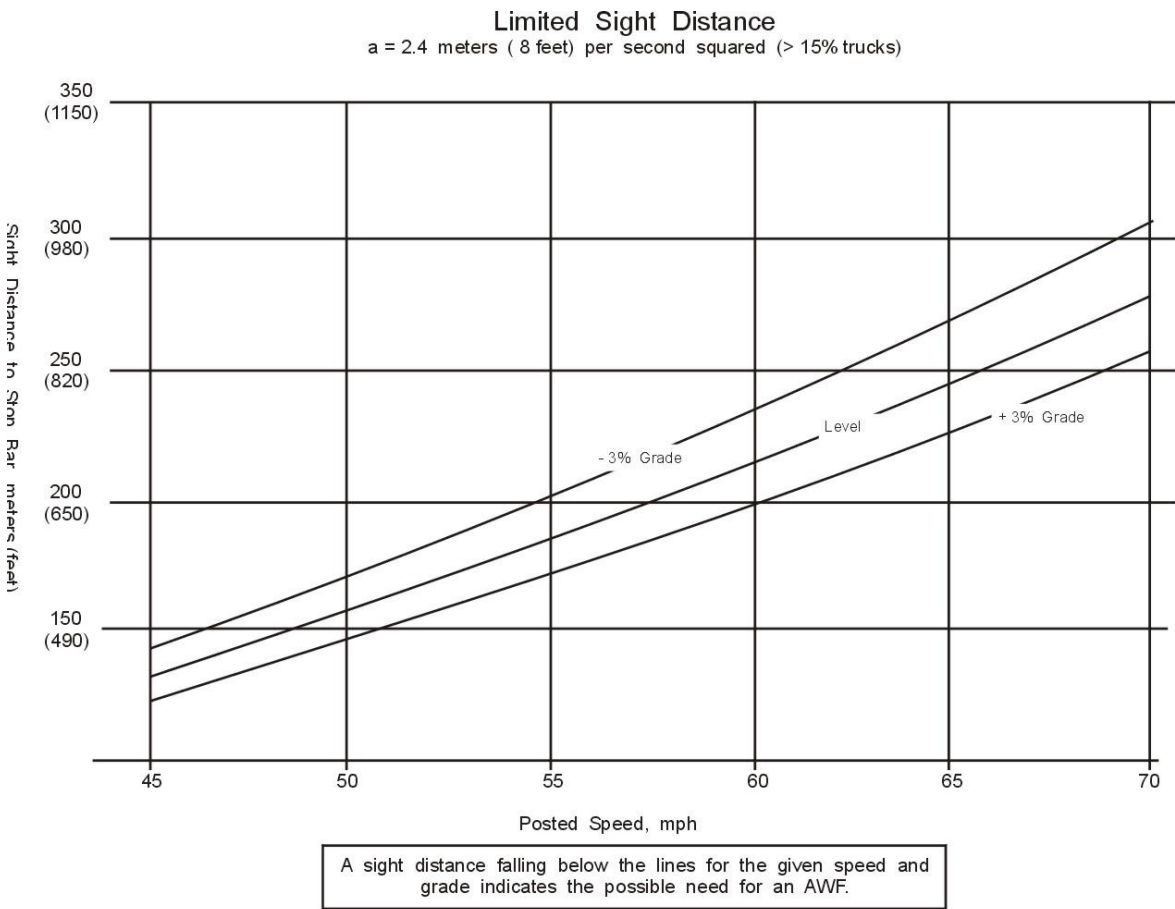
- F = Leading Flash Time, seconds
- D = AWF Placement, meters
- v = posted speeds, mph

$$F = \frac{0.68D}{v} - 1.5$$

4. **Detector Placement** - The detection of the intersection shall be determined without regard to the AWF.

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Exhibit 4-6 AWF Limited Sight Distance (> 15% Trucks)

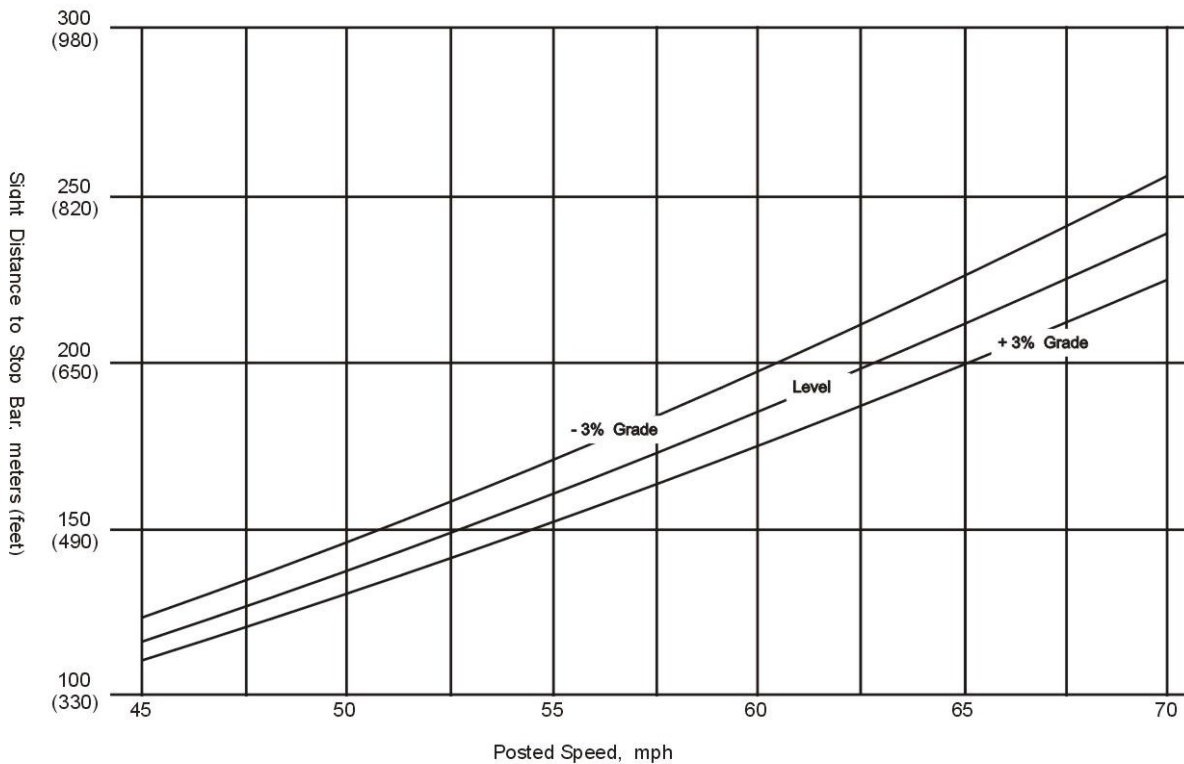


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Exhibit 4-7 AWF Limited Sight Distance (≤ 15% Trucks)

Limited Sight Distance

a = 3.0 meters (10 feet) per second squared (≤ 15% trucks)

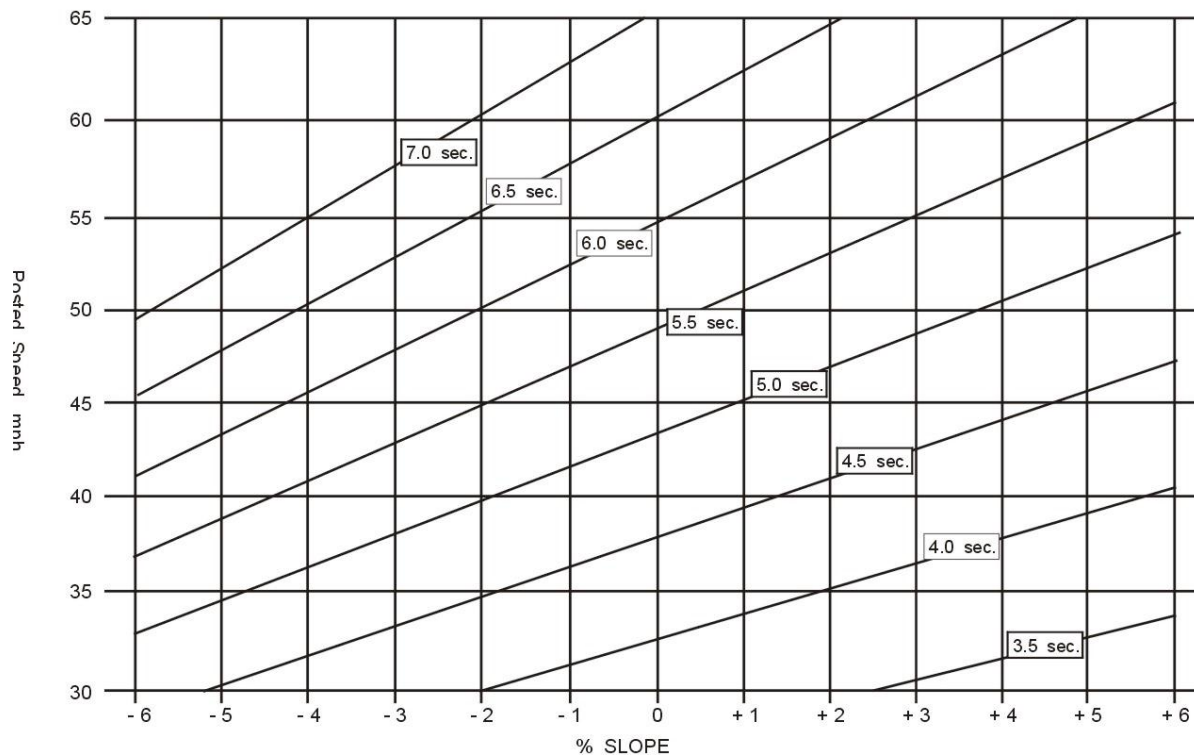


A sight distance falling below the lines for the given speed and grade indicates the possible need for an AWF.

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Exhibit 4-8 AWF Recommended Yellow Intervals (> 15% Trucks)

Recommended Yellow Intervals
a = 2.4 meters (8 feet) per second squared (> 15% trucks)

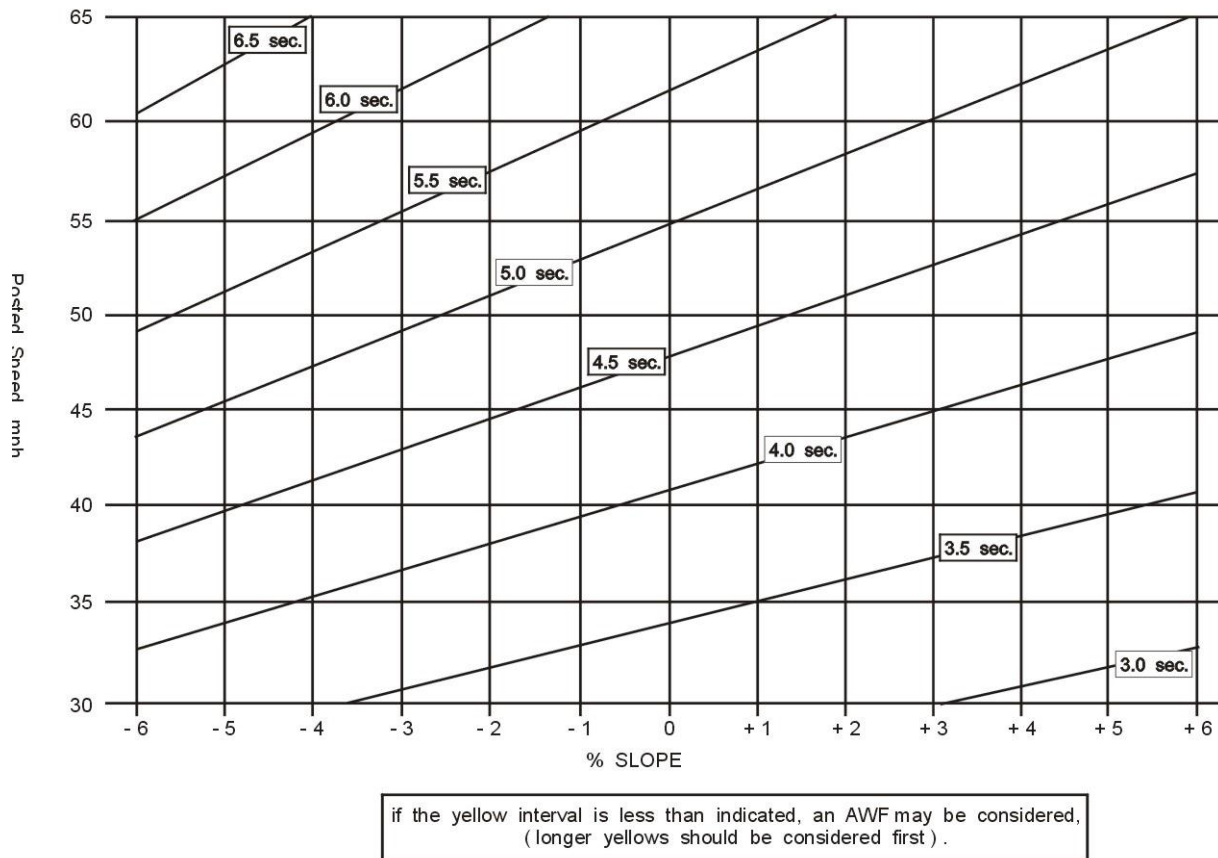


if the yellow interval is less than indicated, an AWF may be considered, (longer yellows should be considered first).

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Exhibit 4-9 AWF Recommended Yellow Intervals (≤ 15% Trucks)

Recommended Yellow Intervals
a = 3.0 meters (10 feet) per second squared (> 15% trucks)



See MN MUTCD for the Installation and Operation of Advanced Warning Flashers.

PART 4. HIGHWAY TRAFFIC SIGNALS

Chapter 40. Advance Warning Flashers

40.1 Description

SUPPORT:

The Advanced Warning Flasher (AWF) is a device which, at certain high speed locations, has been found to provide additional information to the motorist describing the operation of the highway traffic signal. It has been found that an Advance Warning Flasher can assist the driver in making safer and more efficient driving decisions. The additional information includes a visual indication to get the driver's attention and a specific notice that the driver must prepare to stop.

The Minnesota Advance Warning Flasher system consists of a flasher and a sign located on main street approaches to a high speed signalized intersection. The AWF is connected to the highway traffic signal in such a way that when the main street green is about to change to yellow, the flasher is turned on to warn the approaching drivers of the impending change. Basically, the purpose of an optimally designed combination of highway traffic signal and Advance Warning Flasher system is twofold: 1) to inform the driver in advance of a required drive decision (prepare to stop) and 2) to minimize the number of drivers that will be required to make that decision. The amount of time, prior to the signal turning yellow, that the Advance Warning Flasher flashes is known as Leading Flash Period.

OPTION:

Advance Warning Flashers may be used at traffic signals.

40.2 General Design and Operation

STANDARD:

If used, the Advance Warning Flasher assembly shall be as shown in Figure 40-1. The flasher shall flash yellow in an alternating manner prior to the termination of the green, and during the yellow and red periods of the signal. The flasher shall also flash if the signal goes into flashing mode.

Posted Speeds (mph)	AWF Placement (feet)	Leading Flash (seconds)
40	560	8.0
45	560	7.0
50	700	8.0
55	700	7.0
60	850	8.0
65	850	7.5

Table 40-1. Advance Warning Sign Placement

GUIDANCE:

If used, then the following should apply:

Advance Warning Flasher - The Advance Warning Flasher power should be supplied from the signal control cabinet.

Advance Warning Flasher Sign Placement - The Advance Warning Flasher should be set back from the intersection in accordance with Table 40-1. Where this is not possible, the leading flash should be adjusted for the actual distance by using the formula below. At locations on four-lane divided roadways, it should be placed on both sides of the approach.

Leading Flash Period - The Advance Warning Flasher should flash prior to the termination of the green for the Leading Flash Period shown in Table 40-1. For existing systems where the placement is other than what is listed in Table 40-1, the Leading Flash Period should be computed by the following formula:

$$\text{English: } F = \frac{0.68D}{v} - 1.5$$

Where:

F = Leading Flash Time (seconds)

D = AWF Placement (feet)

v = Posted Speeds (mph)

Detector Placement - The detection of the intersection should be determined without regard to the Advance Warning Flasher.

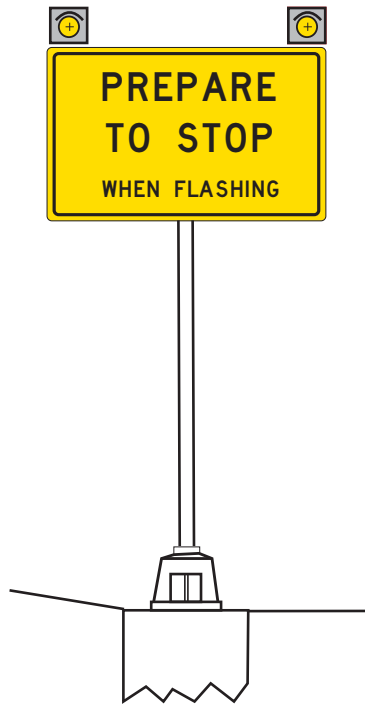


Figure 40-1. Advance Warning Assembly