STATE OF CALIFORNIA• DEPARTMENT OF TRANSPORTATION

POLICY DIRECTIVE

TR-0011 (REV 9/2006)

TRAFFIC OPERATIONS POLICY DIRECTIVE	NUMBER: 09-06	PAGE: 1 of 9
ROBERT COPP, DIVISION CHIEF (Signature)	DATE ISSUED: August 27,2009	EFFECTIVE DATE: September 10, 2009

SUBJECT:

Provide Bicycle and Motorcycle Detection on all new and modified approaches to traffic-actuated signals in the state of California.

DISTRIBUTION

- ☒ All District Directors
- ☒ All Deputy District Directors - Traffic Operations
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- ☒ Chief, Division of Engineering Services
- ☐ Chief Counsel, Legal Division
- ☒ Publications (California MUTCD Website) www.dot.ca.gov/hq/traffops/signtech/mutcdsupp/ca_mutcd.htm
- ☐ Headquarters Division Chiefs for:

DOES THIS DIRECTIVE AFFECT OR SUPERSEDE ANOTHER DOCUMENT? ☒YES ☐NO	IF YES, DESCRIBE Amends Chapter 4D of the California MUTCD
WILL THIS DIRECTIVE BE INCORPORATED IN THE CALIFORNIA MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES ☒YES ☐NO	IF YES, DESCRIBE Chapter 4D - Section 4D.105, Chapter 4A – Section 4A.02 (CA), Figure 4D-111 (CA) & add Table 4D-109 (CA)

DIRECTIVE

Pursuant to the authority granted to the California Department of Transportation (Department) in Section 21400 and 21401 of the California Vehicle Code (CVC), Sections 4A.02, 4D.105 (CA) and Figure 4D-111 (CA) shall be revised and a new Table 4D-109 (CA) added to the California Manual on Uniform Traffic Control Devices (MUTCD) dated September 26, 2006 to provide Bicycle and Motorcycle Detection on all approaches to traffic-actuated signals in the State of California. This Directive is effective September 10, 2009.

IMPLEMENTATION

In this section, for purposes of clarity, strikethrough text is used to denote text in the California MUTCD that is being deleted and italic text is used to denote text that is being added to the California MUTCD. All other formatting as defined under the Definitions section of this Policy Directive is still applicable.

The following shall be incorporated in the California MUTCD:

Section 4A.02 Definitions Relating to Highway Traffic Signals
15. Detector – a device used for determining the presence or passage of vehicles *(including motorcycles), bicycles* or pedestrians.
29A. Limit Line Detection Zone – a Referenced Bicycle-Rider must be detected in a 6 ft x 6 ft area immediately behind the limit line, centered either in a normal width lane or if the lane is more than 12ft wide, centered 6 ft from the left lane line. For a lane of 20 ft or greater, two minimum 6 ft x6 ft areas shall constitute the Limit Line Detection Zone.
50A. Reference Bicycle-Rider – a minimum 4 ft tall person, weighing minimum 90 lb, riding on an unmodified minimum 16-inch wheel bicycle with non-ferromagnetic frame, non-ferromagnetic fork and cranks, aluminum rims, stainless steel spokes, and headlight.

~~Section 4D.105(CA) Bicycle Detectors~~
~~Option:~~
~~Bicycle detectors may be required at traffic-actuated signal installations.~~
~~The loop detector logo shown on Department of Transportation's Standard Plan A24C may be used to show a bicyclist where to stop in a bike lane or traffic lane to be detected.~~
~~Support:~~
~~See Figure 4D-111(CA) for suggested locations of bicycle detectors and Department of Transportation's Standard Plans for typical bike lane pavement markings.~~
~~Efforts need to be made to ensure that signal detection devices are capable of detecting a bicycle. Detectors for traffic-actuated signals need to be located in the bicyclist's expected path, including left-turn lanes and shoulders. Marking the road surface to indicate the optimum location for bicycle detection is helpful to the bicyclist. Video detection is an effective alternate technique to loop detection.~~

Section 4D.105(CA) Bicycle/Motorcycle Detection
Standard:
All new limit line detector installations and modifications to the existing limit line detection on a public or private road or driveway intersecting a public road (see Section 1A.13 for definitions) shall either provide a Limit Line Detection Zone in which the Reference Bicycle-Rider is detected or be placed on permanent recall or fixed time operation. Refer to CVC 21450.5.
All new and modified bike path approaches to a signalized intersection shall be equipped with either a Limit Line Detection Zone or a bicyclist pushbutton, or else the phase serving the bike path shall be placed on permanent recall or fixed time operation. A bicyclist pushbutton, if used, shall be located on the right side of the bike path and where it can be reached from the bike path. See Section 9B.10 for bicycle regulatory signs.
At new signalized intersections or when the advance detection is being replaced at existing signalized intersections, phases with advance detection only shall be placed on permanent recall.

Support:
The requirement to detect the Reference Bicycle-Rider in the Limit Line Detection Zone is technology-neutral.
Option:
The detection zone in a bike lane may be narrower than 6 ft. See Figure 4D-111(CA).
A Bicycle Detector Symbol may be used. See Sections 9B.12 and 9C.05.
A bicyclist pushbutton may be used to supplement the required limit line detection.

IMPLEMENTATION (Continued)

Support:
See Section 9B.10 for bicycle regulatory signs.

Guidance:
If more than 50% of the limit line detectors need to be replaced at a signalized intersection, then the entire intersection should be upgraded so that every lane has a Limit Line Detection Zone.
The Reference Bicycle-Rider or the equivalent should be used to confirm bicycle detection under the following situations:
A. *A new detection system has been installed; or*
B. *The detection configuration has been modified.*

Support:
CVC Section 21202(a) requires bicyclists traveling "at a speed less than the normal speed of traffic" to ride "as close as practicable to the right-hand curb or edge of the roadway" with exceptions, including when the bicyclist is "approaching a place where a right turn is authorized." This exception was intended to provide the bicyclist the flexibility to avoid having to ride against the right hand curb or edge of the road where a potential conflict would be created with a right turning motorist.
A Limit Line Detection Zone provides for the detection of both bicycles and vehicles, including motorcycles.

Guidance:
Where a Limit Line Detection Zone that detects the Reference Bicycle-Rider has been provided, minimum bicycle timing should be provided as follows:
For all phases, the sum of the minimum green, plus the yellow change interval, plus any red clearance interval should be sufficient to allow a bicyclist riding a bicycle 6 ft long to clear the last conflicting lane at a speed of 14.7 ft/sec plus an additional effective start-up time of 6 seconds, according the formula $G_{min} + Y + R_{clear} \geq 6 \text{ sec} + (W+6 \text{ ft})/14.7 \text{ ft/sec}$, *where*
G_{min} = *Length of minimum green interval (sec)*
Y = *Length of yellow interval (sec)*
R_{clear} = *Length of red clearance interval (sec)*
W = *Distance from limit line to far side of last conflicting lane (ft)*

Support:
Bicyclist crossing times are shown in Table 4D-109(CA). The speed of 14.7 ft/sec represents the final crossing speed and the effective start-up time of 6 seconds represents the time lost in reacting to the green light and then accelerating to full speed.
Option:
A limit line detection system that can discriminate between bicyclists and vehicles may be used to extend the length of the minimum green.

DELEGATION

No new delegations of authority are created under this policy.

BACKGROUND

The purpose of this directive is to implement AB 1581 (Fuller), which was signed by the Governor on October 8, 2007, and became law on January 1, 2008. It added Section 21450.5 to the California Vehicle Code, as follows:

(a) A traffic-actuated signal is an official traffic control signal, as specified in Section 445, that displays one or more of its indications in response to the presence of traffic detected by mechanical, visual, electrical, or other means.

(b) Upon the first placement of a traffic-actuated signal or replacement of the loop detector of a traffic-actuated signal, the traffic-actuated signal shall, to the extent feasible and in conformance with professional traffic engineering practice, be installed and maintained so as to detect lawful bicycle or motorcycle traffic on the roadway.

(c) Cities, counties, and cities and counties shall not be required to comply with the provisions contained in subdivision (b) until the Department of Transportation, in consultation with these entities, has established uniform standards, specifications, and guidelines for the detection of bicycles and motorcycles by traffic-actuated signals and related signal timing.

(d) This section shall remain in effect only until January 1, 2018, and as of that date is repealed, unless a later enacted statute, that is enacted before January 1, 2018, deletes or extends that date.

The Department, pursuant to CVC Section 21400; must conduct public hearings before it can revise existing traffic control device policies. The California Traffic Control Devices Committee (CTCDC) is the forum used to satisfy this requirement.

On January 31, 2008, the CTCDC directed the Department to form an AB 1581 Subcommittee to develop recommendations for uniform standards, specifications, and guidelines for the detection of bicycles and motorcycles by traffic actuated signals and related signal timing for the California MUTCD. The AB 1581 Subcommittee, over the course of several meetings, conducted extensive investigation into motorcycle and bicycle detection (see item 08-8 of the May 14, 2009, agenda packet: <http://www.dot.ca.gov/hq/traffops/signtech/newtech/agenda/Agenda051409-amended.pdf>).

On May 14, 2009, the AB 1581 Subcommittee submitted its recommendations to the CTCDC. The CTCDC adopted a motion to forward the Subcommittee's recommendation to the Department with revisions, as reflected in the Implementation section of this document.

The performance standard for the detection of motorcycles and bicycles is technology-neutral in order to accommodate current as well as future detection technologies. The performance standard establishes new definitions for the Reference Bicycle-Rider and the Limit Line Detection Zone, and requires that a Limit Line Detection Zone be provided in each travel lane of a new or modified traffic actuated signal. A motorcycle will be detected wherever the Reference Bicycle-Rider is detected. It is left up to the jurisdiction to ensure that the detection technology meets the performance standard.

A Limit Line Detection Zone is required in each travel lane because bicyclists are not necessarily required to ride as far to the right as practicable. CVC 21202(a) states that a bicyclist traveling "at a speed less than the normal speed of traffic moving in the same direction at that time shall ride as close as practicable to the right-hand curb or edge of the roadway" but provides several exceptions, including when the bicyclist is "approaching a place where a right turn is authorized." The same exception is provided for bike lanes in CVC 21208. And of course, motorcyclists need to be detected in each travel lane regardless.

The AB 1581 Subcommittee determined that at least one practical method of providing a Limit Line Detection Zone is the diagonal quadrupole inductive loop, one example of which is the Type D loop (see Standard Plan ES-5B). Another example is the quadracircle, as used in Palo Alto and some other California cities. The diagonal conductors of a diagonal quadrupole loop provide a horizontal component to the magnetic field everywhere within the loop, which is necessary to detect the vertical metal rims of a bicycle.

The AB 1581 Subcommittee also determined that video detection might also be a practical method of providing the performance standard. Other existing or future detection technologies that meet the performance standard are also acceptable.

The characteristics of the Reference Bicycle-Rider were selected to ensure that (1) most bicycles and riders were included and (2) its selection allowed for a wide variety of existing or future detection technologies.

The signal timing guidance basically follows the pedestrian signal timing guidance in Section 4E.10 of the California MUTCD. As with the pedestrian crossing time guidance, bicyclist-crossing time is a guidance statement and not a standard.

Several sources were used in determining a formula for the time that will allow most bicyclists to cross an intersection of a given width, including the 1983 edition of the *Traffic Control Devices Handbook, the* article *Signal Clearance Timing for Bicycles* from the 1995 ITE Journal, the current *San Francisco Bicycle Plan*, and an ongoing research project being performed for the Department by PATH (Partners for Advance Transportation and Highway) at UC Berkeley. Based on these sources, the guidance is that the final crossing speed for the design bicyclist is 10 mph (14.7 ft/sec) and the additional time needed for a standing start be 6 sec.

Using this formula results in longer minimum green times than are commonly used, but the PATH research team found that the increased minimum green times would have a minimal effect on traffic congestion because during periods of congestion the side street green times are usually longer than the minimum green times anyway. Also, the time needed to serve pedestrian calls has a much bigger impact on congestion. Still, the CTCDC was concerned about the negative impact the bicycle signal timing guidance would have on existing signal operation, so it recommended that the guidance only apply to new and modified traffic actuated signals with more than 50% of the limit line detectors to be replaced.

The Federal Highway Administration has reviewed the proposed modifications to the California MUTCD and has determined that they are in substantial conformance with the MUTCD.

This directive will be retired when it is incorporated in the next revision of the California MUTCD.

DEFINITIONS

When used in this Traffic Operations Policy Directive, the text shall be defined as follows:

1) **Standard** – a statement of required, mandatory or specifically prohibited practice. All standards text appears in **bold** type. The verb **shall** is typically used. Standards are sometimes modified by Options.

2) 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 text appears in underline type. The verb should is typically used. Guidance statements are sometime modified by Options.

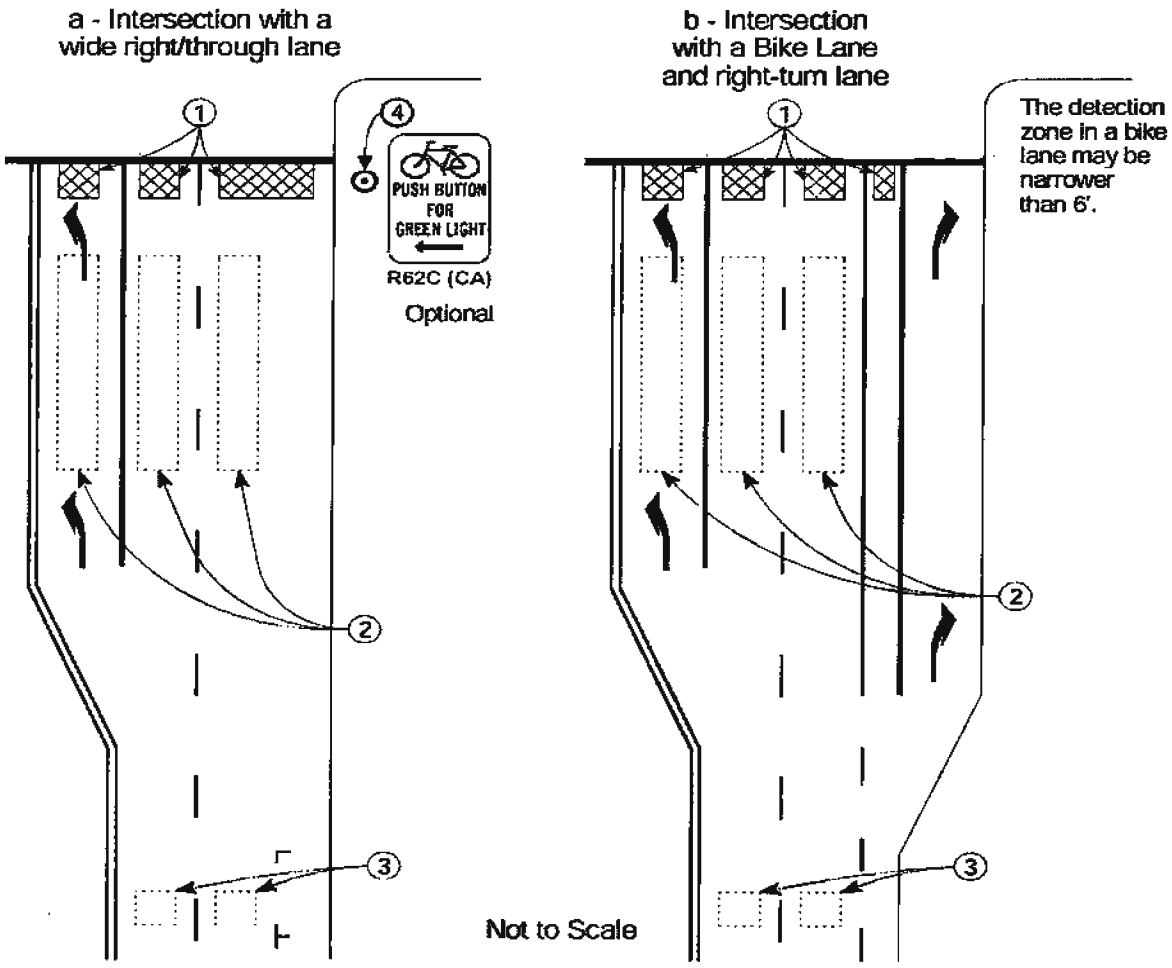
3) Option – a statement of practice that is a permissive condition and carries no requirement or recommendation. Options may contain allowable modifications to a Standard or Guidance. All Option statements text appears in normal type. The verb may is typically used.

4) Support – an informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. Support statements text appears in normal type. The verbs shall, should and may are not used in Support statements.

ATTACHMENTS

1. Page 6-8 Detail of Detection System
2. Page 9 Table of Minimum Bicycle Timing

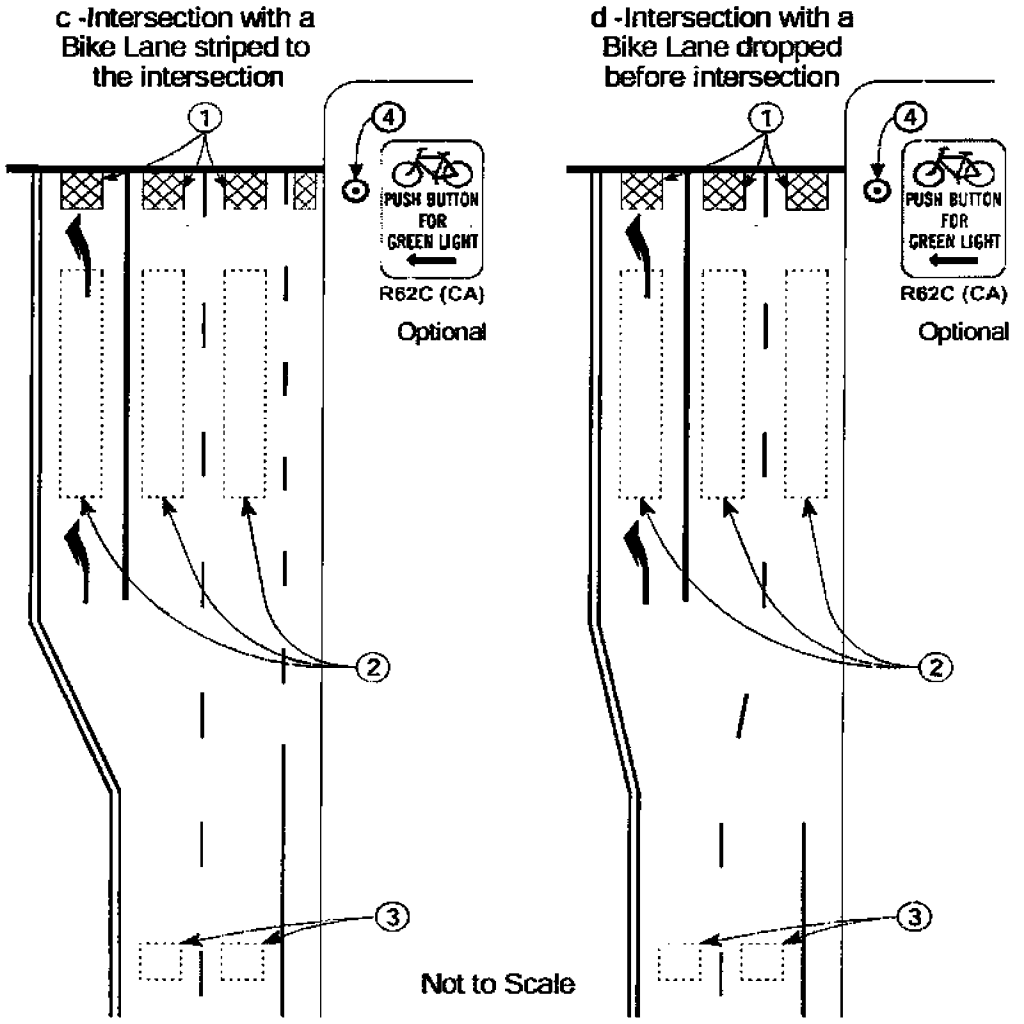
Figure 4D-111(CA) Examples of Detection Systems (Sheet 1 of 3)



1. Typical technology-neutral limit line detection locations. See Section 4D.105(CA).
2. Typical presence detection locations See Section 4D.103(CA).
3. Typical advance detection locations.
4. A bicyclist pushbutton may be used to activate a traffic signal to supplement the required limit line detection. A pushbutton should be located so it is convenient to use by bicyclists. See Section 9B.10 for bicycle regulatory signs.

ATTACHMENTS (Continued)

Figure 4D-111(CA) Examples of Detection Systems (Sheet 2 of 3)



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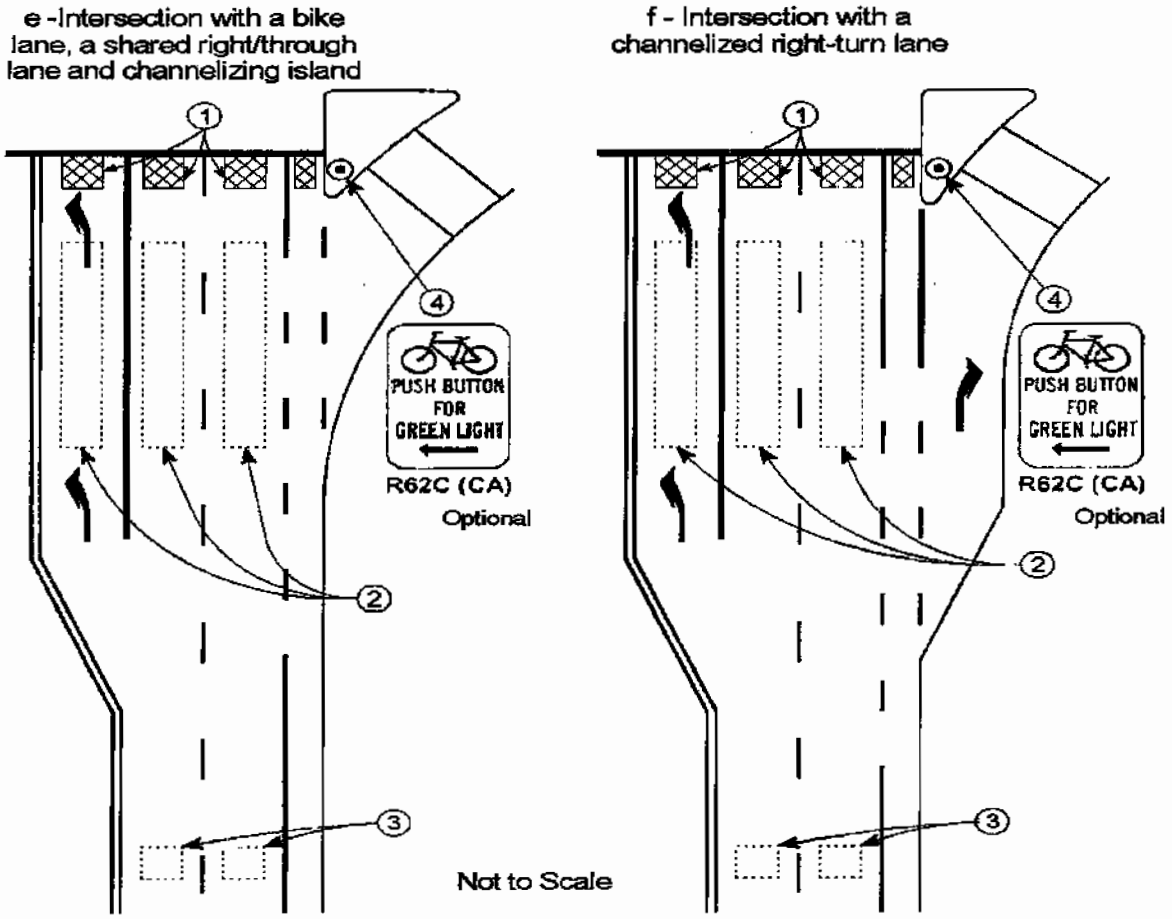
ATTACHMENTS (Continued)

Figure 4D-111(CA) Examples of Detection Systems (Sheet 3 of 3)



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ATTACHMENTS (Continued)

Table 4D-109(CA) Signal Operations - Minimum Bicycle Timing (English Units)

$G_{min} + Y + R_{clear} \geq 6$ sec + (w+6 ft)/14.7 ft/sec, where
G_{min} = Length of minimum green interval (sec)
Y = Length of yellow interval (sec)
R_{clear} = Length of red clearance interval (sec)
W = Distance from limit line to far side of last conflicting lane (ft)

Distance from limit line to far side of last conflicting lane	Minimum phase length (minimum green plus yellow plus red clearance)
Feet	Seconds
40	9.1
50	9.8
60	10.5
70	11.2
80	11.9
90	12.5
100	13.2
110	13.9
120	14.6
130	15.3
140	15.9
150	16.6
160	17.3
170	18.0
180	18.7