

PART 4

HIGHWAY TRAFFIC SIGNALS

CHAPTER 4A. GENERAL

[This is a new section. There is no corresponding section in the MUTCD.]

Section 4A.100 Traffic Control Device Alternatives for Crossings

Guidance:

- 01 Traffic control devices or strategies for improving higher use crossing locations should be selected to provide warning to motorists or to assist pedestrians with gaps for crossing. Traffic control devices or strategies should be matched to conditions at the crossing location with consideration of the following factors associated with the potential for vehicle-pedestrian conflict: pedestrian volume, traffic volume, roadway width, and traffic speed.
- 02 Table 4A-101 should be used to evaluate conditions at crossing locations to determine the grouping of traffic control devices (non-electrical, electrical warning, or electrical regulatory) which most efficiently meets the level of conflict. Pedestrian volumes used in Table 4A-101 should be frequent and routinely occurring, such as an average annual peak hourly volume which recurs on a daily or weekly basis or a seasonal peak hourly volume which recurs over three or more months. Where the operating speed of traffic has been studied and found to be significantly different from the posted speed limit (such as a posted advisory speed, an entry to a roundabout, or a segment with good sight distance and little roadside activity), the operating speed should be used in Table 4A-101, otherwise the posted speed limit should be used.
- 03 Table 4A-102 should be used to select traffic control devices or strategies within the grouping of traffic control devices identified in Table 4A-101. Performance of traffic control devices or strategies should be evaluated with engineering judgment before moving to a device grouping with higher command of motorist attention.

Option:

- 04 Crash history, walking speed, pedestrian age, and maintenance and operations needs may also be considered when selecting traffic control devices or strategies. These additional factors may be used with engineering judgment to adjust upward or downward from the initial traffic control device selection.

Table 4A-101. Grouping of Traffic Control Device Alternatives Based on Conditions at Uncontrolled Crossing Locations

		Vehicular Traffic Volume and Speed																
		Vehicle AADT (vpd)					Speed (MPH)											
Recurring Hourly Pedestrian Crossing Volume (PED)	No. of Lanes	Raised Median or Refuge?	<= 4500		> 4500 to 9,000		> 9,000 to 12,000		> 12,000 to 15,000		> 15,000							
			All	<=30	35	40	>=45	<=30	35	40	>=45	<=30	35	40	<=30	35	40	
< 20 /hr	Any	Any	NE See also 2C.01 and 3B.18															
	2,3	Yes	NE	NE	EW	ER	NE	NE	EW	ER	NE	NE	EW	ER	NE	NE	EW	ER
	2	No	NE: See also 2C.01 and 3B.18	NE	EW	ER	NE	NE	EW	ER	NE	NE	EW	ER	NE	NE	EW	ER
	3	No	NE	NE	EW	ER	NE	NE	EW	ER	NE	NE	EW	ER	NE	NE	EW	ER
	>=4	Yes	NE	NE	EW	ER	NE	NE	EW	ER	NE	NE	EW	ER	NE	NE	EW	ER
>=4	No	No	NE	EW	ER	NE	EW	ER	NE	EW	ER	NE	EW	ER	NE	EW	ER	ER
School Crossing	EW - See Part 7 for school routes, beacon systems, and Part 4 for Signal Warrants																	
>= 20 /hr	ER - See Part 4 for Pedestrian Hybrid Beacon Guidelines and School Crossing Warrants (Engineering Study required)																	
>=75 /hr	ER - See Part 4 for Traffic Control Signal Warrants (Engineering Study required)																	

DEVICE GROUPING

- NE:** Non-electrical devices (sight distance, signs, striping, medians, etc.)
- EW:** Electrical warning devices (beacons, lighting, sign borders, in-pavement lights, etc.)
- ER:** Electrical regulatory devices (hybrid beacons, signals)

Abbreviations

- vpd:** vehicles per day (typically annual average daily traffic or ADT)
- AADT:** Annual Average Daily Traffic (volume in vehicles per day)
- MPH:** Miles per hour

PED Crossing Volume:

Frequent and recurring, e.g. average annual peak hourly volume or seasonal peak hourly volume over three months or more
 Reduce PED volume to 15 / hr for NE, EW devices, or by 50% for ER devices if elderly and/or child pedestrians recur frequently.

Table 4A-102. Recommended Order of Selection for Traffic Control Devices or Strategies at Uncontrolled Crossing Locations

DEVICE GROUPING	Priority of factors for consideration after Table 4A-101				TRAFFIC CONTROL STRATEGIES FOR A CROSSING LOCATION	ORDER OF DEVICE SELECTION	OPTIONAL DEVICES	
	1	2	3	4				
NE - Non-electrical ¹	> 20/hr and factors 2, 3, or 4	< 75 %ile crash history	Above Minimum PSD	≥ 1 per minute average or ≥ 1 per adjacent signal cycle	Devices not provided for sites with adequate gaps, good visibility, low pedestrian volume or low crash history	None		
					Locate or provide alternative crossing location (primarily to improve sight distance)			Increasing Command ↓ of Attention/Respect
					Median refuge island or divided/split highway lanes (primarily to achieve gaps) ²			
					Standard retroreflective signs (primarily for warning or drawing attention)			
					High visibility warning signs, markings, delineators, or post reflectors (primarily for warning or drawing attention)			
Flag-carry Portable in-street signs ³	↓							
EW - Electrical Warning	>20/hr and factors 2, 3, or 4 OR > 75 /hr	> 95 %ile crash history, primarily crossing related	Below minimum PSD, Above minimum SSD with high visibility devices	< 1 per 2 minutes average or < 1/ adjacent signal cycle	Pedestrian street lighting electrolier(s) ⁴	Increasing Command ↓ of Attention/Respect		
					Ped Activated Rectangular Rapid Flashing Beacons RRFB (when >=40 MPH; >2 lanes; or roundabout exits) ⁵			
					Overhead active alternating LED beacon w/ped detection ⁵			
					Continuous single round LED beacons above sign ⁶			
					Continuous single Overhead LED beacon			
					LED bollards for walkways (primarily used in transit areas)			
					Continuous LED flashing borders in-sign			
					Ped activated LED flashing borders in-sign			
					Combined side mount and Overhead ped activated beacons			
					In pavement crosswalk lights ⁷			
Other electrical warning devices	↓							
ER - Electrical Regulatory ⁸	≥= 20/hr ≥= 75/hr	> 95 %ile crash history, primarily crossing related	Below minimum SSD	< 1 per 2 minutes average or < 1 per adjacent signal cycle	Pedestrian Hybrid Beacon (Engineering Study required)	Increasing Command ↓ of Attention/Respect		
					Signal, Midblock signal, or Half-signal (Engineering Study required)			

FOOTNOTES to Table 4A-102

1. NE - nonelectrical project solutions are acceptable until an electrical project can be determined as needed
2. Median refuge may be used to convert undesirable gaps into adequate two stage gaps
3. Consider portable in-street signs primarily for special events and school control. These require active onsite oversight.
4. Provide overhead lighting at marked crosswalks when feasible to address nighttime ped crossing issues
5. Active flashing beacon systems are preferable to passive beacon systems
6. Flashing beacon systems may be used to mark zones not identifiable as a single crossing, or areas without overhead lighting
7. In pavement lights should only be considered in a low risk environment for damage, where there is extensive maintenance capability
8. Should be 1/4 mile or more from existing signals on arterial 2 way roadways, unless coordinated with existing signals

DEVICE GROUPING

- NE: Non-electrical devices. See Section 3B.18.
- EW: Electrical warning devices - use at unsignalized, midblock locations where conflict with signals is not a concern.
- ER: Electrical regulatory devices.
- OPT: Optional devices which are low priority enhancements due to frequent maintenance and resource limitations

OTHER FACTORS/TERMS

- PED VOLUME:** Frequent and recurring, e.g. average annual peak hourly volume or seasonal peak hourly volume over three months or more
Reduce PED volume to 15 / hr for NE, EW devices, or by 50% for ER devices if elderly and/or child pedestrians recur frequently
- SAFETY HISTORY:** Analysis of ped-vehicle crash data related to crossing attempts, including experience at locations with similar characteristics
- %ile:** Percentile grouping of locations based on analysis of statewide crossing-related ped-vehicle crash data
- SIGHT DISTANCE:** Unobstructed road distance visible to a pedestrian or motorist providing time necessary to execute crossing or driving maneuvers
- PSD:** Pedestrian Sight Distance (PSD) = (2.5 s + Crossing Distance/3.5 fps) x Posted Speed fps
- SSD:** Motorist Stopping Sight Distance (SSD), See Tables 3-1 and 3-2, AASHTO Policy on Geometric Design of Highways and Streets
- GAPS:** Spacing of vehicular traffic, such that pedestrians have an opportunity to execute a crossing
- avg:** Average measurement per hour
- LED:** Light Emitting Diode or alternative light source

CHAPTER 4D. TRAFFIC CONTROL SIGNAL FEATURES

Section 4D.02 Responsibility for Operation and Maintenance

Guidance:

- 01 *Prior to installing any traffic control signal, the responsibility for the maintenance of the signal and all of the appurtenances, hardware, software, and the timing plan(s) should be clearly established. The responsible agency should provide for the maintenance of the traffic control signal and all of its appurtenances in a competent manner.*
- 02 *To this end the agency should:*
- A. *Keep every controller assembly in effective operation in accordance with its predetermined timing schedule; check the operation of the controller assembly frequently enough to verify that it is operating in accordance with the predetermined timing schedule; and establish a policy to maintain a record of all timing changes and that only authorized persons are permitted to make timing changes;*
 - B. *Clean the optical system of the signal sections and replace the light sources as frequently as experience proves necessary;*
 - C. *Clean and service equipment and other appurtenances as frequently as experience proves necessary;*
 - D. *Provide for Consider alternate operation of the traffic control signal during a period of failure, using flashing mode or manual control, or manual traffic direction by proper authorities as might be required by traffic volumes or congestion, or by erecting other traffic control devices;*
 - E. *Have properly skilled maintenance personnel available without undue delay for all signal malfunctions and signal indication failures;*
 - F. *Provide spare equipment to minimize the interruption of traffic control signal operation as a result of equipment failure;*
 - G. *Provide for the availability of properly skilled maintenance personnel for the repair of all components; and*
 - H. *Maintain the appearance of the signal displays and equipment.*
 - I. *Keep a signal record in each signal cabinet along with a phasing schematic and wiring diagram. The signal record or log should contain the following:*
 - 1. *Current or intersection-specific default signal timing, which can be kept in printed form or in non-volatile electronic memory. When the signal controller is connected to a central computer that can upload and download timings, the signal timing can be stored at the central computer.*
 - 2. *Date and time of changes or maintenance operations.*
 - 3. *Initials of person changing timing or performing maintenance.*
 - 4. *Type of maintenance operation and characteristics of equipment failure or faulty operation evident before repair.*

Section 4D.04 Meaning of Vehicular Signal Indications

Standard:

[Note: Parts of the following paragraph are omitted from the ATMS for brevity.]

- 03 **The following meanings shall be given to highway traffic signal indications for vehicles and pedestrians:**
- C. **Steady red signal indications shall have the following meanings:**
 - 1. **Vehicular traffic facing a steady CIRCULAR RED signal indication, unless entering the intersection to make another movement permitted by another signal indication, shall stop at a clearly marked stop line; but if there is no stop line, traffic shall stop before entering the crosswalk on the near side of the intersection; or if there is no crosswalk, then before entering**

the intersection; and shall remain stopped until a signal indication to proceed is displayed, or as provided below.

Except when a traffic control device is in place prohibiting a turn on red or a steady RED ARROW signal indication is displayed, vehicular traffic facing a steady CIRCULAR RED signal indication is permitted to enter the intersection to turn right, or to turn left from a one-way street into a one-way street, after stopping. The right to proceed with the turn shall be subject to the rules applicable after making a stop at a STOP sign.

2. Vehicular traffic facing a steady RED ARROW signal indication shall not enter the intersection to make the movement indicated by the arrow and, unless entering the intersection to make another movement permitted by another signal indication, shall stop at a clearly marked stop line; but if there is no stop line, before entering the crosswalk on the near side of the intersection; or if there is no crosswalk, then before entering the intersection; and shall remain stopped until a signal indication or other traffic control device permitting the movement indicated by such RED ARROW is displayed.

~~When a traffic control device is in place permitting a turn on a steady RED ARROW signal indication, vehicular traffic facing a steady RED ARROW signal indication is permitted to enter the intersection to make the movement indicated by the arrow signal indication, after stopping. The right to proceed with the turn shall be limited to the direction indicated by the arrow and shall be subject to the rules applicable after making a stop at a STOP sign.~~

3. Unless otherwise directed by a pedestrian signal indication or other traffic control device, pedestrians facing a steady CIRCULAR RED or steady RED ARROW signal indication shall not enter the roadway.

Section 4D.05 Application of Steady Signal Indications

Standard:

- 01 When a traffic control signal is being operated in a steady (stop-and-go) mode, at least one indication in each signal face shall be displayed at any given time.
- 02 A signal face(s) that controls a particular vehicular movement during any interval of a cycle shall control that same movement during all intervals of the cycle.

[Note: Parts of the following paragraph are omitted from the ATMS for brevity.]

- 03 Steady signal indications shall be applied as follows:

B. A steady CIRCULAR YELLOW signal indication:

4. Shall not be displayed to an approach from which drivers are turning left permissively or making a U-turn to the left permissively unless one of the following conditions exists:

- (a) A steady CIRCULAR YELLOW signal indication is also simultaneously being displayed to the opposing approach;

~~(b) An engineering study has determined that, because of unique intersection conditions, the condition described in Item (a) cannot reasonably be implemented without causing significant operational or safety problems and that the volume of impacted left-turning or U-turning traffic is relatively low, and those left-turning or U-turning drivers are advised that a steady CIRCULAR YELLOW signal indication is not simultaneously being displayed to the opposing traffic if this operation occurs continuously by the installation near the left-most signal head of a W25-1 sign (see Section 2C.48) with the legend ONCOMING TRAFFIC HAS EXTENDED GREEN; or~~

~~(c) Drivers are advised of the operation if it occurs only occasionally, such as during a preemption sequence, by the installation near the left-most signal head of a W25-2 sign (see Section 2C.48) with the legend ONCOMING TRAFFIC MAY HAVE EXTENDED GREEN.~~

E. A steady YELLOW ARROW signal indication:

5. Shall not be displayed to terminate a flashing arrow signal indication on an approach from which drivers are turning left permissively or making a U-turn to the left permissively unless one of the following conditions exists:
 - (a) A steady CIRCULAR YELLOW signal indication is also simultaneously being displayed to the opposing approach;
 - ~~(b) An engineering study has determined that, because of unique intersection conditions, the condition described in Item (a) cannot reasonably be implemented without causing significant operational or safety problems and that the volume of impacted left-turning or U-turning traffic is relatively low, and those left-turning or U-turning drivers are advised that a steady CIRCULAR YELLOW signal indication is not simultaneously being displayed to the opposing traffic if this operation occurs continuously by the installation near the left-most signal head of a W25-1 sign (see Section 2C.48) with the legend ONCOMING TRAFFIC HAS EXTENDED GREEN; or~~
 - ~~(c) Drivers are advised of the operation if it occurs only occasionally, such as during a preemption sequence, by the installation near the left-most signal head of a W25-2 sign (see Section 2C.48) with the legend ONCOMING TRAFFIC MAY HAVE EXTENDED GREEN.~~

Section 4D.11 Number of Signal Faces on an Approach

~~[Delete Table 4D-1.]~~

~~[Delete Figure 4D-3.]~~

~~[Delete Figure 4D-6 through 4D-12, 4D-15, and 4D-20. Figure 4D-100 shows typical signal head locations.]~~

Standard:

01 The signal faces for each approach to an intersection or a midblock location shall be provided as follows:

- A. If a signalized through movement exists on an approach, a minimum of two primary signal faces shall be provided for the through movement. If a signalized through movement does not exist on an approach, a minimum of two primary signal faces shall be provided for the signalized turning movement that is considered to be the major movement from the approach (also see Section 4D.25).
One of the primary signal faces for the through movement shall be a side-mounted or post-mounted signal face on the far side of the cross street and to the right of traffic approaching the signal (far-right position). The side-mounted or post-mounted signal face shall be supplemented by the number of overhead through signal faces as shown in Table 4D-100.

All primary signal faces shall be located on the far side of the intersection.

On a one-way street that is three or more lanes wide, an additional post-mounted signal face shall be installed on the far left side of the intersection.

- B. The primary signal face for a protected left-turn phase shall be located:

1. Overhead approximately over the center of a single left-turn lane.
2. Overhead approximately over the extension of the lane line between dual left-turn lanes.

The shared signal face for a protected/permissive left-turn phase shall be located:

1. Overhead approximately over the lane line separating the turn lane from the adjacent through lane where an exclusive turn lane is provided.
2. Overhead approximately over the center of the left-most lane or approximately over the lane line separating the left-most two lanes where an exclusive turn lane is not provided.

The primary signal face for a protected/permissive left-turn signal indication displaying a flashing YELLOW ARROW shall be located overhead approximately over the center of the left-turn lane.

See Sections 4D.17 through 4D.20 for left-turn (and U-turn to the left) signal faces.

C. The primary signal face for a right-turn movement with exclusive right-turn phasing that overlaps the through-traffic phase shall be side-mounted on the far right side.

See Sections 4D.21 through 4D.24 for right-turn (and U-turn to the right) signal faces.

Option:

- 02 Where a movement (or a certain lane or lanes) at the intersection never conflicts with any other signalized vehicular or pedestrian movement, a continuously-displayed single-section GREEN ARROW signal indication may be used to inform road users that the movement is free-flow and does not need to stop.

02A In urban centers and other locations where the far-right position signal would be obscured or outside the cone of vision as shown in Figure 4D-4 of the 2009 MUTCD, an overhead signal face may be substituted.

02B If the mast arm of an existing signal installation is not long enough to permit installation of a signal face displaying a flashing YELLOW ARROW over the center of the left-turn lane, the signal face may be located within an extension of the lane lines and as close to the center as possible.

Support:

- 03 In some circumstances where the through movement never conflicts with any other signalized vehicular or pedestrian movement at the intersection, such as at T-intersections with appropriate geometrics and/or pavement markings and signing, an engineering study might determine that the through movement (or certain lanes of the through movement) can be free-flow and not signalized.

Guidance:

- 04 *If two or more left-turn lanes are provided for a separately controlled protected only mode left-turn movement, or if a left-turn movement represents the major movement from an approach, two or more primary left-turn signal faces should be provided.*

- 05 *If two or more right-turn lanes are provided for a separately controlled right-turn movement, or if a right-turn movement represents the major movement from an approach, two or more primary right-turn signal faces should be provided.*

05A A supplemental far-side left-turn signal face should be provided where there is protected or protected/permissive left-turn phasing. The signal face should consist of a three-section signal face (all arrows) for a protected-only left-turn movement, a four-section signal face for a protected/permissive left-turn movement with a flashing left-turn YELLOW ARROW, or a five-section vertically arranged signal face for other protected/permissive left-turn phasing.

Support:

- 06 Locating primary signal faces overhead on the far side of the intersection has been shown to provide safer operation by reducing intersection entries late in the yellow interval and by reducing red signal violations, as compared to post-mounting signal faces at the roadside or locating signal faces overhead within the intersection on a diagonally-oriented mast arm or span wire. On approaches with two or more lanes for the through movement, one signal face per through lane, centered over each through lane, has also been shown to provide safer operation.

Guidance:

- 07 *If the posted or statutory speed limit or the 85th-percentile speed on an approach to a signalized location is 45 mph or higher, signal faces should be provided as follows for all new or reconstructed signal installations (see Figure 4D-3):*

A. The minimum number and location of primary (non-supplemental) signal faces for through traffic should be provided in accordance with Table 4D-1.

B. If the number of overhead primary signal faces for through traffic is equal to the number of through lanes on an approach, one overhead signal face should be located approximately over the center of each through lane.

C. Except for shared left-turn and right-turn signal faces, any primary signal face required by Sections 4D.17 through 4D.25 for an exclusive turn lane should be located overhead approximately over the center of each exclusive turn lane.

~~D. All primary signal faces should be located on the far side of the intersection.~~

~~E. In addition to the primary signal faces, one or more supplemental pole-mounted or overhead signal faces should be considered to provide added visibility for approaching traffic that is traveling behind large vehicles.~~

~~F. All signal faces should have backplates.~~

08 ~~This layout of signal faces should also be considered for any major urban or suburban arterial street with four or more lanes and for other approaches with speeds of less than 45 mph.~~

Table 4D-100. Recommended Minimum Number of Through Overhead Signals

Number of Through Approach Lanes	Type of Left-Turn Phasing			
	Permissive, Protected-Only, or Protected/Permissive with Flashing Yellow Arrow		Protected/Permissive Shared Face (Not Flashing Yellow Arrow)	
	HEADS ^A	SPACING ^{B,C}	HEADS ^A	SPACING ^{B,C}
1	1	--	0 ^D	--
2	1	--	1	12'
3	2	12'	2	12'
4 or more	3	12'	--	--

A. Minimum number of heads centered over the through approach

B. Approximate spacing between the overhead signals (based on 12' lane width).

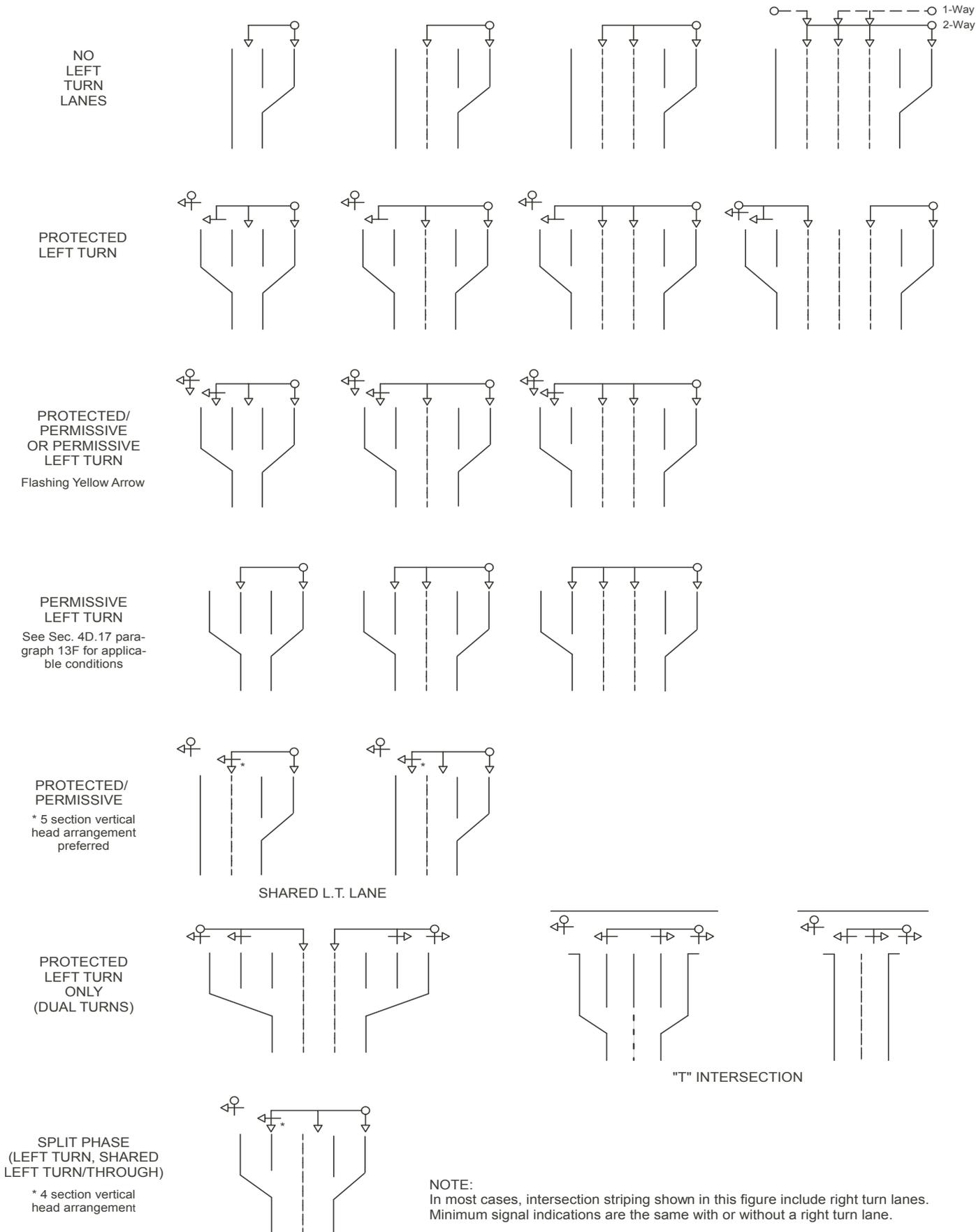
C. If the number of overhead signal faces for through traffic is equal to the number of through lanes on an approach, one overhead signal face should be located approximately over the center of each through lane.

D. Overhead indication is provided by the protected/permissive signal head

Table 4D-100 shows the recommended minimum number of through overhead signals for various intersection configurations. Table 4D-100 is applicable to new, rehabilitated, or reconstructed signals (3R and 4R projects).

NOTE: Near-side heads (not shown) may be needed on wide intersections.

Figure 4D-100. Recommended Minimum Signal Head Location



NO
LEFT
TURN
LANES

PROTECTED
LEFT TURN

PROTECTED/
PERMISSIVE
OR PERMISSIVE
LEFT TURN
Flashing Yellow Arrow

PERMISSIVE
LEFT TURN
See Sec. 4D.17 para-
graph 13F for applica-
ble conditions

PROTECTED/
PERMISSIVE
* 5 section vertical
head arrangement
preferred

SHARED L.T. LANE

PROTECTED
LEFT TURN
ONLY
(DUAL TURNS)

"T" INTERSECTION

SPLIT PHASE
(LEFT TURN, SHARED
LEFT TURN/THROUGH)
* 4 section vertical
head arrangement

NOTE:
In most cases, intersection striping shown in this figure include right turn lanes.
Minimum signal indications are the same with or without a right turn lane.

Section 4D.15 Mounting Height of Signal Faces

Standard:

- 01 The top of the signal housing of a vehicular signal face located over any portion of a highway that can be used by motor vehicles shall not be more than 25.6 feet above the pavement.
- 02 For viewing distances between 40 and 53 feet from the stop line, the maximum mounting height to the top of the signal housing shall be as shown in Figure 4D-5.
- 03 The bottom of the signal housing and any related attachments to a vehicular signal face located over any portion of a highway that can be used by motor vehicles shall be at least ~~15~~ 17.5 feet above the pavement.
- 04 The bottom of the signal housing (including brackets) of a vehicular signal face that is vertically arranged and not located over a roadway:
- A. Shall be a minimum of ~~8~~ 10 feet and a maximum of 19 feet above the sidewalk or, if there is no sidewalk, above the pavement grade at the center of the roadway.
 - B. Shall be a minimum of ~~4.5~~ 7 feet and a maximum of 19 feet above the median island grade of a center median island if located on the near side of the intersection.
- 05 The bottom of the signal housing (including brackets) of a vehicular signal face that is horizontally arranged and not located over a roadway:
- A. Shall be a minimum of ~~8~~ 10 feet and a maximum of 22 feet above the sidewalk or, if there is no sidewalk, above the pavement grade at the center of the roadway.
 - B. Shall be a minimum of ~~4.5~~ 7 feet and a maximum of 22 feet above the median island grade of a center median island if located on the near side of the intersection.

Section 4D.17 Signal Indications for Left-Turn Movements – General

Standard:

13A If a single exclusive left-turn lane is provided on an approach and operated in either permissive only left-turn mode or protected/permissive left-turn mode, the left-turn movement shall be controlled by a flashing left-turn YELLOW ARROW. This standard applies to:

- A. All new traffic signal installations.
- B. Existing traffic signal installations where new left-turn signal faces are installed.

13B A flashing left-turn YELLOW ARROW shall not be terminated before the CIRCULAR GREEN indication for the opposing through movement is terminated.

Guidance:

13C At least two signal faces should be provided for a left-turn movement controlled by a flashing left-turn YELLOW ARROW indication.

Option:

13D Existing shared signal faces for permissive-only or protected/permissive mode left-turn movements may be replaced by a new shared signal face.

13E Permissive-only mode left-turn movements on minor side streets may be controlled by a shared signal face displaying a CIRCULAR GREEN signal indication.

13F A shared signal face for permissive-only or protected/permissive mode left-turn movements may be used for existing signal installations under the following conditions:

- A. The existing signal mast arm is not long enough to position a signal face over the extension of the left-turn lane or engineering judgment indicates installation somewhere other than the center of the left-turn lane would cause driver confusion.
- B. The existing signal controller equipment is not compatible with flashing left-turn YELLOW ARROW operation.

C. The signal pole assembly or foundation is not capable of supporting the load that would result from positioning a signal face over the extension of the left-turn lane.

Guidance:

13G Where the existing signal mast arm, signal pole assembly, pole foundation, or signal controller equipment does not permit the use of flashing left-turn YELLOW ARROW operation, replacement of the limiting components should be considered.

Section 4D.18 Signal Indications for Permissive Only Mode Left-Turn Movements

Standard:

- 01 If a shared signal face is provided for a permissive only mode left turn, it shall meet the following requirements (see Figure ~~4D-6~~4D-100):
- A. It shall be capable of displaying the following signal indications: steady CIRCULAR RED, steady CIRCULAR YELLOW, and CIRCULAR GREEN. Only one of the three indications shall be displayed at any given time.
 - B. During the permissive left-turn movement, a CIRCULAR GREEN signal indication shall be displayed.
 - C. A permissive only shared signal face, regardless of where it is positioned and regardless of how many adjacent through signal faces are provided, shall always simultaneously display the same color of circular indication that the adjacent through signal face or faces display.
 - D. If the permissive only mode is not the only left-turn mode used for the approach, the signal face shall be the same shared signal face that is used for the protected/permissive mode (see Section 4D.20) except that the left-turn GREEN ARROW and left-turn YELLOW ARROW signal indications shall not be displayed when operating in the permissive only mode.
- 02 If a separate left-turn signal face is being operated in a permissive only left-turn mode, a CIRCULAR GREEN signal indication shall not be used in that face.
- 03 If a separate left-turn signal face is being operated in a permissive only left-turn mode and a flashing left-turn YELLOW ARROW signal indication is provided, it shall meet the following requirements (see Figure ~~4D-7~~ 4D-100):
- A. It shall be capable of displaying the following signal indications: steady left-turn RED ARROW, steady left-turn YELLOW ARROW, and flashing left-turn YELLOW ARROW. Only one of the three indications shall be displayed at any given time.
 - B. During the permissive left-turn movement, a flashing left-turn YELLOW ARROW signal indication shall be displayed.
 - C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the flashing left-turn YELLOW ARROW signal indication.
 - D. It shall be permitted to display a flashing left-turn YELLOW ARROW signal indication for a permissive left-turn movement while the signal faces for the adjacent through movement display steady CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement.
 - E. During steady mode (stop-and-go) operation, the signal section that displays the steady left-turn YELLOW ARROW signal indication during change intervals shall not be used to display the flashing left-turn YELLOW ARROW signal indication for permissive left turns.
 - F. During flashing mode operation (see Section 4D.30), the display of a flashing left-turn YELLOW ARROW signal indication shall be only from the signal section that displays a steady left-turn YELLOW ARROW signal indication during steady mode (stop-and-go) operation.
 - G. If the permissive only mode is not the only left-turn mode used for the approach, the signal face shall be the same separate left-turn signal face with a flashing YELLOW ARROW signal indication

that is used for the protected/permissive mode (see Section 4D.20) except that the left-turn GREEN ARROW signal indication shall not be displayed when operating in the permissive only mode.

Option:

- 04 ~~A separate left-turn signal face with a flashing left-turn RED ARROW signal indication during the permissive left-turn movement may be used for unusual geometric conditions, such as wide medians with offset left-turn lanes, but only when an engineering study determines that each and every vehicle must successively come to a full stop before making a permissive left turn.~~

Standard:

- 05 ~~If a separate left-turn signal face is being operated in a permissive only left-turn mode and a flashing left-turn RED ARROW signal indication is provided, it shall meet the following requirements (see Figure 4D-8):~~
- ~~A. It shall be capable of displaying the following signal indications: steady or flashing left-turn RED ARROW, steady left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time. The GREEN ARROW indication is required in order to provide a three-section signal face, but shall not be displayed during the permissive only mode.~~
 - ~~B. During the permissive left-turn movement, a flashing left-turn RED ARROW signal indication shall be displayed, thus indicating that each and every vehicle must successively come to a full stop before making a permissive left turn.~~
 - ~~C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the flashing left-turn RED ARROW signal indication.~~
 - ~~D. It shall be permitted to display a flashing left-turn RED ARROW signal indication for a permissive left-turn movement while the signal faces for the adjacent through movement display steady CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement.~~
 - ~~E. A supplementary sign shall not be required. If used, it shall be a LEFT TURN YIELD ON FLASHING RED ARROW AFTER STOP (R10-27) sign (see Figure 2B-27).~~

Option:

- 06 ~~The requirements of Item A in Paragraph 5 may be met by a vertically-arranged signal face with a horizontal cluster of two left-turn RED ARROW signal indications, the left-most of which displays a steady indication and the right-most of which displays a flashing indication (see Figure 4D-8).~~

Section 4D.19 Signal Indications for Protected Only Mode Left-Turn Movements

Standard:

- 01 A shared signal face shall not be used for protected only mode left turns unless the CIRCULAR GREEN and left-turn GREEN ARROW signal indications always begin and terminate together. If a shared signal face is provided for a protected only mode left turn, it shall meet the following requirements (see Figure ~~4D-9~~ 4D-100):
- A. It shall be capable of displaying the following signal indications: steady CIRCULAR RED, steady CIRCULAR YELLOW, CIRCULAR GREEN, and left-turn GREEN ARROW. Only one of the three colors shall be displayed at any given time.
 - B. During the protected left-turn movement, the shared signal face shall simultaneously display both a CIRCULAR GREEN signal indication and a left-turn GREEN ARROW signal indication.
 - C. The shared signal face shall always simultaneously display the same color of circular indication that the adjacent through signal face or faces display.
 - D. If the protected only mode is not the only left-turn mode used for the approach, the signal face shall be the same shared signal face that is used for the protected/permissive mode (see Section 4D.20).

Option:

- 02 A straight-through GREEN ARROW signal indication may be used instead of the CIRCULAR GREEN signal indication in Items A and B in Paragraph 1 on an approach where right turns are prohibited and a straight-through GREEN ARROW signal indication is also used instead of a CIRCULAR GREEN signal indication in the other signal face(s) for through traffic.

Standard:

- 03 **If a separate left-turn signal face is provided for a protected only mode left turn, it shall meet the following requirements (see Figure ~~4D-10~~ 4D-100):**
- A. It shall be capable of displaying, the following signal indications: steady left-turn RED ARROW, steady left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time. A signal instruction sign shall not be required with this set of signal indications. If used, it shall be a LEFT ON GREEN ARROW ONLY (R10-5) sign (see Figure 2B-27).
 - B. During the protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed.
 - C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication.
 - D. If the protected only mode is not the only left-turn mode used for the approach, the signal face shall be the same separate left-turn signal face that is used for the protected/permissive mode (see Section 4D.20 and ~~Figures 4D-8 and 4D-12~~ Figure 4D-100) except that the flashing left-turn YELLOW ARROW ~~or flashing left-turn RED ARROW~~ signal indication shall not be displayed when operating in the protected only mode.

Section 4D.20 Signal Indications for Protected/Permissive Mode Left-Turn Movements

Standard:

[Note: Parts of the following paragraph are omitted from the ATMS for brevity.]

- 01 **If a shared signal face is provided for a protected/permissive mode left turn, it shall meet the following requirements (see Figure ~~4D-11~~ 4D-100):**
- F. A supplementary sign shall not be required. If used, it shall be a LEFT TURN YIELD ON GREEN (symbolic circular green) (R10-12) sign (~~see Figure 2B-27~~) or R10-100 Left Turn ONLY ON GREEN (symbolic circular green) sign.
- 02 **If a separate left-turn signal face is being operated in a protected/permissive left-turn mode, a CIRCULAR GREEN signal indication shall not be used in that face.**

[Note: Parts of the following paragraph are omitted from the ATMS for brevity.]

- 03 **If a separate left-turn signal face is being operated in a protected/permissive left-turn mode and a flashing left-turn yellow arrow signal indication is provided, it shall meet the following requirements (see Figure ~~4D-12~~ 4D-100):**
- C. A steady left-turn YELLOW ARROW and a steady left-turn RED ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication. The duration of the steady left-turn RED ARROW signal indication shall be at least two seconds.

Standard:

- 05 ~~If a separate left-turn signal face is being operated in a protected/permissive left-turn mode and a flashing left-turn RED arrow signal indication is provided, it shall meet the following requirements (see Figure 4D-8):~~
- ~~A. It shall be capable of displaying the following signal indications: steady or flashing left-turn RED ARROW, steady left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time.~~

- ~~B. During the protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed.~~
- ~~C. A steady left-turn YELLOW ARROW signal indication shall be displayed following the left-turn GREEN ARROW signal indication.~~
- ~~D. During the permissive left-turn movement, a flashing left-turn RED ARROW signal indication shall be displayed.~~
- ~~E. A steady left-turn YELLOW ARROW signal indication shall be displayed following the flashing left-turn RED ARROW signal indication if the permissive left-turn movement is being terminated and the separate left-turn signal face will subsequently display a steady left-turn RED ARROW indication.~~
- ~~F. When a permissive left-turn movement is changing to a protected left-turn movement, a left-turn GREEN ARROW signal indication shall be displayed immediately upon the termination of the flashing left-turn RED ARROW signal indication. A steady left-turn YELLOW ARROW signal indication shall not be displayed between the display of the flashing left-turn RED ARROW signal indication and the display of the steady left-turn GREEN ARROW signal indication.~~
- ~~G. It shall be permitted to display a flashing left-turn RED ARROW signal indication for a permissive left-turn movement while the signal faces for the adjacent through movement display steady CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement.~~
- ~~H. A supplementary sign shall not be required. If used, it shall be a LEFT TURN YIELD ON FLASHING RED ARROW AFTER STOP (R10-27) sign (see Figure 2B-27).~~

Option:

- 06 ~~The requirements of Item A in Paragraph 5 may be met by a vertically-arranged signal face with a horizontal cluster of two left-turn RED ARROW signal indications, the left-most of which displays a steady indication and the right-most of which displays a flashing indication (see Figure 4D-8).~~

Section 4D.22 Signal Indications for Permissive Only Mode Right-Turn Movements

Option:

- 04 ~~When an engineering study determines that each and every vehicle must successively come to a full stop before making a permissive right turn, a separate right-turn signal face with a flashing right-turn RED ARROW signal indication during the permissive right-turn movement may be used.~~

Standard:

- 05 ~~If a separate right-turn signal face is being operated in a permissive only right-turn mode and a flashing right-turn RED arrow signal indication is provided, it shall meet the following requirements (see Figure 4D-15):~~
- ~~A. It shall be capable of displaying one of the following sets of signal indications:

 - ~~1. Steady or flashing right-turn RED ARROW, steady right-turn YELLOW ARROW, and right-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time. The GREEN ARROW indication is required in order to provide a three-section signal face, but shall not be displayed during permissive only mode.~~
 - ~~2. Steady CIRCULAR RED on the left and steady right-turn RED ARROW on the right of the top position, steady right-turn YELLOW ARROW in the middle position, and right-turn GREEN ARROW in the bottom position. Only one of the four indications shall be displayed at any given time. The GREEN ARROW indication is required in order to provide three vertical positions, but shall not be displayed during permissive only mode. If the CIRCULAR RED signal indication is sometimes displayed when the signal faces for the adjacent through lane(s) are not displaying a CIRCULAR RED signal indication, a RIGHT TURN SIGNAL (R10-10R) sign (see Figure 2B-27) shall be used unless the CIRCULAR RED signal indication in the separate right-~~~~

~~turn signal face is shielded, hooded, louvered, positioned, or designed such that it is not readily visible to drivers in the through lane(s).~~

- ~~B. During the permissive right-turn movement, a flashing right-turn RED ARROW signal indication shall be displayed, thus indicating that each and every vehicle must successively come to a full stop before making a permissive right turn.~~
- ~~C. A steady right-turn YELLOW ARROW signal indication shall be displayed following the flashing right-turn RED ARROW signal indication.~~
- ~~D. When the separate right-turn signal face is providing a message to stop and remain stopped, a steady right-turn RED ARROW signal indication shall be displayed if it is intended that right turns on red not be permitted (except when a traffic control device is in place permitting a turn on a steady RED ARROW signal indication) or a steady CIRCULAR RED signal indication shall be displayed if it is intended that right turns on red be permitted.~~
- ~~E. The display of a flashing right-turn RED ARROW signal indication for a permissive right-turn movement while the signal faces for the adjacent through movement display steady CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement shall be permitted.~~
- ~~F. A supplementary sign shall not be required. If used, it shall be a RIGHT TURN YIELD ON FLASHING RED ARROW AFTER STOP (R10-27) sign (see Figure 2B-27).~~

Option:

- 06 ~~The requirements of Item A.1 in Paragraph 5 may be met by a vertically arranged signal face with a horizontal cluster of two right-turn RED ARROW signal indications, the left-most of which displays a steady indication and the right-most of which displays a flashing indication (see Figure 4D-15).~~

Section 4D.23 Signal Indications for Protected Only Mode Right-Turn Movements

Standard:

- 03 If a separate right-turn signal face is provided for a protected only mode right turn, it shall meet the following requirements (see Figure 4D-17):
- A. It shall be capable of displaying one of the following sets of signal indications:
 1. Steady right-turn RED ARROW, steady right-turn YELLOW ARROW, and right-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time. A signal instruction sign shall not be required with this set of signal indications. If used, it shall be a RIGHT ON GREEN ARROW ONLY (R10-5a) sign (see Figure 2B-27).
 2. Steady CIRCULAR RED, steady right-turn YELLOW ARROW, and right-turn GREEN ARROW. Only one of three indications shall be displayed at any given time. If the CIRCULAR RED signal indication is sometimes displayed when the signal faces for the adjacent through lane(s) are not displaying a CIRCULAR RED signal indication, a RIGHT TURN SIGNAL (R10-10R) sign (see Figure 2B-27) shall be used unless the CIRCULAR RED signal indication is shielded, hooded, louvered, positioned, or designed such that it is not readily visible to drivers in the through lane(s).
 - B. During the protected right-turn movement, a right-turn GREEN ARROW signal indication shall be displayed.
 - C. A steady right-turn YELLOW ARROW signal indication shall be displayed following the right-turn GREEN ARROW signal indication.
 - D. When the separate signal face is providing a message to stop and remain stopped, a steady right-turn RED ARROW signal indication shall be displayed if it is intended that right turns on red not be permitted (~~except when a traffic control device is in place permitting a turn on a steady RED ARROW signal indication~~) or a steady CIRCULAR RED signal indication shall be displayed if it is intended that right turns on red be permitted.

- E. If the protected only mode is not the only right-turn mode used for the approach, the signal face shall be the same separate right-turn signal face that is used for the protected/permissive mode (see Section 4D.24 and Figure 4D-19) except that a flashing right-turn YELLOW ARROW ~~or flashing right-turn RED ARROW~~ signal indication shall not be displayed when operating in the protected only mode.

Section 4D.24 Signal Indications for Protected/Permissive Mode Right-Turn Movements

Option:

- 04 ~~When an engineering study determines that each and every vehicle must successively come to a full stop before making a permissive right turn, a separate signal face that has a flashing right-turn RED ARROW signal indication during the permissive right-turn movement may be used.~~

Standard:

- 05 ~~If a separate right-turn signal face is being operated in a protected/permissive right-turn mode and a flashing right-turn RED arrow signal indication is provided, it shall meet the following requirements (see Figure 4D-15):~~
- A. ~~It shall be capable of displaying one of the following sets of signal indications:

 1. ~~Steady or flashing right-turn RED ARROW, steady right-turn YELLOW ARROW, and right-turn GREEN ARROW. Only one of the three indications shall be displayed at any given time.~~
 2. ~~Steady CIRCULAR RED on the left and steady or flashing right-turn RED ARROW on the right of the top position, steady right-turn YELLOW ARROW in the middle position, and right-turn GREEN ARROW in the bottom position. Only one of the four indications shall be displayed at any given time. If the CIRCULAR RED signal indication is sometimes displayed when the signal faces for the adjacent through lane(s) are not displaying a CIRCULAR RED signal indication, a RIGHT TURN SIGNAL (R10-10R) sign (see Figure 2B-27) shall be used unless the CIRCULAR RED signal indication in the separate right-turn signal face is shielded, hooded, louvered, positioned, or designed such that it is not readily visible to drivers in the through lane(s).~~~~
 - B. ~~During the protected right-turn movement, a right-turn GREEN ARROW signal indication shall be displayed.~~
 - C. ~~A steady right-turn YELLOW ARROW signal indication shall be displayed following the right-turn GREEN ARROW signal indication.~~
 - D. ~~During the permissive right-turn movement, the separate right-turn signal face shall display a flashing right-turn RED ARROW signal indication.~~
 - E. ~~A steady right-turn YELLOW ARROW signal indication shall be displayed following the flashing right-turn RED ARROW signal indication if the permissive right-turn movement is being terminated and the separate right-turn signal face will subsequently display a steady red indication.~~
 - F. ~~When a permissive right-turn movement is changing to a protected right-turn movement, a right-turn GREEN ARROW signal indication shall be displayed immediately upon the termination of the flashing right-turn RED ARROW signal indication. A steady right-turn YELLOW ARROW signal indication shall not be displayed between the display of the flashing right-turn RED ARROW signal indication and the display of the steady right-turn GREEN ARROW signal indication.~~
 - G. ~~When the separate right-turn signal face is providing a message to stop and remain stopped, a steady right-turn RED ARROW signal indication shall be displayed if it is intended that right turns on red not be permitted (except when a traffic control device is in place permitting a turn on a steady RED ARROW signal indication) or a steady CIRCULAR RED signal indication shall be displayed if it is intended that right turns on red be permitted.~~
 - H. ~~It shall be permitted to display a flashing right-turn RED ARROW signal indication for a permissive right-turn movement while the signal faces for the adjacent through movement display~~

~~steady CIRCULAR RED signal indications and the opposing left-turn signal faces display left-turn GREEN ARROW signal indications for a protected left-turn movement.~~

~~I. A supplementary sign shall not be required. If used, it shall be a RIGHT TURN YIELD ON FLASHING RED ARROW AFTER STOP (R10-27) sign (see Figure 2B-27).~~

~~Option:~~

- ~~06 The requirements of Item A.1 in Paragraph 5 may be met by a vertically-arranged signal face with a horizontal cluster of two right-turn RED ARROW signal indications, the left-most of which displays a steady indication and the right-most of which displays a flashing indication (see Figure 4D-15).~~

Section 4D.25 Signal Indications for Approaches With Shared Left-Turn/Right-Turn Lanes and No Through Movement

Support:

- 05 Figure ~~4D-20~~ [4D-100](#) illustrates application of these Standards on approaches that have only a shared left-turn/right-turn lane, and on approaches that have one or more exclusive turn lanes in addition to the shared left-turn/right-turn lane.

CHAPTER 4E. PEDESTRIAN CONTROL FEATURES

Section 4E.02 Meaning of Pedestrian Signal Head Indications

Standard:

- 01 Pedestrian signal head indications shall have the following meanings:
- A. A steady WALKING PERSON (symbolizing WALK) signal indication means that a pedestrian facing the signal indication is permitted to start to cross the roadway in the direction of the signal indication, possibly in conflict with turning vehicles. The pedestrian shall yield the right-of-way to vehicles lawfully within the intersection at the time that the WALKING PERSON (symbolizing WALK) signal indication is first shown.
 - B. A flashing UPRAISED HAND (symbolizing DONT WALK) signal indication means that a pedestrian shall not start to cross the roadway in the direction of the signal indication, but that any pedestrian who has already started to cross on a steady WALKING PERSON (symbolizing WALK) signal indication shall proceed to the far side of the traveled way of the street or highway, unless otherwise directed by a traffic control device to proceed only to the median of a divided highway or only to some other island or pedestrian refuge area.
 - C. A steady UPRAISED HAND (symbolizing DONT WALK) signal indication means that a pedestrian shall not enter the roadway in the direction of the signal indication.
 - D. A flashing WALKING PERSON (symbolizing WALK) signal indication has no meaning and shall not be used.
- 01A At all locations with a pedestrian signal indication, THE MEANING OF PEDESTRIAN SIGNALS (R10-101) sign or sticker shall be installed on each pole, between and immediately above the push buttons. These signs or stickers need not be reflectorized.

CHAPTER 4F. PEDESTRIAN HYBRID BEACONS

Section 4F.01 Application of Pedestrian Hybrid Beacons

Support:

- 01 A pedestrian hybrid beacon is a special type of hybrid beacon used to warn and control traffic at an unsignalized location to assist pedestrians in crossing a street or highway at a marked crosswalk.

Option:

- 02 A pedestrian hybrid beacon may be considered for installation to facilitate pedestrian crossings at a location that does not meet traffic signal warrants (see Chapter 4C), or at a location that meets traffic signal warrants under Sections 4C.05 and/or 4C.06 but a decision is made to not install a traffic control signal.

Standard:

- 03 **If used, pedestrian hybrid beacons shall be used in conjunction with signs and pavement markings to warn and control traffic at locations where pedestrians enter or cross a street or highway. A pedestrian hybrid beacon shall only be installed at a marked crosswalk.**

Guidance:

- 04 *If one of the signal warrants of Chapter 4C is met and a traffic control signal is justified by an engineering study, and if a decision is made to install a traffic control signal, it should be installed based upon the provisions of Chapters 4D and 4E.*
- 05 *If a traffic control signal is not justified under the signal warrants of Chapter 4C and if gaps in traffic are not adequate to permit pedestrians to cross, or if the speed for vehicles approaching on the major street is too high to permit pedestrians to cross, or if pedestrian delay is excessive, the need for a pedestrian hybrid beacon should be considered on the basis of an engineering study that considers major-street volumes, speeds, widths, and gaps in conjunction with pedestrian volumes, walking speeds, and delay.*
- 05A *Installation of pedestrian hybrid beacons should be limited to uncontrolled locations evaluated according to Figure 3B-101 as “M - marginal” or “N – should not be installed”. Locations evaluated according to Figure 3B-101 as “C – candidate” for marked crosswalks at uncontrolled locations typically should not be considered for pedestrian hybrid beacons.*
- 06 *For a major street where the posted or statutory speed limit or the 85th-percentile speed is 35 mph or less, the need for a pedestrian hybrid beacon should be considered if the engineering study finds that the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding total of all pedestrians crossing the major street for 1 hour (any four consecutive 15-minute periods) of an average day falls above the applicable curve in Figure 4F-1 for the length of the crosswalk.*
- 07 *For a major street where the posted or statutory speed limit or the 85th-percentile speed exceeds 35 mph, the need for a pedestrian hybrid beacon should be considered if the engineering study finds that the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding total of all pedestrians crossing the major street for 1 hour (any four consecutive 15-minute periods) of an average day falls above the applicable curve in Figure 4F-2 for the length of the crosswalk.*
- 07A *Meeting or exceeding minimum pedestrian volume guidelines indicated in Figure 4F-1 or Figure 4F-2 at a proposed location should not be the sole criterion used for installing a pedestrian hybrid beacon.*
- 08 *For crosswalks that have lengths other than the four that are specifically shown in Figures 4F-1 and 4F-2, the values should be interpolated between the curves.*

Support:

- 08A *Pedestrian hybrid beacons are best used on higher volume multiple lane approaches and roads where other methods have not provided adequate improvement in pedestrian crossing opportunities or safety. Lower cost treatments can be employed at most locations with low to moderate volumes and/or shorter crossing distances to*

[alert motorists of the presence of pedestrians, slow traffic, shorten the crossing distance, or create adequate gaps for crossing.](#)

Section 4F.02 Design of Pedestrian Hybrid Beacons

Standard:

- 01 Except as otherwise provided in this Section, a pedestrian hybrid beacon shall meet the provisions of Chapters 4D and 4E.
- 02 A pedestrian hybrid beacon face shall consist of three signal sections, with a CIRCULAR YELLOW signal indication centered below two horizontally aligned CIRCULAR RED signal indications (see Figure 4F-3).
- 03 When an engineering study finds that installation of a pedestrian hybrid beacon is justified, then:
- A. At least two pedestrian hybrid beacon faces shall be installed for each approach of the major street,
 - B. A stop line shall be installed for each approach to the crosswalk,
 - C. A pedestrian signal head conforming to the provisions set forth in Chapter 4E shall be installed at each end of the marked crosswalk, and
 - D. The pedestrian hybrid beacon shall be pedestrian actuated.
- [E. If a pedestrian hybrid beacon is installed at or immediately adjacent to an intersection with a side road or driveway, vehicular traffic on that side road or driveway shall be controlled by STOP signs.](#)

Guidance:

- 04 When an engineering study finds that installation of a pedestrian hybrid beacon is justified, then:
- ~~A. The pedestrian hybrid beacon should be installed at least 100 feet from side streets or driveways that are controlled by STOP or YIELD signs;~~
 - ~~B. Parking and other sight obstructions should be [evaluated and prohibited for at least 100 feet in advance of and at least 20 feet beyond the marked crosswalk](#), or site accommodations should be made through curb extensions or other techniques to provide adequate sight distance [if necessary](#);~~
 - ~~C. The installation should include suitable standard signs and pavement markings, and~~
 - ~~D. If installed within a signal system, the pedestrian hybrid beacon should be coordinated.~~
- 05 On approaches having posted or statutory speed limits or 85th-percentile speeds in excess of 35 mph and on approaches having traffic or operating conditions that would tend to obscure visibility of roadside hybrid beacon face locations, both of the minimum of two pedestrian hybrid beacon faces should be installed over the roadway.
- 06 On multi-lane approaches having a posted or statutory speed limits or 85th-percentile speeds of 35 mph or less, either a pedestrian hybrid beacon face should be installed on each side of the approach (if a median of sufficient width exists) or at least one of the pedestrian hybrid beacon faces should be installed over the roadway.
- 07 A pedestrian hybrid beacon should comply with the signal face location provisions described in Sections 4D.11 through 4D.16.

Standard:

- 08 A CROSSWALK STOP ON RED (symbolic circular red) (R10-23) sign (see Section 2B.53) shall be mounted adjacent to a pedestrian hybrid beacon face on each major street approach. If an overhead pedestrian hybrid beacon face is provided, the sign shall be mounted adjacent to the overhead signal face.

Option:

- 09 A Pedestrian (W11-2) warning sign (see Section 2C.50) with an AHEAD (W16-9P) supplemental plaque may be placed in advance of a pedestrian hybrid beacon. A warning beacon may be installed to supplement the W11-2 sign.

Guidance:

- 10 If a warning beacon supplements a W11-2 sign in advance of a pedestrian hybrid beacon, it should be programmed to flash only when the pedestrian hybrid beacon is not in the dark mode.

Standard:

- 11 **If a warning beacon is installed to supplement the W11-2 sign, the design and location of the warning beacon shall comply with the provisions of Sections 4L.01 and 4L.03.**

Guidance:

- 11A If installed at a midblock location, a pedestrian hybrid beacon should not be installed less than 300 feet from the nearest location that provides a controlled crossing of the major street or an intersection where pedestrians are permitted to cross the major street.

CHAPTER 4L. FLASHING BEACONS

Section 4L.01 General Design and Operation of Flashing Beacons

Standard:

02 Flashing Beacon units and their mountings shall comply with the provisions of Chapter 4D, except as otherwise provided in this Chapter.

03 Beacons shall be flashed at a rate of not less than 50 or more than 60 times per minute. The illuminated period of each flash shall be a minimum of 1/2 and a maximum of 2/3 of the total cycle.

04 A beacon shall not be included within the border of a sign ~~except for SCHOOL SPEED LIMIT sign beacons (see Sections 4L.04 and 7B.15).~~

Section 4L.02 Intersection Control Beacon

Standard:

01 An Intersection Control Beacon shall consist of one or more signal faces directed toward each approach to an intersection. Each signal face shall consist of one or more signal sections of a standard traffic signal face, with flashing CIRCULAR YELLOW or CIRCULAR RED signal indications in each signal face. They shall be installed and used only at an intersection to control two or more directions of travel.

02 Application of Intersection Control Beacon signal indications shall be limited to the following:

A. Yellow on one route (normally the major street) and red for the remaining approaches, and

B. Red for all approaches (if the warrant described in Section 2B.07 for a multi-way stop is satisfied).

03 Flashing yellow signal indications shall not face conflicting vehicular approaches.

04 A STOP sign shall be used on approaches to which a flashing red signal indication is displayed on an Intersection Control Beacon (see Section 2B.04).

05 If two horizontally aligned red signal indications are used on an approach for an Intersection Control Beacon, they shall be flashed simultaneously to avoid being confused with grade crossing flashing-light signals. If two vertically aligned red signal indications are used on an approach for an Intersection Control Beacon, they shall be flashed alternately.

Guidance:

06 *An Intersection Control Beacon should not be mounted on a pedestal in the roadway unless the pedestal is within the confines of a traffic or pedestrian island.*

Option:

07 Supplemental signal indications may be used on one or more approaches in order to provide adequate visibility to approaching road users.

08 Intersection Control Beacons may be used at intersections where traffic or physical conditions do not justify conventional traffic control signals but crash rates indicate the possibility of a special need.

09 An Intersection Control Beacon is generally located over the center of an intersection; however, it may be used at other suitable locations.

Support:

09A Consider installing intersection control beacons when an intersection has experienced 4 or more angle crashes in a 12-consecutive month period or 6 or more in a 24-consecutive month period.

Section 4L.03 Warning Beacon

Standard:

- 02 A Warning Beacon shall consist of one or more signal sections of a standard traffic signal face with a flashing CIRCULAR YELLOW signal indication in each signal section.
- 03 A Warning Beacon shall be used only to supplement an appropriate warning or regulatory sign or marker.
- 04 Warning Beacons, if used at intersections, shall not face conflicting vehicular approaches.
- 05 If a Warning Beacon is suspended over the roadway, the clearance above the pavement shall be a ~~minimum of 15 feet and a maximum of 19 feet~~ comply with the requirements of Section 4D.15.

[The following is a new section. There is no corresponding section in the MUTCD.]

Section 4L.100 Rectangular Rapid Flashing Beacons

Support:

- 01 A Rectangular Rapid Flashing Beacon is a pedestrian actuated warning beacon with two sections that operate in a flashing mode. It provides emphasis to motorists for existing marked and signed uncontrolled pedestrian and school crosswalk locations. The beacons are not signals and do not establish a regulatory requirement for yield or stop control for motorist.

Option:

- 02 A Rectangular Rapid Flashing Beacon may be installed where all conditions A through F are present:
- A. The crosswalk is installed in accordance with Table 3B-101 of the Alaska Traffic Manual Supplement;
 - B. There are more than two lanes;
 - C. The posted speed is 40 mph or greater;
 - D. The nearest controlled crossing location is more than 300 feet away;
 - E. The yield-to-pedestrian compliance is low; and
 - F. The regional traffic and safety engineer (RTSE) or other public or private authority or official having jurisdiction over traffic control devices (Agency Official) determines adjacent signal operations will not be negatively impacted.
- 03 A Rectangular Rapid Flashing Beacon may be installed at other locations where the Agency Official determines adjacent signal operations will not be negatively impacted and unsatisfactory site-specific conditions exist, such as:
- A. Pedestrian accident history;
 - B. High occurrence of avoidance maneuvers by motorists or pedestrians, or;
 - C. School crossings on a rural NHS route.

Standard:

- 04 Rectangular Rapid Flashing Beacon units and their mountings shall comply with the following FHWA guidance:
- A. Interim Approval for Optional Use of Rectangular Rapid Flashing Beacons (IA-11) 7/16/2008; and,
 - B. Applicable FHWA official interpretations published on the FHWA MUTCD Interim Approvals webpage at the time of installation.
- 05 Rectangular Rapid Flashing Beacon units shall not be installed for overhead applications or with the combined Bicycle/Pedestrian (W11-15) sign without prior written approval of the Agency Official.
- 06 Pushbutton detectors and R10-25 signs, or passive detection, shall be installed for each crossing direction and on the median if pedestrians cross in two stages using a refuge island.

07 Rectangular Rapid Flashing Beacons shall not be installed at signalized, stop or yield controlled approaches.

Guidance:

08 Other crosswalk enhancements should be considered prior to installation of Rectangular Rapid Flashing Beacons.

Standard:

09 Provide the following information to the State Traffic and Safety Engineer for each Rectangular Rapid Flashing Beacon installation:

A. Location;

B. Date installed; and,

C. List of FHWA official interpretations applied in the installation.

CHAPTER 4Z. ACTIVE ADVANCE WARNING FLASHERS

[This is a new chapter. There is no corresponding chapter in the MUTCD.]

Section 4Z.01 Application of Active Advance Warning Flashers

Support:

01 Active Advance Warning Flashers (AAWFs) are a special type of highway traffic signal installed in advance of conventional traffic signals to provide advance notice of the onset of the yellow indication.

Option:

02 AAWFs may be installed only when the following conditions are met:

A. Where sight distance to the conventional traffic signal indications meets or exceeds standards AND

B. High-speed (55 mph or higher) approaches to an intersection spaced at least one mile from another signalized intersection OR

C. At the first signalized intersection after 10 or more miles of uninterrupted highway

Support:

03 AAWFs impact traffic in two ways:

A. They provide drivers advance notice of the onset of yellow

B. They prevent traffic signal electronics from providing “Dilemma Zone Protection”, which attempts to hold the onset of yellow until there are no cars within the “Dilemma Zone” (the area where it is difficult to decide whether to stop or go).

04 When both factors apply, an engineering analysis could be used to consider the effects on signal operation, capacity, safety, and to evaluate specific mitigating strategies such as the addition or relocation of vehicle detectors. If only one approach meets the conditions of the Option statement, the engineering analysis could address the potential loss of dilemma zone protection and extended advance notice on the opposite approach and whether AAWFs on the opposite approach are desirable.

Section 4Z.02 Design of Active Advance Warning Flashers

Guidance:

01 AAWFs should be installed approximately 500 feet in advance of the stop bar or as determined by an engineering analysis.

02 The AAWF sign and flashers should be designed to:

A. Appear distinctively different than standard flashing signal ahead signs/beacons to alert drivers to its different meaning (impending yellow indication)

B. Communicate at a glance that the warning refers to a signal, not construction activity, pedestrian crossing, etc.

C. When the power goes out, it should not imply to drivers that they may proceed through the intersection, as a nonflashing “Prepare to Stop When Flashing” sign does.

D. Be easily visible from all lanes on the approach

03 Figure 4Z-100 shows the recommended AAWF configuration.

Figure 4Z-100. Active Advance Warning Flasher

