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. 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:

03 **The following meanings shall be given to highway traffic signal indications for vehicles and pedestrians:**

A. 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.

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

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.

Guidance:

03 *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.*

04 *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.*

04A *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.*

~~*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.*~~

[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.]

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)

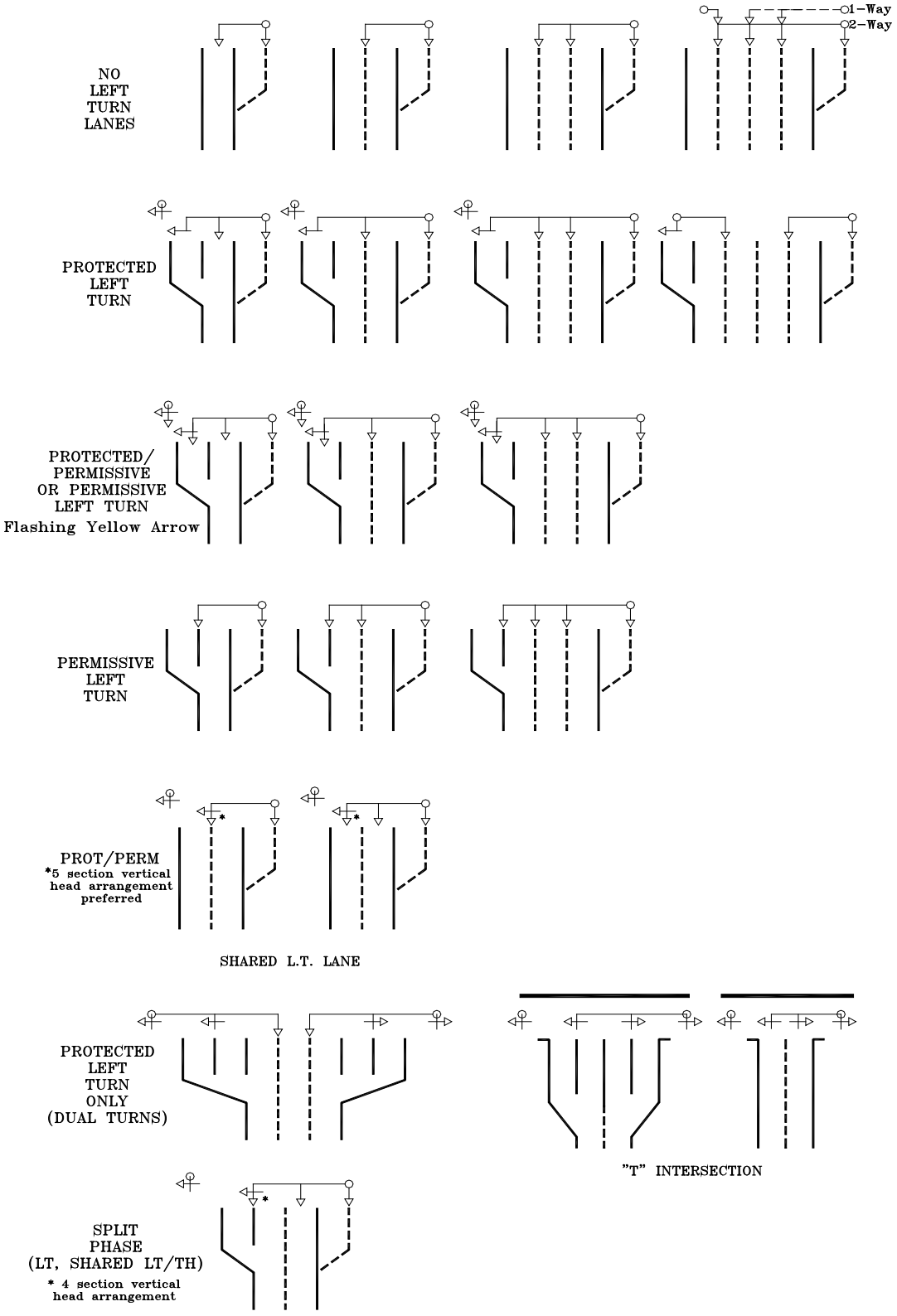
C. If the number of overhead signal faces for through traffic is equal to the number of through lanes on an approach, one overhead signal face should be located approximately over the center of each through lane.

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



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:

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):**

[Note: Items A-E are not modified by this ATMS and are omitted for brevity.]

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.**

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):**

[Note: Items A-B and D-J are not modified by this ATMS and are omitted for brevity.]

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.

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.**

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 the 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.*

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.**

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