

**As approved by the
National Committee
June 30, 2006.**

TECHNICAL COMMITTEE RECOMMENDATION

TECHNICAL COMMITTEE: Signals Technical Committee

DATE OF ACTION: January 19, 2006

TOPIC: **Proposed new Section 4D.06A Application of Flashing Signal Indications for Left Turns**

ORIGIN OF REQUEST: Signals Technical Committee

DISCUSSION: Protected/permissive (P/P) left turn traffic controls increase the left turn capacity and reduce delay at intersections by providing an exclusive turn phase for left turns as well as a phase during which left turns can be made as gaps in opposing traffic permit. The protected left turn can either precede (lead) or follow (lag) the opposing through signal phase. P/P left turn traffic controls have been implemented in a variety of ways, because the MUTCD initially provided limited guidance. At least six displays to indicate the permissive phase are known to exist (i.e., straight five-section head, five-section "doghouse" head, flashing circular red, flashing circular yellow, flashing red arrow, flashing yellow arrow). Variations also exist in the phasing, signal displays, arrangement, signal placement, and use of supplemental signs. There have been concerns that some of these variations may confuse motorists, and validation of their relative operational and safety advantages is needed.

A major concern with the use of P/P left turn traffic control is the "yellow trap" which occurs during the change from permitted left turns in both directions to a lagging protected left turn in one direction. The left turning driver whose permitted interval is ending may try to proceed through the intersection on the yellow indication, not realizing that the opposing through traffic still has a green indication. To avoid the yellow trap, many agencies do not use leading/lagging P/P left turns. An operation typically referred to as "Dallas phasing" allows this operation without the yellow trap by operating the permissive left turns simultaneously with the opposing through movement. Research has shown that this operation reduces delay and improves safety, but it is not easily implemented in all situations.

NCHRP Projects 3-54 and 3-54(2) reviewed and evaluated traffic signal displays for protected/permmissive left turn control. NCHRP Report 493, Evaluation of Traffic Signal Displays for Protected/Permissive Left-Turn Control, recommends that a flashing yellow arrow display be included in the MUTCD as an allowable alternative display to the circular green indication when used in P/P left turn control operation.

The Traffic Control Signal Features Task Force as well as the Signals Technical Committee had extensive discussions concerning alternatives for the implementation of flashing yellow arrow displays. Following thorough deliberations, the Signal Technical Committee approved a recommendation for a new Section 4D.06A Application of Flashing Signal Indications for Left Turns with the following major points:

- Permits the use of a flashing yellow arrow display to indicate a permmissive left turn movement
- Continues to permit all existing left turn displays described in Section 4D.06 of the MUTCD
- Prohibits mixing left turn operation features from both Section 4D.06 and Section 4D.06A for a given intersection approach. However, the type display for permmissive left turn operation for each intersection approach may be determined independently. That is, flashing yellow arrows may be used on some approaches while circular greens may be used on other approaches.
- ~~Requires that the flashing yellow arrow and the steady yellow arrow not be displayed in the same signal section in a signal face.~~
- ~~Prohibits the use of dual arrow sections in left turn signal faces that display a flashing yellow arrow.~~
- Permits the use of dual-arrow sections to display both the steady green arrow indication and the flashing yellow arrow indication.
- Requires the use of signal heads with specified indications when using flashing yellow arrows.

The Signals Technical Committee recommends that the National Committee submit the following proposed MUTCD changes to sponsors for comments.

COMMITTEE ACTION :

See following pages for proposed text. All the text for Section 4D.06A is new so no underline or strikethrough is used.

VOTE:

For	- 25
Opposed	- 0
Abstentions	- 0

REFERENCE TO AFFECTED

PAGE NUMBERS IN MUTCD: Not in 2003 Edition of MUTCD, Rev. 1. Proposed for addition on Page 4D-7 immediately following Section 4D.06.

Note: Since the FHWA Interim Approval permits the use of a dual arrow section, the STC proposed and the National Committee approved changes to this recommendation to permit the use of a dual arrow (steady green/flashing yellow) section. The red strikethrough and blue underline in the preceding original recommendation document reflects the impact of that change.

Notes: All of the following Section 4D.06A is proposed new text.

Section 4D.06A Application of Flashing Signal Indications for Left Turns

Support:

This Section describes the optional use of a flashing left-turn YELLOW ARROW signal indication (instead of a steady CIRCULAR GREEN signal indication) during steady mode (stop-and-go) operation to control permissive left-turning movements from an intersection approach. There are no provisions in this Section or any other Section that requires that a flashing left-turn YELLOW ARROW signal indication be used instead of a steady CIRCULAR GREEN signal indication to control permissive left-turning movements from an intersection approach. The selection of the flashing left-turn YELLOW ARROW signal indication alternative is a matter of engineering judgment.

Standard:

When this Section is applied to an intersection approach, it shall supersede all provisions contained in Section 4D.06. In no case shall the provisions of Section 4D.06 and the provisions of this Section be used in conjunction with each other for the same intersection approach. However, the use of the provisions of this Section for one or more approaches to a signalized intersection and the use of the provisions of Section 4D.06 for the other approaches to the same signalized intersection shall be permitted.

Support:

This Section sets forth Standards for the display of four types of messages to drivers intending to turn left from a signalized intersection approach:

- A. A message to stop, which is accomplished by displaying either:
 - 1. A steady left-turn RED ARROW signal indication that requires a driver to stop and await authorization to proceed; or
 - 2. A steady CIRCULAR RED signal indication that requires a driver to stop and await authorization to proceed under the rules as set forth in the applicable Motor Vehicle Code.
- B. A message to turn left in a protected manner, which is accomplished by displaying a steady left-turn GREEN ARROW signal indication.
- C. A message to turn left in a permissive manner, which is accomplished by displaying a flashing left-turn YELLOW ARROW signal indication.

D. A message that the status of the left-turn operation is changing, which is accomplished by displaying a steady left-turn YELLOW ARROW signal indication when the left-turn status is changing from:

1. Protected to permissive;
2. Permissive to stopped; or
3. Protected to stopped.

It is not necessary to display a change interval when the status of the left-turn operation is changing from permissive to protected.

Left-turning traffic is controlled by one of three modes as follows:

- A. Permissive Only Mode—turns made on the flashing left-turn YELLOW ARROW signal indication after yielding to oncoming traffic and pedestrians;
- B. Protected Only Mode—turns made only when the steady left-turn GREEN ARROW signal indication is displayed; or
- C. Protected/Permissive Mode—both modes occur on an approach during the same cycle.

It is not necessary that the left-turn mode for an approach always be the same throughout the day. Varying the left-turn mode on an approach among the permissive only and/or the protected/permissive and/or the protected only left-turn modes during different periods of the day is acceptable.

Standard:

The required left-turn signal faces and operation for an approach shall be determined by the selected mode of left-turn operation, as follows:

- A. Permissive Only Mode—If the permissive only mode is the only left-turn mode used for an approach, the signal indications shall be provided by a separate three-section signal face that shall be capable of displaying, from top to bottom or left to right, one of the following sets of signal indications:**

Steady left-turn RED ARROW, steady left-turn YELLOW ARROW, and flashing left-turn YELLOW ARROW signal indications, or

Steady CIRCULAR RED, steady left-turn YELLOW ARROW, and flashing left-turn YELLOW ARROW signal indications.

The separate three-section signal face shall meet the following requirements:

1. During the permissive left-turn movement, the left-turn signal face shall display a flashing left-turn **YELLOW ARROW** signal indication.
2. If the left-turn signal face sometimes displays a steady **CIRCULAR RED** signal indication at a time when the signal faces for the adjacent through movement are not displaying steady **CIRCULAR RED** signal indications, the **CIRCULAR RED** signal indication in the left-turn signal face shall be shielded, hooded, louvered, positioned, or designed such that it is not readily visible to drivers in the through lane(s) or a **LEFT TURN SIGNAL** sign (R10-10) or a **LEFT TURN SIGNAL—YIELD ON FLASHING YELLOW** (symbolic yellow arrow) (R10-XX) sign (see Figure 2B-19) shall be used.

If the permissive only mode is not the only left-turn mode used for an approach, the left-turn signal face shall be the same signal face that is used for the protected/permissive mode in Paragraph B of this Standard except that the steady left-turn **GREEN ARROW** signal indication shall not be displayed when operating in the permissive only mode.

- B. Protected/Permissive Mode—**The signal indications for protected/permissive mode left turns shall be provided by a separate left-turn signal face that shall be capable of displaying, from top to bottom or left to right, one of the following sets of signal indications:

Steady left-turn **RED ARROW**, steady left-turn **YELLOW ARROW**, flashing left-turn **YELLOW ARROW**, and steady left-turn **GREEN ARROW** signal indications, or

Steady **CIRCULAR RED**, steady left-turn **YELLOW ARROW**, flashing left-turn **YELLOW ARROW**, and steady left-turn **GREEN ARROW** signal indications.

The display shall be a four-section signal face except that a three-section signal face containing a dual-arrow signal section shall be permitted where signal head height limitations will not permit the use of a four-section signal face. The dual-arrow signal section, where used, shall display a steady **GREEN ARROW** for the protected left-turn movement and a flashing **YELLOW ARROW** for the permissive left-turn movement.

The separate left-turn signal face shall meet the following requirements:

1. During the protected left-turn movement, the left-turn signal face shall display a steady left-turn **GREEN ARROW** signal indication.

During the protected left-turn movement, the signal faces for through traffic on the opposing approach shall simultaneously display CIRCULAR RED signal indications. If pedestrians crossing the lane or lanes used by the protected left-turn movement to depart the intersection are controlled by pedestrian signal heads, the pedestrian signal heads shall display a steady UPRAISED HAND (symbolizing DONT WALK) signal indication during the protected left-turn movement.

2. During the permissive left-turn movement, the left-turn signal face shall display a flashing left-turn YELLOW ARROW signal indication.

During the permissive left-turn movement, the signal faces for through traffic on the opposing approach shall simultaneously display green or yellow signal indications. If pedestrians crossing the lane or lanes used by the permissive left-turn movement to depart the intersection are controlled by pedestrian signal heads, the signal indications displayed by those pedestrian signal heads shall not be limited to any particular display.

3. If the left-turn signal face sometimes displays a steady CIRCULAR RED signal indication at a time when the signal faces for the adjacent through movement are not displaying steady CIRCULAR RED signal indications, the CIRCULAR RED signal indication for the left-turn signal face shall be shielded, hooded, louvered, positioned, or designed such that it is not readily visible to drivers in the through lane(s) or a LEFT TURN SIGNAL sign (R10-10) or a LEFT TURN SIGNAL—YIELD ON FLASHING YELLOW (symbolic yellow arrow) (R10-XX) sign (see Figure 2B-19) shall be used.

- C. Protected Only Mode—If the protected only mode is the only left-turn mode used for an approach, the provisions of Section 4D.06 shall be used. If the protected only left-turn mode is used during some periods of the day and the permissive only and/or the protected/permissive left-turn modes are also used on the same approach during other periods of the day, the left-turn signal face shall be the same signal face that is used for the protected/permissive mode in Paragraph B of this Standard except that the flashing left-turn YELLOW ARROW signal indication shall not be displayed when operating in the protected only mode.

The separate left-turn signal face shall meet the following requirements:

1. During the protected left-turn movement, the left-turn signal face shall display only a steady left-turn GREEN ARROW signal indication.

During the protected left-turn movement, the signal faces for through traffic on the opposing approach shall simultaneously display

CIRCULAR RED signal indications. If pedestrians crossing the lane or lanes used by the protected left-turn movement to depart the intersection are controlled by pedestrian signal heads, the pedestrian signal heads shall display a steady UPRAISED HAND (symbolizing DONT WALK) signal indication during the protected left-turn movement.

- 2. If the left-turn signal face with a left-turn RED ARROW signal indication is used, a signal instruction sign shall not be required.**
- 3. If the left-turn signal face with a CIRCULAR RED signal indication is 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), a LEFT TURN SIGNAL sign (R10-10) (see Figure 2B-19) shall be used.**

If the left-turn operating mode varies on an approach among the protected only mode, the permissive only mode, and/or the protected/permissive mode during various periods of the day, the requirements of Paragraphs A, B, and C in this Standard that are appropriate to that mode of operation shall be met.

Option:

Additional static signs or changeable message signs may be used to inform drivers that left-turn green arrows will not be available during certain times of the day.

Standard:

The Standards in the following six paragraphs shall apply when the left-turn signal faces are provided for an approach based on the provisions of Section 4D.06A.

A steady left-turn YELLOW ARROW signal indication shall be displayed following every steady left-turn GREEN ARROW signal indication.

A steady left-turn YELLOW ARROW signal indication shall be displayed following the flashing left-turn YELLOW ARROW signal indication if the permissive left-turn movement is being terminated and the left-turn signal face will subsequently display a steady red signal indication.

When a permissive left-turn movement is changing to a protected left-turn movement, a steady left-turn GREEN ARROW signal indication shall be displayed immediately upon termination of the flashing left-turn YELLOW ARROW signal indication. A steady left-turn YELLOW ARROW signal indication shall not be displayed between the display of the flashing left-turn YELLOW ARROW signal indication and the display of the steady left-turn GREEN ARROW signal indication.

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.

During flashing mode operation (see Section 4D.12), 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.

If an exclusive left-turn lane is present on the approach and if a left-turn signal face is mounted over the roadway, the left-turn signal face shall not be positioned any further to the right than the lane line (or the extension of the lane line) between the left-turn lane and the adjacent through lane nor any further to the left than the left edge of the left turn lane or lanes. Supplemental left-turn signal faces mounted over the roadway shall not be subject to these positioning requirements.

Following are items in existing sections of Part 4 that have been identified as needing modification in conjunction with the incorporation of the new Section 4D.06A Application of Flashing Signal Indications for Left Turns. These were approved by the National Committee in conjunction with the approval of new Section 4D.06A above.

New text is shown in blue underline. Deleted text is shown as ~~red double strikethrough~~.

Section 4A.02 Definitions Relating to Highway Traffic Signals

Permissive Mode—a mode of traffic control signal operation in which, ~~when a CIRCULAR GREEN signal indication is displayed,~~ left or right turns are permitted to be made after yielding to pedestrians and/or oncoming traffic. When a CIRCULAR GREEN signal indication is displayed, both left and right turns are permitted unless otherwise prohibited by another traffic control device. When a flashing YELLOW ARROW signal indication is displayed, the turn indicated by the arrow is permitted.

Section 4D.05 Application of Steady Signal Indications

Standard:

When a traffic control signal is being operated in a steady (stop-and-go) mode, at least one lens in each signal face shall be illuminated at any given time.

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.

Steady signal indications shall be applied as follows:

A. A steady CIRCULAR RED signal indication:

1. Shall be displayed when it is intended to prohibit traffic, except pedestrians directed by a pedestrian signal head, from entering the intersection or other controlled area. Turning after stopping is permitted as stated in Item C.1 of Section 4D.04.
2. Shall be displayed with the appropriate GREEN ARROW signal indications when it is intended to permit traffic to make a specified turn or turns, and to prohibit traffic from proceeding straight ahead through the intersection or other controlled area, except in protected only mode turn signal faces, or in protected/permissive mode left-turn operation with separate left-turn signal faces (see Section 4D.06 or 4D.06A).

B. A steady CIRCULAR YELLOW signal indication:

1. Shall be displayed following a CIRCULAR GREEN or straight-through GREEN ARROW signal indication in the same signal face.
 2. Shall not be displayed in conjunction with the change from the CIRCULAR RED signal indication to the CIRCULAR GREEN signal indication.
 3. Shall be followed by a CIRCULAR RED signal indication except that, when entering preemption operation, the return to the previous CIRCULAR GREEN signal indication shall be permitted following a CIRCULAR YELLOW signal indication (see Section 4D.13).
 4. Shall not be displayed to an approach from which drivers are turning left permissively unless one of the following conditions exists:
 - (a) A steady CIRCULAR YELLOW signal indication is also being shown simultaneously to the opposing approach;
 - (b) A separate left-turn signal face is provided and operated as described in Section 4D.06;
 - (c) An engineering study has determined that, because of unique intersection conditions, the conditions described in Items (a) and (b) above cannot reasonably be implemented without causing significant operational or safety problems and that the volume of impacted left-turning traffic is relatively low, and those left-turning drivers are advised that the opposing traffic is not simultaneous being shown a CIRCULAR YELLOW signal indication if this operation occurs continuously by the installation near the left-most signal head of a W25-1 sign (see Section 2C.39) with the legend ONCOMING TRAFFIC HAS EXTENDED GREEN; or
 - (d) Drivers are advised of the operation if it occurs only occasionally, such as during a preemption sequence, or because of the skipping of actuated phases, by the installation near the left-most signal head of a W25-2 sign (see Section 2C.39) with the legend ONCOMING TRAFFIC MAY HAVE EXTENDED GREEN.
- C. A steady CIRCULAR GREEN signal indication shall be displayed only when it is intended to permit traffic to proceed in any direction that is lawful and practical.
- D. A steady RED ARROW signal indication shall be displayed when it is intended to prohibit traffic, except pedestrians directed by a pedestrian signal head, from entering the intersection or other controlled area to

make the indicated turn. Except as described in Item C.2 of Section 4D.04, turning on a steady RED ARROW signal indication shall not be permitted.

E. A steady YELLOW ARROW signal indication:

1. Shall be displayed in the same direction as a GREEN ARROW signal indication following a GREEN ARROW signal indication in the same signal face, unless:
 - (a) The GREEN ARROW signal indication and a CIRCULAR GREEN (or straight-through GREEN ARROW) signal indication terminate simultaneously in the same signal face, or
 - (b) The green arrow is a straight-through GREEN ARROW.
2. Shall not be displayed in conjunction with the change from a RED ARROW signal indication to a GREEN ARROW signal indication.
3. Shall not be displayed when any conflicting vehicular movement has a green or yellow signal indication or any conflicting pedestrian movement has a WALKING PERSON (symbolizing WALK) or flashing UPRAISED HAND (symbolizing DONT WALK) signal indication (see Section 4D.09) except that, in a separate signal face controlling a permissive left-turn movement as described in Section 4D.06A, a steady left-turn YELLOW ARROW signal indication used to terminate a flashing left-turn YELLOW ARROW signal indication shall be permitted to be displayed when a CIRCULAR YELLOW signal indication is displayed for the opposing through movement.
4. Shall be terminated by a RED ARROW signal indication for the same direction or a CIRCULAR RED signal indication except:
 - (a) When entering preemption operation, the return to the previous GREEN ARROW signal indication shall be permitted following a YELLOW ARROW signal indication.
 - (b) When the movement controlled by the arrow is to continue on a permissive mode basis during an immediately following CIRCULAR GREEN or flashing YELLOW ARROW signal indication.

Section 4D.15 Size, Number, and Location of Signal Faces by Approach

Support:

Sections 4D.05, and 4D.16 through 4D.18 contain additional information regarding the design of signal faces.

Standard:

There shall be two nominal diameter sizes for vehicular signal lenses: 200 mm (8 in) and 300 mm (12 in).

Three-hundred millimeter (12 in) signal lenses shall be used:

- A. For signal indications for approaches (see definition in Section 4A.02) where road users view both traffic control and lane-use control signal heads simultaneously;**
- B. If the nearest signal face is between 35 m (120 ft) and 45 m (150 ft) beyond the stop line, unless a supplemental near-side signal face is provided;**
- C. For signal faces located more than 45 m (150 ft) from the stop line;**
- D. For approaches to all signalized locations for which the minimum sight distance in Table 4D-1 cannot be met; and**
- E. For arrow signal indications.**

A 200 mm (8 in) signal lens for a CIRCULAR RED signal indication shall not be used in combination with 300 mm (12 in) signal lens for a CIRCULAR GREEN signal indication or 300 mm (12 in) signal lens for a CIRCULAR YELLOW signal indication.

Option:

Different sizes of signal lenses may be used in the same signal face or signal head, except for the prohibitions listed in the Standards in this Section.

Guidance:

Three-hundred millimeter (12 in) signal lenses should be used for all signal indications for the following:

- A. Approaches with 85th-percentile approach speeds exceeding 60 km/h (40 mph);
- B. Approaches where a traffic control signal might be unexpected;
- C. All approaches without curbs and gutters where only post-mounted signal heads are used; and
- D. Locations where there is a significant percentage of elderly drivers.

Standard:

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

- A. A minimum of two signal faces shall be provided for the major movement on the approach, even if the major movement is a turning movement.**
- B. See Section 4D.06 [or 4D.06A](#) for left-turn signal faces.**
- C. See Section 4D.07 for right-turn signal faces.**
- D. Except where the width of an intersecting roadway or other conditions make it physically impractical:**
 - 1. A signal face installed to satisfy the requirements for left-turn signal faces (see Section 4D.06 [or 4D.06A](#)) and right-turn signal faces (see Section 4D.07), and at least one and preferably both of the two signal faces required for the major movement on the approach shall be located:**
 - (a) Not less than 12 m (40 ft) beyond the stop line.**
 - (b) Not more than 55 m (180 ft) beyond the stop line unless a supplemental near side signal face is provided.**
 - (c) As near as practical to the line of the driver's normal view, if mounted over the roadway.**
 - 2. Where the nearest signal face is located between 45 and 55 m (150 and 180 ft) beyond the stop line, engineering judgment of the conditions, including the worst-case visibility conditions, shall be used to determine if the provision of a supplemental near side signal face would be beneficial.**
 - 3. A signal face installed to satisfy the requirements or left-turn signal faces (see Section 4D.06 [or 4D.06A](#)) and right-turn signal faces (see Section 4D.07), and at least one and preferably both of the two signal faces required for the major movement on the approach shall be located no higher than at a maximum height to the top of the signal housing mounted over a roadway of 7.8 m (25.6 ft) above the pavement (see Section 4D.17). For viewing distances between 12 m (40 ft) and 16 m (53 ft) from the stop line, the maximum mounting height to the top of the signal housing shall be as shown on Figure 4D-1. (See Section 4D.17 for additional information regarding mounting heights.)**