Baystate Roads Program
Local Technical Assistance Program (LTAP)
TECHnotes

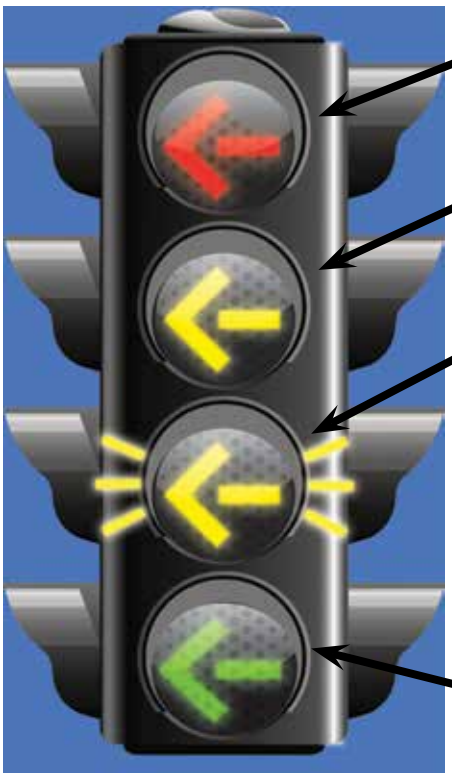
FLASHING LEFT-TURN YELLOW ARROW SIGNAL #64

Introduction to the Flashing Left Turn Yellow Arrow for Protected/Permissive left turns

For many years, engineers have had concerns that drivers turning left on a permissive circular green signal indication might inadvertently mistake that indication as implying the left turn has the right of way over opposing traffic, especially under certain geometric conditions. Although road authorities tried a variety of different indications and signal face arrangements to address these concerns, no comprehensive research was conducted to evaluate all potential displays until the mid 1990s.

Research on the Flashing Yellow Arrow

National Cooperative Highway Research Program (NCHRP) Project 3-54, Evaluation of Traffic Signal Displays for Protected/Permissive Left-Turn Control, was initiated in the mid-1990s for the purpose of conducting the necessary definitive research to evaluate the wide variety of potential displays for permissive left-turn movements. Over a 7-year period, a comprehensive research process which included engineering analyses, static and video-based driver comprehension studies, field implementation, video conflict studies, and crash analyses was conducted. In 2003, the completed research was published as NCHRP Report 493. *The full report may be accessed via the Interim Approvals page of the MUTCD website at http://mutcd.fhwa.dot.gov.*



STEADY RED ARROW
Drivers wishing to turn left must stop and wait at the stop line.

STEADY YELLOW ARROW
Drivers should not enter the intersection if they can stop safely.

FLASHING YELLOW ARROW
Because oncoming traffic still has a green light, drivers are allowed to turn after pulling into the intersection and yielding to oncoming traffic as well as crossing pedestrians. Drivers must determine when the flow of oncoming traffic makes it safe to turn.

STEADY GREEN ARROW
Drivers have clearance to make a protected left turn as oncoming traffic has a red light.

Key findings of the research include:

The Flashing Yellow Arrow (FYA) was found to be the best overall alternative to the circular green as the permissive signal display for a left-turn movement.

FYA was found to have a high level of understanding and correct response by left-turn drivers, and a lower fail-critical rate than the circular green.

The FYA display in a separate signal face for the left-turn movement offers more versatility in field application. It is capable of being operated in any of the various modes of left-turn operation by time of day and is easily programmed to avoid the "yellow trap" associated with some permissive turns at the end of the circular green display.

NCHRP Report 493 recommends that the FYA be allowed as an alternative to the circular green for permissive left-turn intervals. It also recommends certain specific signal face arrangements and locations, based on driver understanding and performance.

From MUTCD – Interim Approval for Optional Use of Flashing Yellow Arrow for Permissive Left Turns (IA-10) March 20 , 2006.

MUTCD requirements when using a flashing left-turn yellow arrow in a protected/permissive left-turn mode

The following text is from Sect. 4D.20, December 2009. MUTCD 2009 Edition

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):

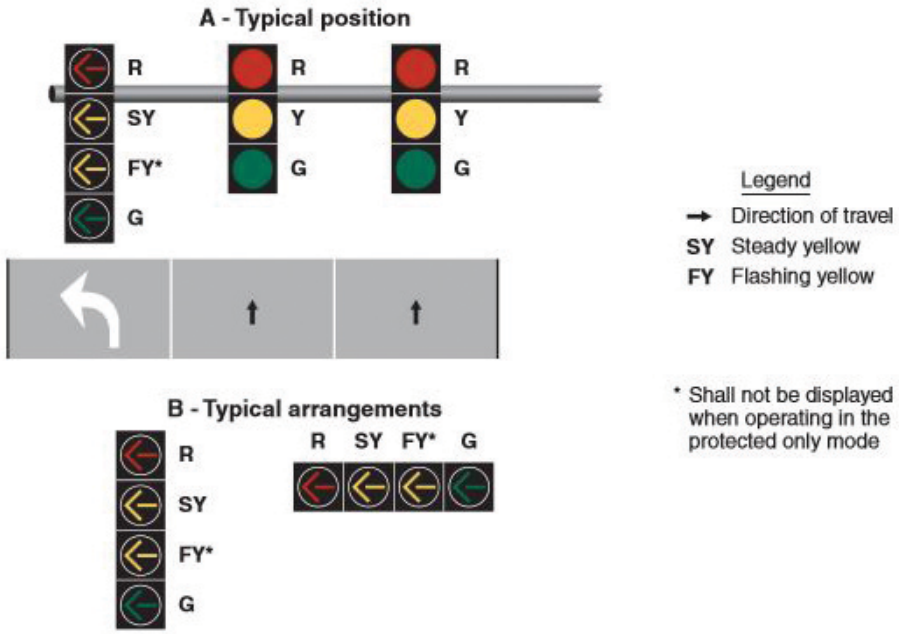


Figure 4D-12. Typical Position and Arrangements of Separate Signal Faces with Flashing Yellow Arrow for Protected/Permissive Mode and Protected Only Mode Left Turns

A. It shall be capable of displaying the following signal indications: steady left-turn RED ARROW, steady left-turn YELLOW ARROW, flashing left-turn YELLOW ARROW, and left-turn GREEN ARROW. Only one of the four 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 YELLOW ARROW signal indication shall be displayed.

E. 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 separate left-turn signal face will subsequently display a steady left-turn RED ARROW indication.

F. 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.

G. 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 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. (Figure 4D-11.)

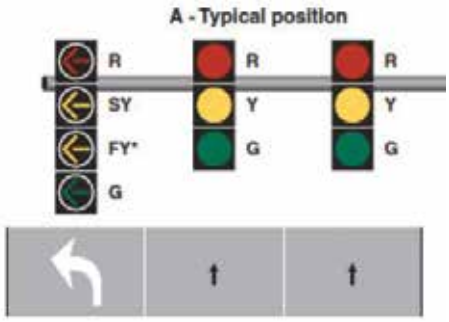
H. The display shall be a four-section signal face except that a three-section signal face containing a dual-arrow signal section shall be permitted where signal head height limitations (or lateral positioning limitations for a horizontally-mounted signal face) will not permit the use of a four-section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

I. During steady mode (stop-and-go) operation, the signal section that displays the steady left-turn

Please see MUTCD on page 8

MassDOT to implement Flashing Yellow Arrow

MassDOT plans to upgrade all State Highway intersections that have Protected/Permissive Left Turn (PPLT) phasing and a seperate left turn lane, to incorporate Flashing Yellow Arrow (FYA). This will be accomplished using a systematic approach where signals will be changed out in a short period of time rather than gradually across the Commonwealth.



FYA indication centered in travel lane above left-turn lane. *MUTCD 2009 Edition Figure 4D-12.*

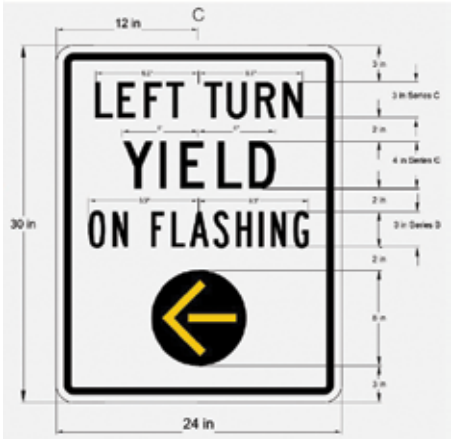
The benefits to this upgrade include:

- A 2 to 3 year time frame for implementation rather than 15-20 years via betterments.
- The method will allow the use of Highway Safety Improvement Program (HSIP) funds.
- It will provide a consistent message throughout the MassDOT system.
- Public outreach will be easier.
- It will encourage municipalities to adopt the FYA sooner.
- Safety should immediately improve across the Commonwealth.

MUTCD Experiment

The new R10-12a sign is based on the existing R10-12. The sign is being designed in-house and manufactured by the MassDOT sign shop. This sign required that MassDOT follow the MUTCD experimentation process.

There are two components of proposed R10-12a sign that do not match existing standards:



The R10-12a sign is based on R10-12.

- The Graphical symbol for Yellow Left Arrow is not used elsewhere in Part 2 of the MUTCD.
- The "ON FLASHING" text uses Series B instead of Series C font.

Approval to experiment was received from FHWA on March 28, 2013. Municipalities cannot use this sign unless they make a formal experiment request with the FHWA. *Experiment Number: 2(09) 72 (E), Left Turn Yield to FYA, MassDOT.*

FYA Deployment

The first step will be to identify locations for immediate upgrade. These will be intersections that only need signal heads, a controller, a malfunction management unit (MMU), and/or minor wiring upgrades. Projects will be advertised in 2014 using HSIP funds. The next step will be to identify locations that need major upgrades, such as new signal structures, conduit installations, a new controller and/or a new cabinet. These projects will be advertised in 2015 using HSIP funds or by incorporating the work into other projects.

Local Impacts

MassDOT is responsible for 2,381 centerline miles of arterial and collector roadways, and approximately 1,400 traffic signals. Municipalities and other agencies are responsible for 8,954 centerline miles of roadway and an unknown number of traffic signals. MassDOT

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MassDOT's 1st Installation

Lenox: Pittsfield Road (U.S. 7 & 20) at Holmes Rd.
62 reported crashes since 2002.
Reports indicate 37% of crashes were caused by vehicles turning left and failing to yield to oncoming traffic. Installation of the FYA was completed on January 15, 2013. Since then there have been 0 reported crashes.

MUTCD

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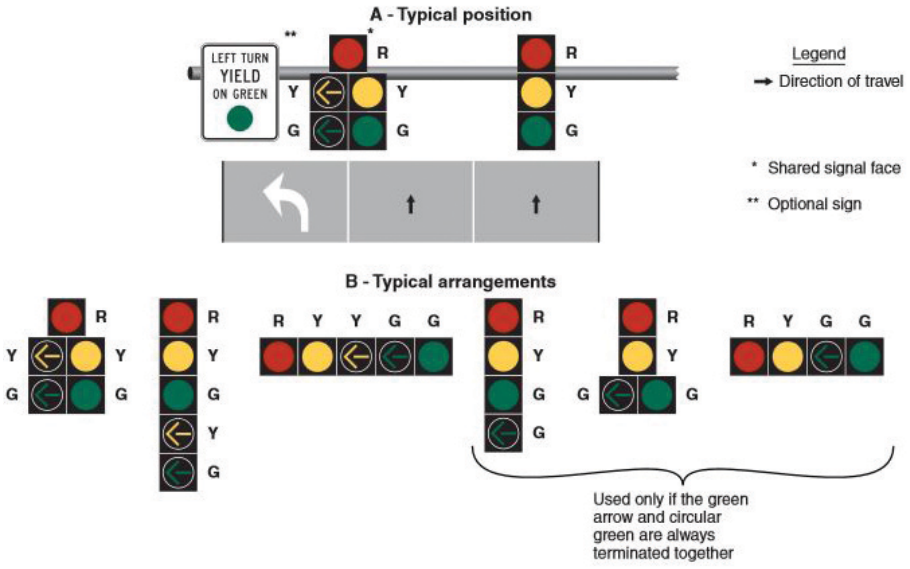
YELLOW ARROW signal indication during change intervals shall not be used to display the flashing left-turn YELLOW ARROW signal indication for permissive left turns.

J. During flashing mode operation, 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.

Figure 4D-11. Typical Position and Arrangements of Shared Signal Faces for Protected/Permissive Mode Left Turns



MassDOT

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will use the Baystate Roads Program and other organizations to inform municipalities of the new FYA requirements, and encourage installation of FYA signals at non-MassDOT owned intersections throughout the state.

Revisions to the MassDOT Qualified Products List for Signal Control Equipment will also be addressed. In addition, MassDOT reviewers will recommend FYA for all PPLT's on municipal jobs with 2014 and beyond construction dates. The objective will be to build all signals with enough spare conductors and strong enough mast arms so that all PPLT signals can be converted to FYA in the future.

Article compiled from MassDOT's Approach to Flashing Yellow Arrow Implementation, Jim Danila, P.E., PTOE, james.danila@state.ma.us (857) 368-9640. Originally presented at the ITE Northeastern District Annual Meeting May 23, 2013.

References

The Manual on Uniform Traffic Control Devices(MUTCD)
Published by the FHWA, the MUTCD defines the standards used by transportation professionals nationwide to install and maintain traffic control devices on all streets and highways. The most recent version (2009) can be found at **http://mutcd.fhwa.dot.gov/index.htm**

Approach to Flashing Yellow Arrow Implementation
Jim Danila, P.E., PTOE, james.danila@state.ma.us (857) 368-9640. Originally presented at the ITE Northeastern District Annual Meeting May 23, 2013.

The Baystate Roads Program *is a cooperative effort of the Federal Highway Administration, Massachusetts Department of Transportation (MassDOT), and the University of Massachusetts. Program Director, Dr. John Collura, and Program Manager, Dr. Christopher J. Ahmadjian, provide technology transfer assistance to all communities in the Commonwealth. Our purpose is to provide information and training on transportation and related topics, to answer the needs and problems of local agencies, to identify and transfer new technologies and innovations into a usable format, and to operate as a link between transportation research and practicing highway personnel.* ***www.baystateroads.org.***