

ATTACHMENT NO. 27

Bicycle No. 1



## National Committee on Uniform Traffic Control Devices

12615 West Keystone Drive \* Sun City West, AZ, 85375  
Telephone (623)680-9592 \* e-mail: ncutcd@aol.com

NOTE: This is a recommendation by NCUTCD to FHWA to add or revise the content of the MUTCD. This proposal by itself does not constitute official standards or guidance. Regardless of NCUTCD approval status, any proposed change or revision has no legal or official status until specifically approved by FHWA through either the Interim Approval process or adoption into a new edition of the MUTCD.

**TECHNICAL COMMITTEE:** Bicycle Technical Committee

**TOPIC:** Bicycle Box

**STATUS/DATE OF ACTION:**

**BTC Drafts:** 01/10/2013

**BTC Approval:** 06/27/2013 (vote: 14-3-0)

**MTC Concurrence:** 01/09/2014

**Transmitted to Sponsors:** 03/25/2014

**TC Revision:** 06/27/2014

**Council Approval:** **06/28/2014 (v.1.8)**

**ORIGIN OF REQUEST:** NCUTCD Bicycle Technical Committee

**AFFECTED SECTIONS OF MUTCD:** 1A.13, 3B.16, Chapter 9C

**SUMMARY:**

Similar to a recessed or advanced stop line, a bicycle box creates a reserved space in front of one or more travel lanes, but outside of pedestrian crosswalks, for bicyclists to wait for a green signal ahead of queuing motorists. The bicycle box can improve bicyclist visibility, provides a head start ahead of motorized traffic to reduce conflicts with vehicular turning movements, and reduce conflicts with pedestrians.

**DISCUSSION:**

1 In May 2009, a scan team of 12 transportation professionals with expertise in bicycle  
2 and pedestrian issues from the United States (U.S.) visited five countries in Europe to  
3 identify and assess effective approaches to improve pedestrian and bicyclist safety and  
4 mobility. The trip was part of the International Technology Scanning Program sponsored  
5 by the American Association of State Highway Transportation Officials (AASHTO),  
6 National Cooperative Highway Research Program (NCHRP), and FHWA. The scan  
7 team observed several approaches and design practices that could be used to improve  
8 bicyclist safety in the U.S. at intersections, including the use of recessed stop lines for  
9 motorists (advanced stop lines for bicyclists) and bicycle boxes. The scan team  
10 encouraged further investigation and implementation of bicycle specific infrastructure  
11 observed to improve bicyclist safety in the United States. Bicycle boxes have been in  
12 use for over 20 years in Northern Europe, and recently have been adopted for use in  
13 Australia, New Zealand, and Canada.

14

15 **Bicycle Box in Portland with Green Color**



16

17

18 **Bicycle Box in Portland with No Color**



19

20

21 **Background:** The Bicycle Technical Committee proposes to define a traffic control  
22 device to add to the MUTCD – the bicycle box. This is a combination of existing traffic  
23 control devices -a stop line for bicyclists offset a distance upstream of the crosswalk or  
24 intersection, a separate recessed stop line for motorists located behind the bicycle box,  
25 regulatory signs, standard word and/or symbol markings, and (optionally) colored

1 pavement. The bicycle box creates a reserved space in front of one or more lanes of  
2 queuing traffic to allow bicyclists to wait for a green signal at signalized intersections  
3 displaying a red signal. While these individual traffic control devices are currently in the  
4 Manual, it is recommended that the combination of features be incorporated into the  
5 MUTCD to provide the necessary guidance to practitioners to implement the device in a  
6 uniform manner around the country.

7  
8 The bicycle box improves the visibility of bicyclists to motorists waiting behind them,  
9 provides a built in “head start” for bicyclists to reduce turning conflicts between bicyclists  
10 and other traffic at the onset of a green signal indication, reduces speed differentials  
11 between motorists and bicyclists within the intersection, reduces encroachments into  
12 pedestrian crosswalks by both motorists and bicyclists, and in some locations, creates a  
13 space for transitioning to different sides of the roadway or for left turns.

14  
15 The bicycle box is similar to an offset stop line, which is already permissible per Part 3  
16 of the MUTCD. However, neither Part 3 nor Part 9 mentions the use of an advance stop  
17 line to create an advance queuing area for bicyclists at signalized intersections.

18  
19 **Research on Bicycle Boxes:** Bicycle boxes are currently in use in over twenty  
20 municipalities throughout the United States. Ten cities have completed or are currently  
21 in the process of conducting FHWA-approved experiments on bicycle boxes. Bicycle  
22 boxes are being used successfully in several countries. Numerous research studies  
23 within the United States have consistently observed:

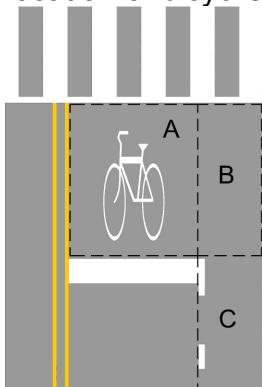
- 24 • 40-70% of arriving bicyclists filter forward in traffic queues to wait in front of  
25 stopped vehicles at traffic signals, often stopping within or beyond crosswalks at  
26 locations without bicycle boxes.
- 27 • A significant majority of bicyclists use bicycle boxes to get a head start on  
28 motorized traffic to go straight versus to turn left at the onset of green.
- 29 • The default stopping position of bicyclists is within the portion of the bike lane  
30 extended into the bicycle box, not in front of stopped motorists, unless other  
31 bicyclists are present within the extended bicycle lane at which point bicyclists  
32 may shift in front of the stopped motorists or they may wait behind the stopped  
33 bicyclist.

34  
35 The most robust research on bicycle boxes in the United States was recently completed  
36 in Portland, OR (Dill) with before/after evaluation of bicycle and motorists behaviors at  
37 12 signalized locations.

- 38 • 2 control intersections
- 39 • 7 locations with green bicycle boxes
- 40 • 3 locations with no color in bicycle boxes

41  
42 Observations were collected with video to allow a more nuanced understanding of  
43 bicyclists and motorists behaviors and conflicts than a crash assessment could provide  
44 (as crashes between motorists and bicyclists are generally infrequent). The following  
45 summarizes results from the research. Over 239 hours of video was analyzed allowing  
46 over 12,000 observations of bicyclists.

1 The following graphic was used by the Portland researchers to code the stopping  
 2 location of bicyclists within the bike box, bike lane, or crosswalk.



3 Pre-Bicycle Box:

- 5 • 41% of bicyclists encroached into the pedestrian crosswalk
- 6 • 23% of motorists encroached into the pedestrian crosswalk

8 Post-Bike Box without Color:

- 9 • 25% of bicyclists encroached into the pedestrian crosswalk (40% reduction)
- 10 • 7% of motorists encroached into the pedestrian crosswalk (67% reduction)

12 Effect of Green Color

- 13 • Color has limited influence on motorists and bicyclists encroachments compared
- 14 to no-color treatments (other factors are likely influencing encroachments)
- 15 • Motorists and bicyclists preferred use of color to mark the bicycle box in
- 16 preference survey, including 90% of non-cycling motorists

18 Bicyclist Stopping Position with Bike Boxes in Place:

- 19 • Presence of 1<sup>st</sup> stopped bicyclist determines where a following bicyclist stops:
  - 20 ○ When bike not present at location B, 5% stop at location A, 68% location
  - 21 B, less than 1% at location C
  - 22 ○ When bike present at location B, 38% stop at location A, 62% location C
- 23 • Color has a strong influence on bicyclists stopping in front of the stopped
- 24 motorists compared to the no-color treatments
  - 25 ○ 75% stop at A or B with color
  - 26 ○ 66% stop at A or B without color

28 Portland Summary of Bicycle Box Effect on safety:

- 29 • Conflicts: Overall, the number of observed conflicts decreased from 29 to 20,
- 30 while the total number of cyclists increased 94% and motor vehicle right-turn
- 31 volumes increased by 15%. Controlling for differences in volumes of bicycles and
- 32 right-turning vehicles, fewer bicycle-motor vehicle conflicts are expected for an
- 33 intersection with a bike box.
- 34 • Yielding: Our analysis of the three additional intersections for yielding behavior
- 35 found an increase in the key behavior of right-turning drivers yielding to cyclists
- 36 at the treatment locations and a decrease at the control location. The increase is

1        partially driven by additional interactions as a result of increased volumes;  
2        however, the increase in yielding is proportionally more than the volume  
3        increase.

- 4        • Perception of Safety: The surveys found that both motorists and cyclists  
5        perceived the intersections to be safer after the installation of the bike boxes. In  
6        particular, 42% of motorists who are not cyclists felt driving through the  
7        intersections was safer with the bike boxes (compared to 14% who felt it was  
8        more dangerous). Moreover, 77% of cyclists felt bicycling through the  
9        intersections was safer with the bike boxes (compared to 2% who felt it was more  
10      dangerous).
- 11      • Understanding of Treatment: 86% of motorists understood the purpose and use  
12      of the bicycle box from a survey of 721 motorists.

13     Additional research studies in Columbus, OH and Austin, TX completed as part of  
14     FHWA experiment process have documented the following:

15     Pre-Bicycle Box:

- 16     • 70% of bicyclists stopped in or beyond crosswalks, 7% stop at location A, 15% at  
17     location B/C (EMH&T)
- 18     • 40-55% of bicyclists stopped in or beyond crosswalks, 7% stop at location A,  
19     15% at location B/C (Loskern)
- 20     • 30-55% of bicyclists depart prior to motorists (Loskern)
- 21     • 5-20% of interactions required avoidance maneuver by motorists or bicyclists  
22     (Loskern)

23     Post-Bike Box without Color:

- 24     • 43% of bicyclists stopped in or beyond crosswalks, 16% stop at location A, 28%  
25     at location B/C (EMH&T)
- 26     • 17% of bicyclists stopped in or beyond crosswalks, 15% stop at location A, 37%  
27     at location B/C (Loskern)
- 28     • 55-65% of bicyclists depart prior to motorists (Loskern)
- 29     • 0-5% of interactions required avoidance maneuver by motorists or bicyclists  
30     (Loskern)

31     Post-Bike Box with Green Color

- 32     • 24% of bicyclists stopped in or beyond crosswalks, 12% stop at location A, 71%  
33     at location B/C (EMH&T, 6 months post installation)
- 34     • 65-70% of bicyclists depart prior to motorists (Loskern)
- 35     • 6% of bicyclists stopped in or beyond crosswalks, 22% stop at location A, 70% at  
36     location B/C (Loskern)
- 37     • 0-10% of interactions required avoidance maneuver by motorists or bicyclists  
38     (Loskern)

39     Safety:

- 1       • Columbus (EMH&T) observed nearly 18,000 vehicles, and 8,500 bicyclists  
2       observing 5 conflicts which could not be attributed to the bicycle box treatment

3

4 **Research Citations:**

5 Allen, D., S. Bygrave, and H. Harper. 2005. Behavior at Cycle Advanced Stop Lines  
6 Report No. PR240. London, UK: Transport for London, London Road Safety Unit.

7 Atkins Services, 2005. Advanced Stop Line Variations, Research Study Report No. 503  
8 1271. London: Transport for London.

9 Dill, J., Monsere, C., McNeil, N. 2011. Evaluation of Bike Boxes at Signalized  
10 Intersections. OTREC-RR-11-06. Oregon Transportation Research and Education  
11 Consortium. Portland, Oregon.

12 Loskorn, J., Mills, A., Brady, J., Duthie, J., Machemehl, R. 2010. Effects of Bicycle  
13 Boxes on Bicyclists and Motorists Behavior at Intersections. Center for Transportation  
14 Research, The University of Texas at Austin. Austin, Texas.

15 EMH&T. 2012. Milton Avenue Bike Box FHWA Experimentation Study. City of  
16 Columbus, OH.

17 Newman, A. 2002. Marking of Advanced Cycle Lanes and Advanced Stop Boxes at  
18 Signalized Intersections, the Report. Christchurch, NZ: Christchurch City Council, City  
19 Streets Unit.

20 Rodgers, A.. 2005. A23 & A202 ASL Before & After Study Report No. T40900;  
21 5085R/AB – CD1/RF. Hertfordshire, UK: Transport for London, Cycling Centre of  
22 Excellence.

23 Wall, G. T., D.G. Davies, and M. Crabtree. 2003. Capacity implications of advanced  
24 stop lines for cyclists. UK: Transport Research Laboratory

25 The NCUTCD Markings Technical Committee reviewed and concurred with this  
26 proposal in January 2014.

1   **RECOMMENDED MUTCD PROVISIONS/ REVISIONS:**

2  
3   **Note:** Deletions from the 2009 MUTCD text are noted in ~~strikethrough red~~, and  
4   insertions in underline blue.

5  
6   **Section 1A.13 of the MUTCD is modified by adding a new definition:**

7   **Section 1A.13 Definitions**

8   **xx. Bicycle Box- a designated area on the approach to a signalized intersection, between an**  
9   **advance motorist stop line and the crosswalk or intersection, intended to provide bicyclists**  
10   **a visible place to wait in front of stopped motorists during the red signal phase.**

11  
12   **Section 3B.16 of the MUTCD is modified as follows:**

13   **Section 3B.16 Stop and Yield Lines**

14   *Guidance:*

15  
16   **10   Where used, stop and yield lines should be placed a minimum of 4 feet in advance of the**  
17   **nearest crosswalk line at controlled intersections, except for yield lines at roundabouts as**  
18   **provided for in Section 3C.04, at bicycle boxes as provided for in Section 9C.xx, and or at**  
19   **midblock crosswalks.**

20  
21   **A new Section 9C.xx is inserted into Part 9 of the MUTCD:**

22   **Section 9C.xx Bicycle Box**

23   *Support:*

24  
25   **01 A bicycle box (see Figure 9C-xx) on the approach to a signalized intersection can provide**  
26   **one or more of the following benefits:**

- 27  
28   A. Increase the visibility of stopped bicyclists at an intersection during the red signal  
29   indication,  
30   B. Provide a head start for stopped bicyclists at an intersection upon the green signal  
31   indication,  
32   C. Reduce conflicts between bicyclists and turning traffic at an intersection at the onset of  
33   the green signal indication,  
34   D. Group bicyclists together to clear an intersection quickly, minimizing impediments to  
35   other traffic at the onset of the green indication,

36   *Guidance:*

1   02 At intersections with high numbers of conflicts between turning motorists and bicyclists  
2   during the green interval of a signal, consideration should be given to treatments instead of or in  
3   addition to the bicycle box.

4  
5   Option:

6  
7   03 These treatments may include, but are not limited to, the following:

- 8       A.    Separating conflicting traffic with leading or exclusive signal phases  
9       B.    Separating turning traffic from through traffic by providing exclusive turn lanes

10  
11   Standard:

12  
13   04 Where a bicycle box shall be formed by placing a stop line for motor vehicles a  
14   minimum of 10 feet in advance of the crosswalk or intersection. A minimum of one bicycle  
15   symbol marking (see Figure 9C-xx) shall be placed in the bicycle box.

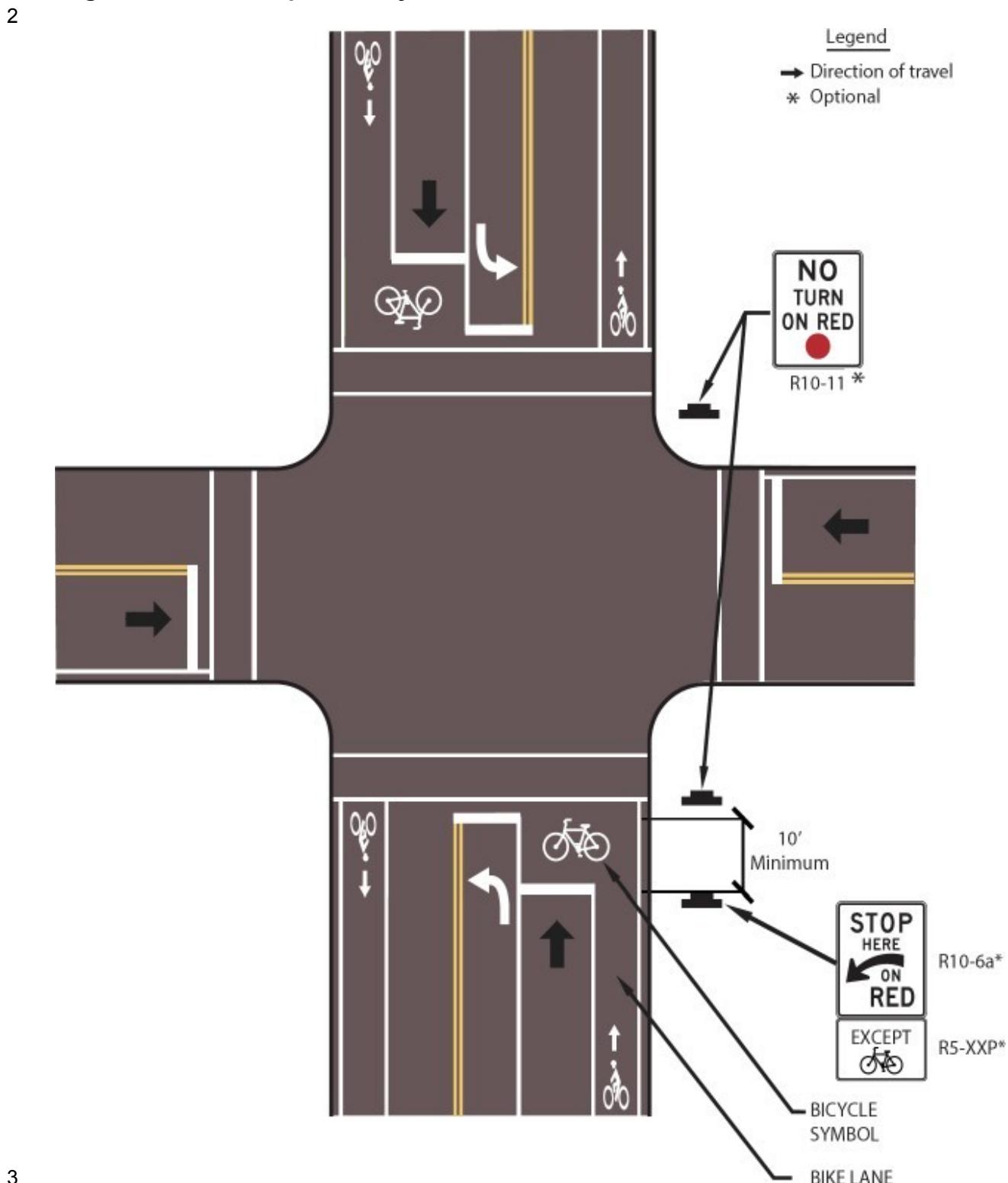
16  
17   Guidance:

18  
19   05 A bicycle lane should be used on the approach to a bicycle box.

20  
21   Option:

22   06 Green colored pavement may be used within the bicycle box and the approach bicycle lane.

23  
24   07 A NO TURN ON RED (R10-11) sign may be installed wherever a bicycle box is placed in a  
25   lane from which turns on red would otherwise be permitted.

1      **Figure 9C-xx. Example of Bicycle Box**

3