Evolution Of The MUTCD: The MUTCD Since World War II

BY H. GENE HAWKINS, JR.

The previous articles in this series have traced the development of the *Manual on Uniform Traffic Control Devices* (MUTCD) from its early efforts to create a uniform system of traffic control devices through the rural manual in 1927 and an urban manual in 1930. These two manuals led to the publication of the first edition of the MUTCD in 1935, followed by the *War Emergency Edition* in 1942, which was published to address the unique demands of wartime traffic control. Since World War II, updated editions of the MUTCD have been published in 1948, 1961, 1971, 1978, and 1988. Reviewing the history of these five editions provides some insight into how standards for traffic control devices have developed during the modern age of the automobile.

1948 MUTCD

As World War II neared its end, traffic engineers recognized that they had a once-in-a-lifetime opportunity to quickly adopt the standards of a new MUTCD as a result of wartime limitations on traffic control devices. Therefore, the Joint Committee on Uniform Traffic Control Devices (JC) began meeting in 1944 to prepare a new edition of the manual that would incorporate all the lessons learned since 1935.

The first task facing the JC was to develop a new format for the manual. Experience with the 1935 MUTCD had demonstrated the difficulties of locating standards for a single device in several different sections. The new MUTCD was formatted to put all the standards for a single device in one location. The illustrations in the new manual were blended into the text, instead of being located at the end of the manual as had been done in previous editions. As a result the MUTCD was much easier to use. Following the review of a preliminary draft copy, the updated MUTCD was published by the Public Roads Administration in August 1948.[1] Although the 1948 edition had the same four parts (signs, markings, signals, and islands) as previous editions, it contained a number of significant changes.

Signs

There were a number of important signing changes in the 1948 MUTCD. The rounded letter alphabet was adopted for all signs, sign legends were simplified by eliminating unnecessary words, sign sizes received increased emphasis, and reflectorization or illumination was required for all regulatory and warning signs. Among the changes to warning signs was the elimination of the square sign shape and the introduction of an optional advisory speed plate. Two of the changes to guide signs included adding the option of using white letters on a black background for oversized guide signs and the introduction of the bent arrow marker to replace the L and R used previously. Figure 1 illustrates some of the new signs in the 1948 MUTCD.

Conversion Factors

to convert from	to	multiply by
ft	m	0.3048
in.	cm	2.54

Markings

The standards for center lines and no-passing-zone markings sparked so much discussion that two special polls of state highway departments were required to resolve the controversy. Part of the reason for the controversy was that the new standards negated those that had been adopted by the American Association of State Highway Officials (AASHO) in 1940.[2] The JC eventually decided that white markings were to be used for all applications except for double center lines on multilane highways and the barrier line of no-passing zones, for which yellow was recommended. White continued to be permitted as an alternative to yellow. Solid lines were specified where crossing was prohibited and broken lines where crossing was permitted. Although the 1935 manual had identified the benefit of using pavement edge lines, the 1948 manual recommended against the practice, asserting that experience had shown they were easily mistaken for center lines or lane lines.

Signals

The traffic signals part of the MUTCD continued to provide detailed informa-

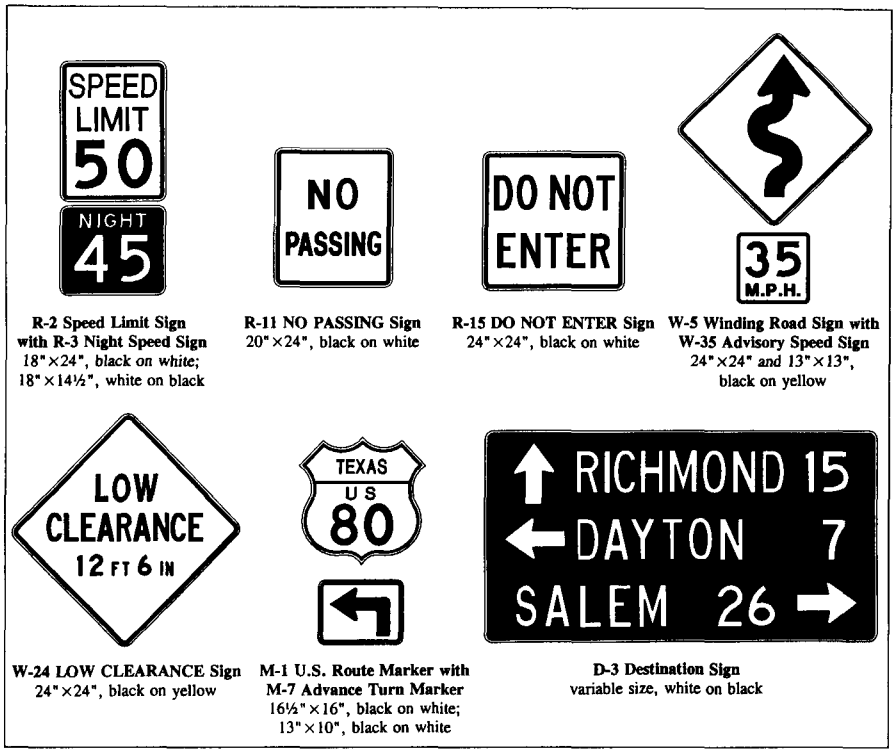


Figure 1. Signs from the 1948 MUTCD.

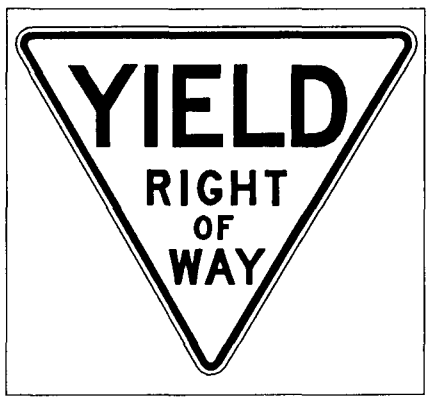


Figure 2. R-39 "yield" sign—30-in. sides, black on yellow.

tion about signal operation. In particular, a full discussion of the relative advantages of fixed-time and actuated signals under differing circumstances was added as a guide to the selection of equipment. New signal warrants that recognized the different needs of rural and urban areas were also added to the manual. The standards for the location of signal faces at an intersection were relaxed from the far-right corner standard in the 1935 MUTCD, with the emphasis placed on the need for adequate visibility. Two signal faces were required to be visible on each approach in urban areas. Two alternatives were provided for pedestrian signal indications: circular with the words "walk/wait" or rectangular with the words "walk/don't walk." The 1948 MUTCD introduced the use of lane direction control signals for controlling the direction of traffic flow on reversible lanes. These signals consisted of a red ball and a green ball, located over each reversible lane. A red or green ball was to be located over any nonreversible lanes.

1954 MUTCD Revision

A revision to the 1948 MUTCD was published in September 1954.[3] There were a total of 47 changes in the revision, several of which were notable. Probably the most significant revision was a change in the color of the "stop" sign, from black on yellow to white on red. The primary reason for the change was the availability of durable red finishes that would not fade with time. Among the other reasons for the change was a desire to eliminate the many different center-panel designs used to increase nighttime legibility of the yellow "stop" sign. The 1954 revision also prohibited the use of secondary messages on "stop" signs, a practice common before the revision.

The "yield" sign was first introduced in the 1954 revision, in the form of a yellow triangle with a black "yield right of way" legend as shown in Figure 2. Various shapes, colors, and legends had been used in experiments with the "yield" sign during the early 1950s, and a keystone shape was considered to be the most likely standard until the National Joint Committee (NJC), in what was probably the first concession to international uniformity, adopted the triangle, which had been used in Europe for a similar purpose.

Two other changes in the 1954 revision dealt with the location of signs. One increased the minimum mounting height of signs in rural areas from the 2.5 ft above the crown specified in the 1948 MUTCD to at least 5 ft above the crown. The other change specified that warning signs should be posted 250 ft in advance of the hazard in cities and 750 ft in advance in rural areas. Changes to signal standards included a requirement that two signal heads be visible to each approach in both rural and urban areas and modification of several signal warrants.

AASHO Interstate Manual

When the Interstate Highway System began construction in the mid-1950s, traffic engineers quickly recognized that the high-speed, controlled access nature of these highways created some unique needs for traffic control devices, and that the current MUTCD standards did not adequately address those needs. Therefore, AASHO published the first edition of the *Manual for Signing and Pavement Marking of the National System of Interstate and Defense Highways* in February 1958 to fill the gap between the MUTCD standards and the traffic control needs of interstate highways.[4]

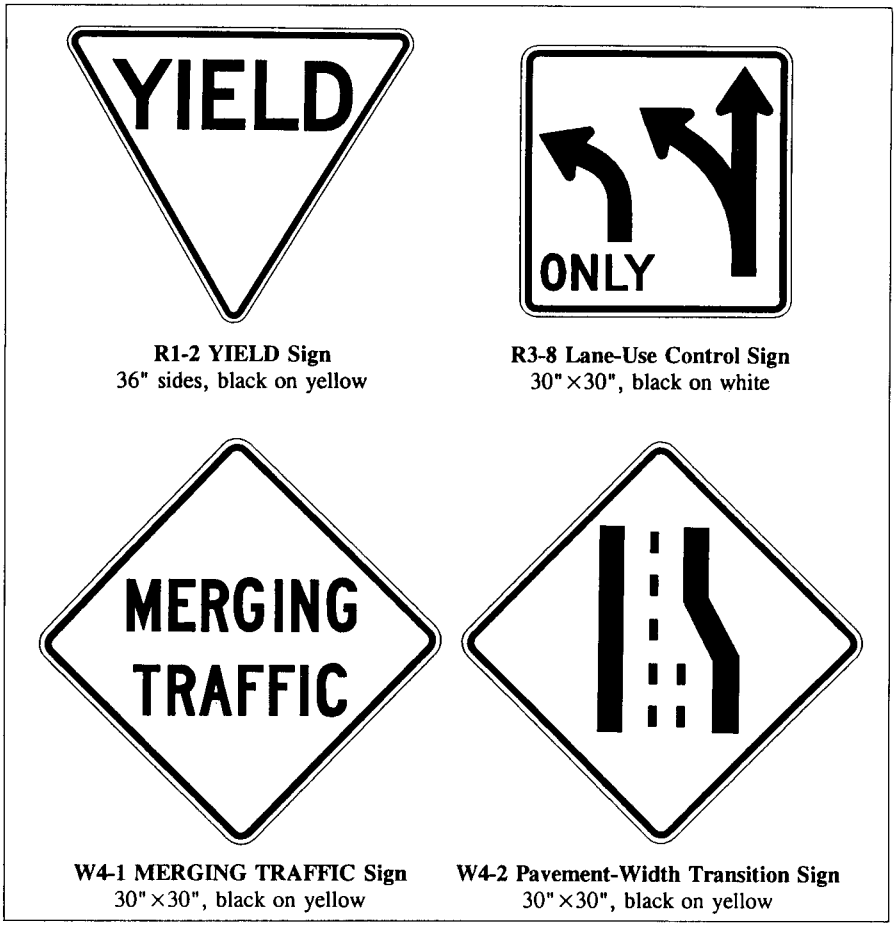
Because of its very nature, the emphasis of traffic control devices on interstate highways shifted from regulation and warning to guidance. Most of the standards in this document related to the use of guide signs. Two new signing practices introduced by this manual were the use of the white legend on a green background for guide signs and the use of lowercase letters in certain guide signs. Introducing green was not an easy decision to make and required several tests before being accepted. Both black and blue were given serious consideration for possible use in guide signs before green was selected. The use of lowercase let-

ters was not as controversial, but the decision was also based on the results of research. The interstate manual also introduced the interstate shield, along with a number of new warning and regulatory signs. Material covering the use of pavement markings and delineators was also included in this manual. Later editions of the interstate manual were published in 1961, 1962, and 1970.

1961 MUTCD

In June 1961 the Bureau of Public Roads (BPR) published the 1961 MUTCD, which the NJC had been preparing for four years.[5] The new MUTCD provided greater uniformity by eliminating many of the alternatives permitted in the previous edition and by replacing them with a single standard. The emphasis on uniformity was indicated by a BPR requirement that all traffic control devices used on federal-aid highways must conform to the new manual. This was the first time that compliance with MUTCD standards had been linked to receiving federal highway funds.

The 1961 MUTCD had several important changes in content and format, despite the desire of the NJC to minimize changes in the appearance of traffic control devices. New material was introduced, increasing the size of the manual from four parts to six parts. The two new parts addressed traffic control for construction and maintenance operations and signing for civil defense. New material on freeway signing was also added to the manual.



R1-2 YIELD Sign
36" sides, black on yellow

R3-8 Lane-Use Control Sign
30"×30", black on white

W4-1 MERGING TRAFFIC Sign
30"×30", black on yellow

W4-2 Pavement-Width Transition Sign
30"×30", black on yellow

Figure 3. Signs from the 1961 MUTCD.

Signs

The 1961 MUTCD recognized the desirability of using symbols in signs, and although few new symbol signs were introduced at the time, this recognition set the stage for greater use of symbols in the next MUTCD. Despite the lack of new symbol signs, there were a number of other signing changes. Sign sizes were increased and several new signs were added. The legend of the "yield" sign was shortened by deleting the words "right-of-way," although the sign maintained its black-on-yellow color. The chapter on guide signs was expanded to include guide signs for freeways and expressways. This new material incorporated most of the standards contained in the AASHO Interstate Manual, including the use of white-on-green guide signs, lowercase letters, larger and higher freeway signs, and overhead mountings.[4] Figure 3 illustrates some of the new or revised signs from the 1961 MUTCD.

Markings

No-passing-zone markings continued to generate attention with the new manual. Before 1961 some states had used a yellow barrier line, and other states had used a white barrier line. The 1961 manual eliminated this option and established a solid yellow line to the right of a white center line as the standard for marking no-passing zones. The 1961 MUTCD also recommended a centerline stripe on all paved highways and reduced the warrants for the application of a center line. A new section established standards and warrants for the permissive use of white edge lines, eliminating the earlier recommendation against edge lines.

Signals

Some of the more noteworthy changes in the new manual related to the use of pedestrian signals. The 1961 MUTCD required pedestrian signals to be rectangular in shape and carry the messages "walk" (in green or white) and "don't walk" (in red or orange). The new standards eliminated many of the options permitted in the previous manual for pedestrian signals, including the use of the word "wait."

There were a number of other changes to signal standards. Pretimed and actuated signals continued to be treated separately. The required volumes for the minimum vehicular volume and interruption of continuous traffic warrants were increased to the level used in the current MUTCD. The 12-inch signal lens became available in the mid-1950s, and the 1961 MUTCD recognized its value and included standards describing conditions where its use would benefit drivers. The new edition also stated that

an auxiliary signal or advance warning sign should be used when a signal was not visible for 10 seconds. Standards for lane-direction control signals were clarified, establishing rectangular signals with a red "X" or a downward green arrow as the standard design.

Construction and Maintenance Operations

A new part on traffic controls for construction and maintenance operations was added to the 1961 MUTCD in response to the dramatic increase in highway construction projects and the need for improved safety for these areas. The color for construction warning signs was specified to be black on yellow. A taper rate of 20 to 1 was recommended for normal conditions, and a taper rate of 40 to 1 or greater was recommended for high-volume, high-speed facilities. This part of the MUTCD was also published as a separate document, which was the first time that any part of the manual had been published separately.

1971 MUTCD

Recognizing the need for some fundamental changes in the MUTCD, the NJC began developing the next edition of the manual in 1964. As part of the development process, the NJC sought suggestions for improving the manual from practicing professionals. Many suggestions came out of a series of workshops sponsored by the Institute of Transportation Engineers (ITE) during in the mid-1960s.[6] Work on the new edition continued for several years, and in May 1970 the NJC submitted a completely rewritten manual to the Federal Highway Administration (FHWA) for approval. The FHWA made a number of changes and published the updated MUTCD in October 1971.[7]

The 1971 MUTCD was the first to provide formal definitions for "shall, should, and may." Although previous editions had used these terms, they had never been defined in the MUTCD itself. The 1971 manual was also the first not to put the mandatory (shall) standards in boldface type.

Signs

The most obvious change in the 1971 MUTCD was a large increase in the use of symbols in signs, which was done to increase international uniformity. Most of the new symbol signs were developed to replace existing word message signs, although the word signs were still allowed as an alternative. A number of completely new symbol signs were also introduced. Education of the driving public was to be accomplished through the use of educational plaques positioned below the symbol signs. Some of the symbol signs that were introduced in the 1971 MUTCD are shown in Figure 4. The 1971 MUTCD introduced the pennant-shaped "no passing zone" sign, and the color red, which had previously been used only for "stop" and parking signs, was added to several regulatory signs. Other changes in the signing part of the 1971 MUTCD included moving civil defense signs to the signing part of the manual, changing the crossbuck from a warning to a regulatory sign and setting the angle of the sign to 90 degrees, eliminating the version of the U.S. route marker sign that displayed the state name, and making white-on-green the standard color for guide signs (although black-on-white guide signs continued to be permitted on conventional roads).

Markings

Virtually all of the pavement-marking changes were related to the use of yellow, a subject that had stirred debate with nearly every previous edition of the MUTCD. For the 1971 edition, the NJC eventually decided that yellow would be used to separate traffic traveling in opposing directions, eliminating the use of white as a center-line marking. The use of a yellow edge line was restricted to those locations where medians were extremely narrow or where obstructions prevented the use of the left shoulder.

Signals

Some of the changes to the signal part of the 1971 manual included adding the red and yellow arrow indications, limiting the use of the green arrow, specifying the use of the 12-in. signal lens for all arrow indications, relating the required signal visibility to speeds, eliminating the warrants for actuated traffic signals, adding two new warrants, and adding the steady and flashing-yellow "X" indications to lane-use control signals. Orange and white were specified as the standard colors for pedestrian signals, thereby eliminating the use of red and green in pedestrian signals. A flashing "walk" indication was also added.

Construction and Maintenance Operations

The 1971 MUTCD introduced the color orange for use in signs, barricades, and

Figure 4. New signs from the 1971 MUTCD.

channeling devices used in work zones. A new section on expressways and limited-access facilities was added to address the unique work-zone traffic control needs of these high-speed, high-volume facilities. This part of the manual was also published as a separate document.

School Areas

Recognizing the special considerations of traffic control in school areas, the 1971 manual added a new part on this subject. This part was also published as a separate document, along with pertinent material from other sections, for school officials' use. The standards of this part introduced the pentagon-shaped school signs.

1971 MUTCD Revisions

Revisions to the 1971 MUTCD were in the form of "MUTCD Official Rulings on Request for Interpretations, Changes, and Experimentations," of which eight volumes were published between November 1971 and December 1977.[8] By the time volume 8 was issued, there had been more than 100 approved changes to the MUTCD, including the addition of two new parts and the deletion of the definitions section. Unfortunately, distribution of these revisions was limited. Although they were free to anyone who requested them, it was estimated that only 20 percent of the manual owners received all eight volumes. As a result, there were a large number of MUTCDs that were seriously out of date by the time volume 8 was published.

1978 MUTCD

The many changes that had been made to the 1971 MUTCD, combined with the limited distribution of the revisions, had created the need for an updated version of the manual, which was published in September 1978.[9] The 1978 MUTCD was not a new manual in the sense that it contained new standards; it simply incorporated all of the changes that had been made to the 1971 edition into a single publication. A secondary reason for publishing the 1978 MUTCD was to provide a reliable procedure for updating the MUTCD. To that end, the 1978 manual was published in a loose-leaf format to facilitate the replacement of revised pages.

Signs

More than half of the changes made were in the signing part of the manual. Several new symbol signs were provided as alternatives for word signs. A number of completely new signs were also introduced, and a new section on preferential signing was added. The option of using a black-on-white color scheme for guide signs on conventional roads was eliminated, resulting in the requirement that all guide signs be white-on-green. Figure 5 illustrates some of the signs that appeared in the 1978 MUTCD.

Markings

The use of yellow pavement markings went through another change with the publication of the 1978 edition, which specified that edge lines were to be white on the right side and yellow on the left. The barricade and channeling chapter, located in the construction part of the prior edition, was moved to the markings part of the 1978 edition.

Signals

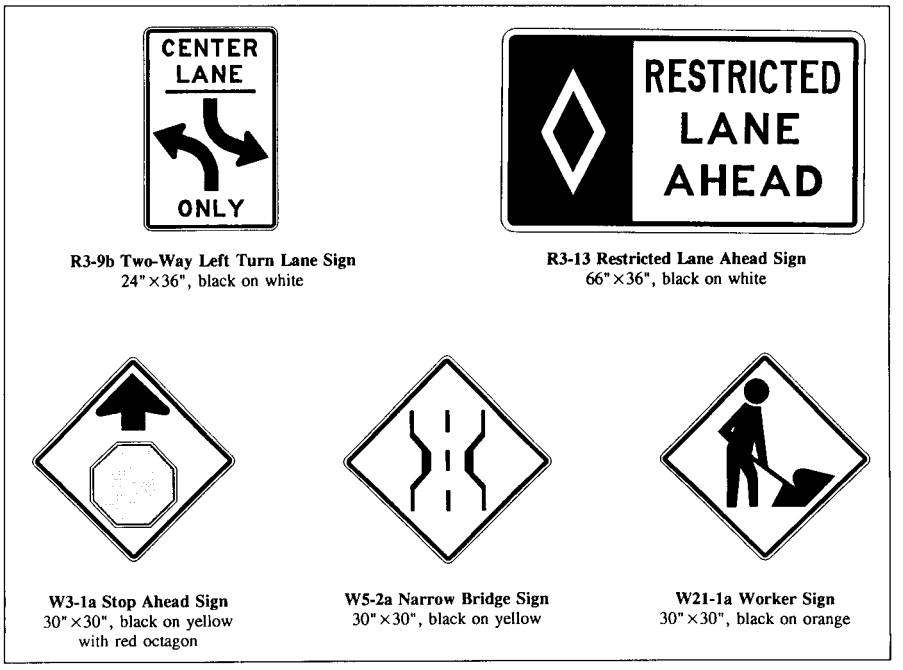
Changes to the signal part were minor in nature. The most significant change was the addition of symbolic pedestrian indications as an alternative to word messages and the addition of material on freeway ramp-control signals.

Construction and Maintenance Operations

The construction and maintenance operations part of the 1978 edition included revisions addressing the fundamental principles of safety through work zones, the need for a traffic-control plan, an upgrading of the section on barricades and channeling devices, and improvements in the illustrations. Symbol signs for the flagger and worker were added. The emphasis on removing pavement markings that were no longer applicable was increased, and the flashing arrow panel was added as a traffic-control device.

New Parts in 1978 MUTCD

The 1978 edition added two new parts to the manual. The first new part addressed traffic control for railroad-highway grade crossings. Most of this material had previously been contained in other parts of earlier editions and was consolidated in one location for the 1978 edition. The second new part addressed traffic control for bicycle facilities. The majority of the signs in the bicycle part were identical to those found elsewhere in the manual, although some new signs intended specifically for bicycle facilities were added.



R3-9b Two-Way Left Turn Lane Sign
24"×36", black on white

R3-13 Restricted Lane Ahead Sign
66"×36", black on white

W3-1a Stop Ahead Sign
30"×30", black on yellow with red octagon

W5-2a Narrow Bridge Sign
30"×30", black on yellow

W21-1a Worker Sign
30"×30", black on orange

Figure 5. New signs from the 1978 MUTCD.

1978 MUTCD Revisions

Updates and changes to the 1978 edition were distributed to registered MUTCD owners as revisions 1 through 4, which were published between December 1979 and March 1986.[10] Each revision included pen-and-ink changes, official rulings on request, and the new pages to be inserted in the manual. Most of the changes contained in these four revisions were relatively minor in nature, although there were several changes worth mentioning. The use of symbols increased with the introduction of several new symbol signs. The flashing "walk" pedestrian indication was eliminated, new signal warrants were added, and requirements for signal location and visibility were changed. Other changes affected the placement of warning signs and required edge lines on rural multilane highways.

By 1988 the FHWA had officially adopted more than 130 changes to the 1978 MUTCD, most of the changes being distributed in the four revisions to the 1978 edition. More than one-half of them, however, had not been distributed. Additionally, the concept behind the loose-leaf format had not worked well. More than 85,000 copies of the 1978 manual were distributed, but there were less than 20,000 subscriptions to the updating service.

1988 MUTCD

Once again the traffic engineering profession realized that most manuals were out of date because of the ineffectiveness of the revision process. Therefore, the FHWA decided to publish a new edition of the manual that would incorporate all the changes that had been made to the 1978 edition. It was also decided to publish the updated manual as a bound document and limit future revisions to those that affected safety. The current edition of the manual is the 1988 MUTCD, although it was not actually available until April 1989.[11] Once again, the updated manual was simply an update to the previous manual, although the 1988 edition incorporated a fifth revision that had not been previously issued.

The most significant of the changes in the 1988 MUTCD eliminated the blind-change interval, required a yellow arrow to be used for clearing a green arrow, modified two traffic signal warrants, required the use of temporary lane markings in work zones, and added a new signing section on recreational and cultural-interest signs.

Next Edition of the MUTCD

Although the FHWA still maintains responsibility for the MUTCD, the National Committee on Uniform Traffic Control Devices (NC) has begun preparation of the next edition of the manual for submission to the FHWA for approval. The next edition of the MUTCD will be rewritten in a new, more usable format. Although the new format is still under development, it is likely to place increased emphasis on the standards (shall or mandatory requirements) in the manual and decrease emphasis on the recommended or optional guidelines. The NC has set a target date of 1995 for publication of the next edition of the MUTCD.

Summary

The development of our modern standards for traffic control devices has taken place over a span of 65 years and several publications. The earliest efforts culminated in the publication of a rural-signing manual in 1927. This was followed in 1930 by an urban manual on signs, markings, signals, and islands. These two manuals laid the foundation for the first edition of the MUTCD, which was published in 1935. Since then a new edition of the MUTCD has been published

Table 1. Evolution of the MUTCD

Edition	*Parts*	*Sections*	*Pages*	*Cost*	*Revisions*
1935	4	443	166	N/A	1
1942	4	443	208	N/A	None
1948	4	366	223	$0.50	1
1961	6	366	333	$2.00	None
1971	8	549	377	$3.50	8
1978	9	622	425	$18.00	4
1988	9	675	473	$22.00	None

Table 2. Parts of the MUTCD

	Edition of the MUTCD			
Part	*1935,[1] 1942,[1] & 1948[1]*	*1961[1]*	*1971*	*1978 & 1988*
1	Signs	Signs	General Provisions	General Provisions
2	Markings	Markings	Signs	Signs
3	Signals	Signals	Markings	Markings
4	Islands	Islands	Signals	Signals
5	None	Construct. & Mainten. Oper.	Islands	Islands
6	None	Civil Defense[2]	Construct. & Mainten. Oper.	Construct. & Mainten. Oper.
7	None	None	School Areas	School Areas
8	None	None	Definitions[3]	Grade Crossings
9	None	None	None	Bicycles

[1]These editions contained an introduction that was not classified as one of the parts of the MUTCD.
[2]Civil Defense signing became a chapter of the signs part in the 1971 and later editions.
[3]Definitions were included in the introduction of the 1935 MUTCD and as an appendix in the 1948 and 1961 editions. The 1978 and 1988 editions did not include detailed definitions.

about every 10 years. With each new edition, the MUTCD has grown in size and stature as a traffic engineering tool. Table 1 compares the various editions and provides a quick perspective on the growth of the manual. Table 2 shows how each edition was organized and how the basic subject matter covered by the manual has increased with time.

The MUTCD of today has evolved from its humble beginnings to one of the most prominent of all traffic engineering publications. Unfortunately, the pioneers who were a part of the early development are no longer with us, and with their passing we have lost much of our knowledge about how our current standards have evolved over the years. This series of articles is only a brief description of how the MUTCD has evolved. Much still needs to be documented and learned from the experiences of those who have gone before us.

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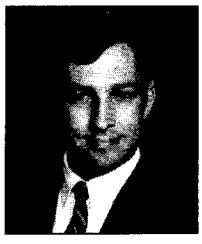

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