Evolution of the MUTCD: Early Editions of the MUTCD

BY H. GENE HAWKINS, JR.

In the July 1992 issue of *ITE Journal*, "Evolution of the MUTCD: Early Standards for Traffic Control Devices" described the early development of standards for traffic control devices and how efforts to establish a national system of uniform traffic control devices began in the mid 1920s. By the early 1930s, there were two national manuals. The American Association of State Highway Officials (AASHO) published a manual on signing for rural areas in 1927. In 1930 the National Conference on Street and Highway Safety (NCSHS) published a manual on traffic control devices in urban areas. In addition to signs, the urban manual also addressed pavement markings, traffic signals, and islands.

Because of the conflict of having two separate manuals, one for urban conditions and one for rural conditions, efforts began to combine the two manuals. AASHO and the NCSHS joined together and created the Joint Committee on Uniform Traffic Control Devices (JC), which held its first meeting in March 1932 (see sidebar). The JC was to combine the two manuals into a single, complete manual of traffic control devices for both rural and urban use, adding any information that might be needed. At first it was thought that the JC's work would largely be an editorial task of rewriting the two manuals as one. Only three items of the two codes appear to have been seriously questioned—the color code, use of signs at night, and the use of reduced sizes of signs in municipalities. At its first meeting, however, the JC decided that certain details should be thoroughly investigated before completing the new manual. The JC established research activities to resolve these differences and provide a factual foundation for the new manual.

The most extensive research was sponsored by the Bureau of Public Roads on the visibility of various color combinations of reflective and nonreflective signs[1] and delay at traffic signals.[2] The results of the visibility research are summarized below:

Daylight observations on nonreflective signs. The standard yellow background with black letters was found to be much superior to black on white or white on black for all daylight conditions that could reasonably be expected in rural or urban conditions.

Night observations on nonreflective signs. While the results were inconclusive, the inadequacy of nonreflective signs in nighttime conditions was indicated.

Night observations on reflective signs. Observations on three sizes of reflector buttons indicated a colorless 0.76-inch diameter reflector button with 1-in. center-to-center spacing was the most efficient.

Daylight observations on reflective signs. The effect on distinctness in daylight of inserting reflector buttons in letters was not serious.

Recognition by shape of sign. The practice of outlining the border of highway signs with reflector buttons so users could recognize the shape of the sign at a distance was found to be worthy of further development. The use of symbols, except for arrows indicating curve or direction, was considered less effective than outlining signs with buttons.

Conversion Factors

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

1935 MUTCD

Armed with the Bureau of Public Roads' research and other data, the JC was able to develop a combined manual. A preliminary draft was finished in 1934, and the following year the original *Manual on Uniform Traffic Control Devices for Streets and Highways*[3] was completed and approved by AASHO and the fourth NCSHS. Although the secretary of agriculture also approved the manual, with the exception of the part on islands, he expressed reservations as to railroad grade crossing protection. The MUTCD was approved as an American Standard in November 1935.

Two versions of the 1935 MUTCD were actually published. The original publication in 1935 was a mimeograph document, but demand for the manual was so great that it was reprinted in 1937 as a typeset document. The contents of

the two versions are almost identical and each is usually referred to as the 1935 edition.

The first MUTCD contained four parts addressing signs, markings, signals, and islands. Each of the parts was divided into several articles, such as legal authority, application, design, location, maintenance, and others. Each article was then subdivided into sections on the appropriate aspect of a specific traffic control device. This format required users to look at several sections to obtain all the information about a specific device. For example, the application of a "stop" sign was addressed in Section 106, the design of a stop sign was described in Section 140, and the location of a stop sign was described in Section 152. The manual included 443 sections, plus illustrations, and several appendices.

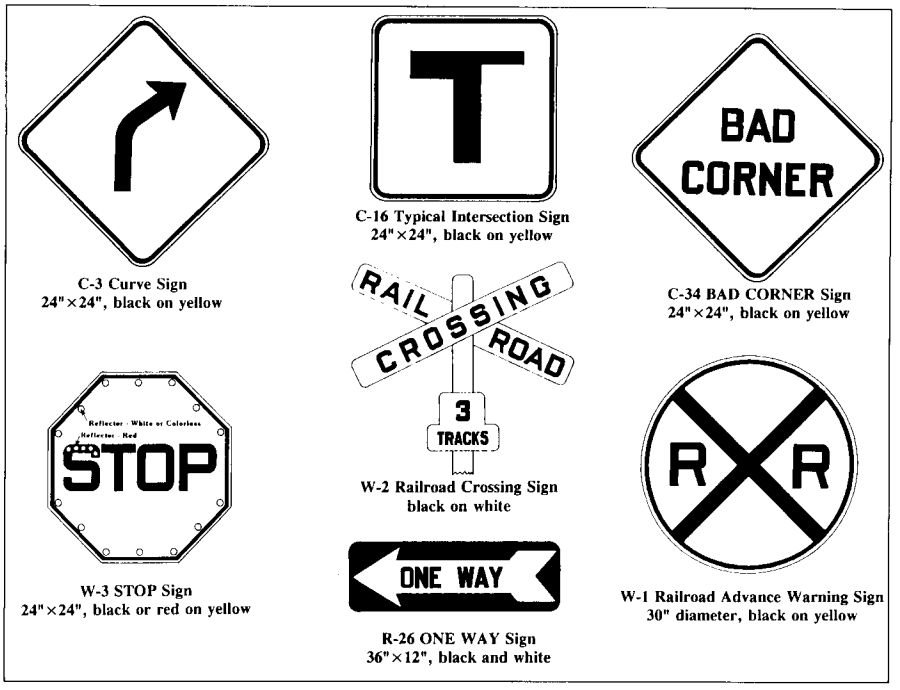

Figure 1. Signs from the 1935 *Manual on Uniform Traffic Control Devices.*[3]

Signs

The signing part of the manual maintained the standards of the two prior manuals. Signs were classified as regulatory, warning, or guide signs. All of the signs continued to use the block letter alphabet, which had been the standard for many years, although the desirability of rounded letters was identified when embossing dies were not used. The 1935 edition took into account the recommendation of the Sixth International Road Congress that consideration be given to the more extensive use of symbols, eliminating the words "turn" and "curve" from those signs. The new edition also recommended that the outline of stop, railroad advance, and slow-type warning signs be illuminated at night, with the idea that such illumination would make motorists conscious of the meaning of the shapes of the signs. Illumination was accomplished through the use of individual "cats-eyes," glass spheres placed around the border, by focusing a floodlight on the face of the sign, or by placing a floodlight behind the sign. The concept of placing the light behind the sign was to highlight the shape of the sign to drivers. Reflectorized sheeting was not yet being used at that time. The minimum outside dimension of signs was 24 in., with increases in 6-in. increments. Only 40 of the signs were illustrated in the MUTCD, and these were at the back of the manual. Most of these figures were identical to those contained in the AASHO rural manual. Figure 1 illustrates some of the signs from the 1935 manual.

Regulatory signs included stop, speed, movement, parking, and miscellaneous signs. All regulatory signs were rectangular (with long dimension vertical) and black on white, except for stop and parking signs. Stop signs continued to be black on yellow octagon, with red letters as an alternate to black. Red cats-eyes were to be used if the main message of the stop sign was illuminated. Parking signs used red on white for prohibitions and green on white for restrictions. Three speed limit signs were described: "begin XX mile speed," "end XX mile speed," and "speed limit XX miles." These were to be used to mark the beginning of a speed zone, the end of a speed zone, and as confirmation of the speed zone, respectively.

Warning signs included slow-type, caution-type, railroad advance, and railroad crossing signs. The slow-type warning sign was black on yellow diamond, the caution-type sign was black on yellow square, the railroad advance sign was black on yellow circle, and the railroad crossing sign was black on white crossbuck. The advance railroad sign changed from the vertical cross used previously to a diagonal cross with the letter "R" in the quadrants on the left and right. This was done to reduce confusion with the intersection symbol (+). Slow-type signs were to be used where a permanent physical hazard required a reduction in speed for safety. The caution-type signs were to be used where a potential operating hazard required drivers to proceed with caution.

Guide signs were white on black rectangular signs with the long dimension horizontal, except for the "rest station" sign, which continued to be white on green cloverleaf, and the route marker, which continued to use the U.S.-highway shield developed by AASHO in 1925. A supplemental plate with the letter "L" or "R" mounted below a route marker continued to provide advance notice that a highway would turn to the left or right at the next intersection.

Markings

The 1935 MUTCD described several applications for pavement markings, including their use to indicate the center of the roadway in dangerous locations, traffic lanes, pavement edges, boundaries of pedestrian crosswalks, and other features. The manual also described the use of markings to warn of hazardous objects.

Center lines were recommended for approaches to hillcrests, curves with a clear view of less than 500 feet, pavements wider than 40 ft, approaches to a railroad grade crossing, approaches to signals, two-lane roads less than 16-ft wide, and wherever there were large traffic volumes. Lane markings were to

The National Committee on Uniform Traffic Control Devices

From its initial inception, the *Manual on Uniform Traffic Control Devices* (MUTCD) has been developed by a committee. This committee has been known by four different names and has undergone many changes in membership. In its early years, the committee was responsible for the development and publication of the MUTCD. Since 1948, however, the committee has served as an independent organization providing professional input on the content of the manual, which is published by the federal government.

In response to the conflicts caused by having separate manuals for rural and urban areas, the first committee was created in 1931; it was named the Joint Committee on Uniform Traffic Control Devices (JC). The committee's purpose was to bring all standards for traffic control devices under one cover and to recognize the rapid developments in the art of traffic control. In its original form, the JC consisted of members representing the American Association of State Highway Officials (AASHO) and the National Conference on Street and Highway Safety (NCSHS). The first committee meeting was held in March 1932. The JC published a preliminary draft of the MUTCD in 1934 and the first edition of the MUTCD in 1935. The JC reconvened in 1938 to re-examine the manual, and it published a supplement to the MUTCD in February 1939.

The United States' entry into World War II placed many demands on traffic control. Subsequently, the JC met shortly after the start of World War II to help meet the needs of wartime traffic control. It was expanded to add representatives of the Institute of Traffic Engineers (ITE) to those of AASHO and the NCSHS. Because of the special nature of wartime conditions, the JC was further expanded to included a representative from the War Department and a representative from the Office of Civilian Defense. Close relations were also established with the War Production Board. In November 1942 the JC published a war emergency edition of the MUTCD.

Still represented by AASHO, ITE, and NCSHS, the JC began working on the peacetime edition of the MUTCD in December 1944. The committee developed a preliminary review copy of the manual in January 1947. The review comments from this draft were used to prepare the 1948 MUTCD, which was published by the Public Roads Administration in August 1948. After the 1948 MUTCD was published, the NCSHS was dissolved and its representation replaced on the JC by the National Committee on Uniform Traffic Laws and Ordinances; the committee was renamed the National Joint Committee on Uniform Traffic Control Devices (NJC). The NJC developed a revision to the 1948 MUTCD, which was published in 1954.

The NJC began meeting in the late 1950s to prepare a new edition of the MUTCD. In 1960 the American Municipal Association and the National Association of County Officials were added to the committee. The 1961 MUTCD was prepared by the NJC and published by the Bureau of Public Roads in June 1961. As committees had done in the past, the NJC developed the MUTCD with the cooperation of the federal government.

Partly because of several deficiencies in the 1961 edition, the NJC continued in existence after publication of the 1961 edition. The committee determined that a complete rewrite of the MUTCD was needed and work on the new edition began in 1965. The final draft of the 1971 MUTCD was approved by the five parent organizations of the NJC in May 1970.

The publication of the 1971 MUTCD was significant for a number of reasons and marked a point of departure for the NJC. Following the publication of the 1971 manual, the Federal Highway Administration (FHWA) took over full responsibility for the development of the MUTCD from the NJC, although the NJC continued to exist in an advisory role to FHWA. In 1972 the name of the committee was changed to the National Advisory Committee on Uniform Traffic Control Devices (NAC) and its role was changed to that of an official advisory committee to the secretary of transportation. Requests for rulings or changes were submitted by FHWA to the NAC and the committee returned its recommendations to FHWA for a final decision. The NAC continued to grow, and by the time the 1978 MUTCD was published, NAC membership had grown to ten organizations.

In June 1979, the secretary of transportation terminated its sponsorship of the NAC in accordance with President Jimmy Carter's policy to limit the number of federal advisory committees. About the same time, FHWA also announced it would adopt all future changes to the MUTCD through the *Federal Register* rulemaking process. The NAC responded to this action in 1980 by forming a new National Committee on Uniform Traffic Control Devices (NC) that was independent of the federal government. In its new role, the responsibilities of the NC were to initiate, review, or comment on proposed changes to the MUTCD. As such, the NC had the opportunity to review proposals and make recommendations to FHWA in the same manner as any other member of the public.

Today, the NC continues to function in an advisory role. The governing body of the NC is a council, which has 37 members appointed by the sponsoring organizations. All recommendations and comments of the NC must be approved by the council. The NC also has an executive board, which has 12 members, that appoints members to the NC's five permanent technical committees—traffic signs, traffic markings, traffic signals, traffic control devices for construction and maintenance, and traffic control devices for railroad/highway grade crossings. The technical committees are responsible for developing the recommendations and comments that go to the council for final action. The NC meets twice a year, in January (before the Transportation Research Board's annual meeting) and in June. The NC, in a major effort to make the MUTCD more useable, is currently preparing a completely reformatted and rewritten edition for submission to FHWA.

be spaced so that the minimum width of a lane was 10 ft. The use of a center line and lane lines was described in the following manner:

> In some states the practice is to use center lines on two-lane roadways only at points where overtaking and passing is hazardous and unlawful. In others, they are extensively used even on straight level stretches as aids to driving. Wherever the latter practice is followed, distinctive lines shall be used at the points of hazard. A double line is suggested for this purpose. . . . In some instances, lane lines are distinguished from center lines by being broken into sections, while center lines in four-, six-, or eight-lane roadways should be continuous in all cases.

Lines on the pavement could be marked by construction joints in the pavement filled with material of contrasting color, pavement of contrasting color, paint of contrasting color, or inserts set on or in the pavement. Lines were to be between 4 in. and 8 in. wide. For center lines and lane lines, the length of the line and gap were to be equal, with each between 5 ft and 75 ft. The color of markings could be white, yellow, or black, depending on which color provided the greatest contrast with the pavement surface. None of the markings were illustrated in the 1935 MUTCD.

Signals

The signal part of the manual contained information about traffic signals that had not been previously published. It was divided into Division A on traffic control signals and Division B on flashing signals. Division A covered pretimed, actuated, and pedestrian signals, and Division B addressed slow, stop, and railroad signals.

The 1935 MUTCD provided the first useful warrants for traffic signal installation. Pretimed signal warrants included minimum vehicular volume, heavy left turn, minimum pedestrian volume, coordinated movement, through highway, accident hazard, and combination of warrants. The minimum vehicular volume warrant required that the total entering volume be at least 1,000 vehicles per hour (vph) for 8 hours, the minor street volume must be at least 250 vph for 8 hours, and the minor street traffic must be of sufficient percentage to require the green for at least 25 percent of the cycle. Warrants for actuated signals used the pretimed warrants as a starting point, but relaxed the requirements because of the ability of actuated signals to adapt to changing traffic conditions.

The 1935 *MUTCD* established the three-color signal head as the standard for traffic signals, stating that "the important functions of the yellow light cannot be satisfactorily taken care of with a signal face having only two lenses." All traffic signal indications were 8 in. in diameter and included the circular red, circular yellow, circular green, green arrow, circular "walk," and circular "wait." At least one signal face was required for each street entering the intersection.

Islands

The island section addressed safety zones, which were areas set aside for pedestrians, and traffic islands, which were areas created for the diversion or segregation of vehicular traffic. This part of the MUTCD provided guidelines for the geometric design of islands and the use of signs and markings with islands. This part of the manual was not approved by the Bureau of Public Roads.

1939 Revision to the MUTCD

The early experiences with the 1935 MUTCD indicated the need to revise some aspects of the manual, and the JC met in the summer of 1938 for that purpose. The JC recommended several revisions, including changes in sign illumination, speed signs, no-passing zone pavement markings, signal warrants, and pedestrian signals. Changes to the island part of the 1935 MUTCD were limited. The resulting 25-page supplement to the 1935 MUTCD was issued in February 1939.[4]

The revision required that, in addition to the outline of the sign, the main message of the stop, slow-type, speed-limit, and railroad advance warning (both the cross and letters) signs be illuminated. Experience had shown that illumination of the outline itself was not a sufficient warning to motorists. Illumination was further recommended, but not required, for route-marker, destination, and one-way signs. White reflectors were used to illuminate all signs, except for the stop sign, for which red could be used.

The "begin XX mile speed" and "end XX mile speed" signs were eliminated from the MUTCD in the 1939 revision. The new "end speed zone" sign was to be used when a vehicle was leaving a speed zone and entering a section of highway for which no speed limit existed. The appearance of the speed limit sign was changed from "speed limit XX miles" to "speed limit XX." The "no passing XX feet" sign from the 1935 MUTCD was replaced by the "no passing" and "end no passing zone" signs.

The 1939 revision added material specifically addressing the marking of no-passing zones. An auxiliary marking on the side from which passing was prohibited was to be used to mark the no-passing zone on two-lane highways. This marking was to be an additional line of a different width or color from the center line, or an additional broken line of the same color. Many of the highways of the day were three-lane highways, in which the center lane was used for passing. On three-lane highways, the center lane was to be discontinued when the clear view ahead was insufficient for safe passing, at railroad grade crossings, on bridges narrower than the adjoining pavements, and at signalized intersections. Markings alone were not to be depended upon to prevent overtaking and passing in hazardous areas. Therefore, these areas were to be marked with no passing signs.

Revisions to the signals section of the 1935 MUTCD included changes to some of the warrants for fixed-time and traffic-actuated signals and the addition of information on pedestrian signals. The suggested design for pedestrian signals was two rectangular lenses, one showing the word "walk" in 3-in. white letters on a black background, and the other showing the word "wait" in 3-in. black letters on a white background. The circular pedestrian signal, however, continued to be widely used even after the revision. The revision also clarified the meaning of the various traffic signal indications.

1942 MUTCD—War Emergency Edition

World War II placed many demands on highway travel and traffic control in the United States. Because of the new demands, the JC reconvened in May 1942 to consider revisions to the MUTCD. At its first meeting, the JC unanimously agreed to direct its energies to the preparation of a manual of emergency standards for traffic control devices adapted to existing and foreseeable wartime conditions. This decision was necessitated by a shortage of materials, which made it more difficult to adhere to accepted standards for traffic control devices. The migration of war workers and military personnel into unfamiliar areas made it even more urgent to preserve recognized standards in traffic control devices. In addition, the demands for blackout and dimout traffic control placed new requirements on the use of traffic control devices. Therefore, the first major function of the JC was to determine which standards were of greatest importance and how they could be maintained with limited and substitute materials. The other major function of the JC was to serve as a liaison agency between military and civilian authorities for the movement of authorized civilian traffic under emergency conditions.

The *War Emergency Edition—Manual on Uniform Traffic Control Devices for Streets and Highways* was published in November 1942.[5] It was organized into two divisions: Division I covered normal conditions, and Division II contained special standards for traffic control devices in blackout conditions. A third division on standards for dimout conditions was planned as a supplement but was never prepared.

Division I—Normal Operating Conditions

Division I, which described normal operating conditions, was basically a condensed version of the 1935 edition, incorporating the 1939 revisions. In condensing Division I, the JC omitted portions not applicable to wartime conditions and also omitted much explanatory information in order to conserve paper. Although the war emergency edition was designed to be a complete document as far as standards were concerned, the introduction indicated the continuing usefulness of much of the information in the 1935 MUTCD, and the 1942 edition retained the same organization as the 1935 edition in order to facilitate comparisons and make it easy to refer to the more detailed discussions found in the previous edition.

Division I largely avoided changes in standards for traffic control devices other than those needed for the prosecution of the war. There were, however, some important differences between the revised 1935 edition and the 1942 edition. For instance, the 1942 edition added this statement to the markings section of the manual: "It is very important to distinguish the lane lines from the center line marking on multiple-lane roads."

The conservation of materials was a key provision of the 1942 edition. The manual stated that sign installations should be limited to locations necessary for public safety or the efficient movement of essential traffic. Conservation was promoted because changes in the standards were not retroactive to existing traffic control devices in place, traffic control devices transferred to new locations, or those drawn from existing stocks. The most critical materials were the metal used in signs and the chromium used in yellow paint. Wood and composition board signs became more common, as did signs made from recycled old metal signs. The use of other pigments in yellow paint was permitted in order to provide an acceptable, albeit substandard, yellow paint for use in signs and markings. The 1942 MUTCD also contained appendices describing procedures for requesting materials for traffic signals from the War Production Board and specifications for materials in traffic control devices.

Division II—Blackout Conditions

The threat of operating civilian vehicles in blackout conditions presented one of the gravest problems ever faced by traffic officials. The control of nonmilitary traffic during blackout conditions was a civilian responsibility, unless the area was declared a military theater of operations. Blackout conditions, however, could be imposed by military authorities at any time in any area. Blackout operations created many difficulties because civilians were less familiar with blackout conditions than military personnel.

Only vehicles equipped with approved blackout lights could move during blackout conditions. Roadway illumination during blackout conditions was accomplished with a single headlight located near the driver's line of vision. This light had extremely low candlepower and uniformly illuminated the road surface between 20 ft and 100 ft in front of the vehicle. This low level of illumination limited vehicle speeds to 15 mph, required blackout signs to be located as

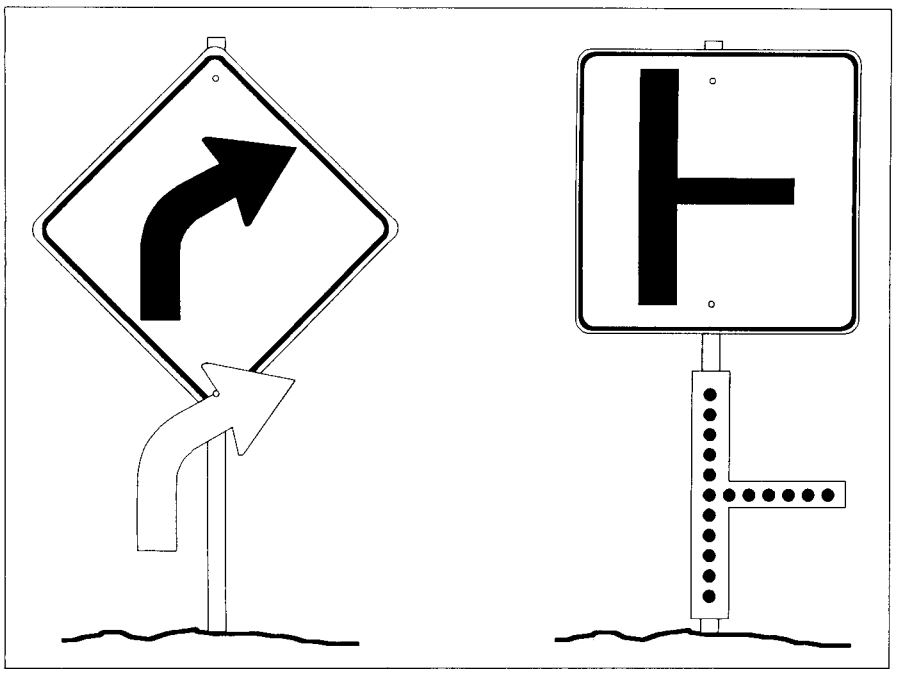

Figure 2. Traffic signs for blackout conditions.

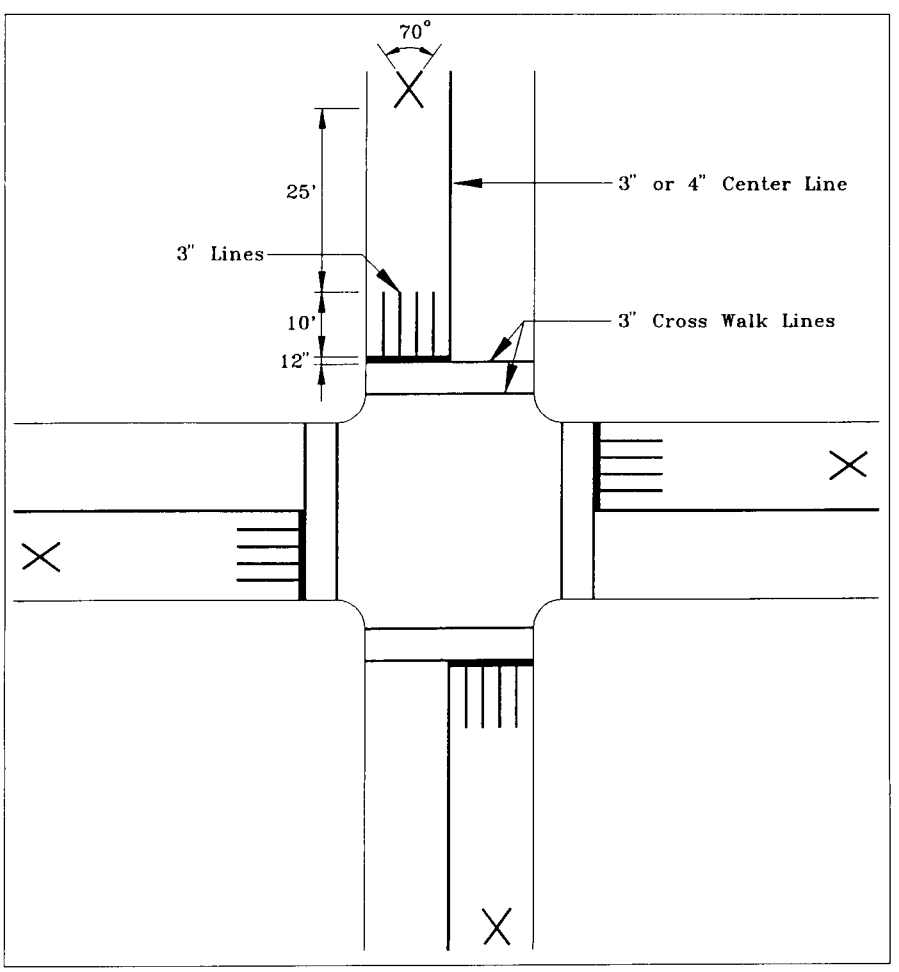

Figure 3. Blackout markings at intersections.

near to the ground as possible, and required that blackout pavement markings be reflectorized. It also required that drivers adapt their eyes to the dark before driving.

Division II of the 1942 MUTCD described the types of traffic control devices to be used during blackout periods. The 1942 manual also contained appendices containing War Department specifications on blackout requirements for highway movement and traffic control during blackout conditions. Traffic control standards for normal conditions were not to be lowered in order to take care of blackout conditions. Instead, special blackout devices were to be used where necessary.

The reduced light level of the vehicle lamp for blackouts rendered standard highway signs virtually useless. There was little to be gained from sign shape, as only the message of blackout signs was reflectorized. The top of the sign message was to be placed no more than 24 in. above the road crown. A typical sign installation would consist of the standard sign mounted normally on a post with a blackout version of the sign message located on the same post at ground level, as illustrated in Figure 2.

All pavement markings required for blackout conditions were reflectorized with glass beads. This marked the beginning of reflectorized pavement markings. Markings also assumed functions of many signs that would not be visible during blackout conditions. Transverse pavement markings were more difficult to see in blackout conditions; therefore, greater use was made of longitudinal markings. Intersections were marked with longitudinal markings extending 5 ft upstream from the limit (stop) line, as shown in Figure 3.

The need for traffic signals was greatly reduced during blackout conditions, as traffic volumes would substantially decrease. Most traffic signals were to be replaced with blackout stop signs. At locations where signals continued to be necessary, the signals were operated at one-fourth the rated voltage in order to reduce light output.

Initial concerns over an attack or invasion of the continental United States subsided as the war progressed. As a result, the need to operate traffic under blackout conditions subsided and use of blackout traffic control devices was limited. The 1942 MUTCD, however, con-

tinued to be used throughout the duration of the war and for several years afterward.

Summary

The 1935 MUTCD was the first publication to be accepted as a national standard for traffic control devices. Its publication helped to establish more uniform use of traffic control devices in the United States. Experience from the early application of the standards in the 1935 MUTCD led to a revision in 1939. Unfortunately, World War II interrupted the continued advancement of traffic control devices standards. The 1942 war emergency edition of the MUTCD was published to address the difficulties related to traffic control devices created by the war, but avoided any real changes in standards. Most of the changes in the 1942 edition were related to the use of traffic control devices in blackout conditions and the conservation of materials for the war effort.

Near the end of the war, traffic engineers realized that a completely rewritten MUTCD would be needed after the war and work began on the peacetime edition in 1944. A subsequent article to be published in *ITE Journal* will look at the 1948 edition of the MUTCD and those editions that followed it.

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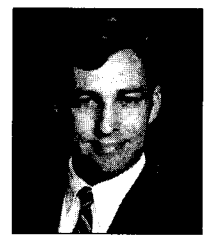

H. Gene Hawkins, Jr., *P.E., is an assistant research engineer for the Texas Transportation Institute of the Texas A&M University System in College Station, Texas. He received his B.S. and M.E. degrees in civil engineering from Texas A&M University and expects to complete his Ph.D. degree at Texas A&M University in December 1992. He is on the Signals Technical Committee of the National Committee on Uniform Traffic Control Devices and is an Associate Member of ITE.*