

Revisions to the
**Manual on Uniform
Traffic Control Devices
for Streets and Highways**

Approved by
American Association of State Highway Officials
Institute of Traffic Engineers
National Committee on Uniform Traffic Laws and Ordinances

DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS
WASHINGTON, D. C. : 1954

U. S. DEPARTMENT OF COMMERCE

Sinclair Weeks, Secretary

BUREAU OF PUBLIC ROADS

Francis V. du Pont, Commissioner



The *Manual on Uniform Traffic Control Devices for Streets and Highways*, published in 1948 by the Bureau of Public Roads (then the Public Roads Administration), may be purchased from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at 75 cents a copy. The price includes this supplement.

The supplement may be purchased separately from the Superintendent of Documents at 15 cents a copy.

MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES

Revisions, September 1954

The *Manual on Uniform Traffic Control Devices*, 1948 edition, has been amended as shown herein on the recommendation of the National Joint Committee on Uniform Traffic Control Devices and with the formal approval of its three parent organizations, the American Association of State Highway Officials, the Institute of Traffic Engineers, and the National Committee on Uniform Traffic Laws and Ordinances.

As in the case of previous revisions of this manual, it is assumed that traffic control devices acquired and installed hereafter will conform to the amended standards and that existing nonstandard equipment will be replaced within a reasonable period as it wears out.

The changes are given in order, according to the numbered manual sections to which they apply. In each case, immediately following the section title, there is a brief note on the nature of the revised material and the point of its insertion. These comments, not an actual part of the revised text, are printed in italics.

As a matter of convenience in use, this pamphlet is printed on one side of the page only, and where practicable the changes are set up in the same style as the Manual (1948 edition). Thus, for the most part, the changes can be inserted in the manual by cutting them from this pamphlet and pasting them directly over or adjacent to the superseded material.

In a number of instances it is apparent that the revision of one section of the manual will require corresponding changes in other sections. In such cases the affected sections are listed herein, but their specific editorial revision is to await the preparation of a complete new edition of the manual at some time in the future. Meanwhile these secondary changes can be indicated, in most cases, by relatively simple pen-and-ink corrections or deletions. Of course, where sections so modified are also amended for other reasons, the revised text contains all changes.

REVISIONS BY SECTIONS

NATIONAL JOINT COMMITTEE ON UNIFORM TRAFFIC CONTROL DEVICES

COMMITTEE MEMBERSHIP, SEPTEMBER 1954

From the American Association of State Highway Officials

- E. H. HOLMES, Chief, Highway Transport Research Branch, U. S. Bureau of Public Roads, Washington, D. C. (*chairman, National Joint Committee*)
J. CARL McMONAGLE, Director, Planning and Traffic Division, Michigan State Highway Department, Lansing, Mich. (*chairman, AASHO group*)
F. B. CRANDALL, Traffic Engineer, Oregon State Highway Department, Salem, Oreg.
JAMES E. P. DARRELL, Director of Traffic and Planning, Minnesota Department of Highways, St. Paul, Minn.
J. L. STACKHOUSE, Maintenance Engineer, Washington State Department of Highways, Olympia, Wash.
I. L. THOMAS, JR., Traffic and Planning Engineer, State Department of Highways, Baton Rouge, La.
C. R. WATERS, District Engineer, New York State Department of Public Works, Buffalo, N. Y.

From the Institute of Traffic Engineers

- WILBUR S. SMITH, Associate Director, Yale Bureau of Highway Traffic, New Haven, Conn. (*chairman, ITE group*)
D. JACKSON FAUSTMAN, City Traffic Engineer, Sacramento, Calif.
ROSS C. HARGER, Assistant Director, Department of Streets and Traffic, Detroit, Mich.
HOWARD F. ILGNER, Superintendent, Bureau of Traffic Engineering and Electrical Services, Milwaukee, Wis.
EUGENE MAIER, Director, Department of Traffic and Transportation, Houston, Tex.
LESLIE J. SORENSON, City Traffic Engineer, Chicago, Ill.
T. T. WILEY, Commissioner, Department of Traffic, New York, N. Y.

From the National Committee on Uniform Traffic Laws and Ordinances

- D. GRANT MICKLE, Director, Traffic Engineering Division, Automotive Safety Foundation, Washington, D. C. (*chairman, NCUTLO group*)
DAVID M. BALDWIN, Director, Traffic and Transportation Division, National Safety Council, Chicago, Ill.
DONALD S. BERRY, Assistant Director, Institute of Transportation and Traffic Engineering, University of California, Berkeley, Calif.
J. W. JOHNSON, Chief Engineer, California State Automobile Association, San Francisco, Calif.
BURTON W. MARSH, Director, Traffic Engineering and Safety, American Automobile Association, Washington, D. C.
J. K. MURPHY, Secretary, Train Operation, Control, and Signals, Association of American Railroads, Washington, D. C.
C. W. STARK, Secretary, National Committee on Uniform Traffic Laws and Ordinances, Washington, D. C.

WILLIAM G. ELIOT, 3d, *secretary*, Highway Engineer, Highway Transport Research Branch, Bureau of Public Roads, Washington, D. C.

Part I.—SIGNS

Section 9.—Dimensions

Section 9 no longer recommends that oversize signs should be used "sparingly." The first paragraph of the section is changed to read as follows:

The sign dimensions shown in this manual are to be regarded as the minimum standard. Increases above this minimum are permissible and desirable where investigation has shown that a larger sign is needed for adequate emphasis. The size of any sign must depend on the length of its message and the size and spacing of the letters that form the message, when the message is designed for adequate legibility.

Section 12.—Lettering

Section 12 now recommends against the use of Series A and Series B letters in reflectorized signs. The following paragraphs are added at the end of the section:

In reflectorized signs, other than street-name and parking signs, the use of the Series A and Series B alphabets should be avoided, because of their limited breadth and stroke width.

The Series A and B alphabets are the narrowest of the several standard alphabets designed for highway signs, as specified in this section.

(This may require redesign of the standard drawings for signs R-17, W-19, W-29, W-34 (pedestrian), M-4, M-5, M-6, M-15, M-16, M-17, M-18, and M-19.)

Section 16.—Sign Borders

Section 16 is revised to make sign borders optional rather than mandatory, and to specify no definite radius for the rounding of sign corners. The section now reads as follows:

With few exceptions, all signs illustrated herein have a narrow border of the same color as the message, just inside the edge. This improves the appearance and, in the case of embossed metal signs, the embossed border adds materially to their rigidity. A suitable border for 24-inch signs is from three-eighths to five-eighths inch in width, set in three-eighths inch from the edge, and for other sign sizes approximately in proportion. **On metal signs, corners shall be rounded.**

Section 17.—Standardization of Position

Section 17 is changed to provide for a higher mounting of rural signs. The following two paragraphs are substituted for the fifth paragraph of the section:

Signs in rural areas should normally be mounted at a height of at least 5 feet above the crown of the pavement to the bottom of the sign.

However, where parking is likely to occur, or where other obstructions are present, the height should be at least 7 feet to the bottom of the sign. In business and in residence districts signs should be mounted at least 7 feet high to the bottom of the sign.

Previous editions of this manual prescribed a lower minimum height for rural signs, but the higher mounting has been found to put the sign above much of the road splash, without a significant loss of nighttime legibility.

(Change of this section will require changes in figs. 1 and 2, and secs. 31, 33, 41, 42, 43, 44, 49, 50, 53, 54, 86, 91, 98, 99, 105, 114, and 115.)

Section 29.—Design of Stop Sign

Section 29 now specifies a red Stop sign, in place of the heretofore standard yellow sign. The section is revised, in its entirety, to read as follows:

Owing to the importance of Stop signs they are given a distinctive shape (octagon) and color (red). The red color is consistent with the accepted use of a red light as a Stop signal and of the color red as a special warning of danger.

The Stop sign shall be octagonal in shape, shall have a red background, and shall carry the word STOP in white letters at least one-third the height of the sign.

It is generally understood that the original decision to standardize on a yellow background for the Stop sign, rather than on the more logical red, was based largely on the unavailability of red pigments that would not fade on exposure. The standard design, therefore, has hitherto called for a yellow background with black letters, though various arrangements of a contrasting horizontal panel have also been used in an effort to improve legibility, especially in connection with reflectorization. California, having solved the problem of durability by resort to porcelain enamel, has used red for many years. The recent achievement of dependable red finishes, available in competitive materials, has made the red sign practical, and the Joint Committee has recognized an apparent trend of opinion among highway departments by accepting the red sign as the sole standard, eliminating the yellow sign and its variants with contrasting panels.

The minimum size of Stop signs in rural districts shall be 30 inches by 30 inches. In residence and business districts a minimum size of 24 inches by 24 inches may be used where speeds are low, traffic is light, and mounting space is limited. The 24-inch Stop sign is disproportionately small in relation to its importance, having an actual area less than 85 percent of that of the standard 24-inch warning sign.

All Stop signs shall be illuminated or reflectorized at least in the lettering. Illumination may be by floodlight, or by fixed white light in the letters. Reflectorization may be by white or clear reflecting units or reflecting coating in the letters, with or without a red reflecting coating on the background. In addition to such illumination or reflectorization, a flashing red signal, in operation both by day and by night, may be incorporated in the face of the sign or placed just above it.

Secondary messages, such as STATE HIGHWAY or THROUGH STREET, shall not be used on Stop signs.

(Revision of this section will require changes in secs. 8, 15, and 27, and in figs. 1, 3, 5, 8, 9, and 10.)

New Section: Yield Sign

This is a wholly new section providing for a Yield Right of Way sign to be inserted following section 31. The new section is as follows:

Section 31.1.—Yield Sign (R-39)

Some States and cities have found that at certain intersections where safety and efficiency require the normal right-of-way rule to be modified in favor of one of the highways, but where the standard Stop regulation is unduly restrictive, a YIELD RIGHT OF WAY sign is both effective and convenient. The effect of the sign is similar to that of a Stop sign, but vehicles controlled by it need not come to a full stop except when necessary to avoid interference with other traffic that is given the right of way.

The YIELD RIGHT OF WAY sign shall be an equilateral triangle with one point downward, having a yellow background with black lettering. Its sides shall be a minimum of 30 inches in length. It shall be reflectorized or illuminated. It shall be located and erected in the same manner as the Stop sign (sec. 31).

The Yield sign is still to be regarded as experimental in this country, though as a "Priority Road Ahead" sign it has had extensive and apparently successful use in Europe. Until it has proved its acceptability here it should be used cautiously, and only where suitable legislation has been adopted to define its meaning and to authorize its use. It should not be regarded as a substitute for the Stop sign where a Stop sign is warranted.

(The addition of this section will call for changes in or additions to sections 7, 8, 17, 26, 27, and 143.)

Section 35.—Speed Zone Ahead Sign (R-4)

To section 35 is added a specification that the length of the speed zone be shown under some circumstances. A new paragraph is inserted after the first paragraph of the section, as follows:

If the speed zone exceeds 3 miles in length, the sign shall indicate its approximate length.

Section 39.—No Passing Sign (R-11)

The change in section 39 provides for a shorter message that does not require an odd-sized plate. The title and first two paragraphs of the section are changed as follows:

Section 39.—Do Not Pass Sign (R-11)

The DO NOT PASS sign may be used on two- and three-lane roads at the beginning of a zone through which restricted sight distance makes overtaking and passing hazardous. It shall have black letters on a white background, and be of a minimum size of 18 inches by 24 inches. It shall be erected at the right-hand side of the roadway at a height of 5 feet to the bottom of the sign, not less than 6 feet nor more than 10



R-39
30" sides
(black on yellow)



R-11
18" x 24"

feet from the edge of the roadway. Because a driver about to pass a vehicle ahead often has only a restricted view to the right, an additional sign on the left-hand side of the road may be desirable.

The sign normally should be supplementary to standard pavement markings as described in part II of this manual (secs. 134, 135). Where pavement markings are well maintained, and weather conditions are not likely to hide the markings, the Do Not Pass sign need not be used.

Section 40.—End No Passing Zone Sign (R-12)

The change in section 40, as in section 39, provides for a shorter message and a new title. The section is changed in its entirety as follows:



R-12
18" x 24"

Section 40.—Pass With Care Sign (R-12)

The PASS WITH CARE sign may be used at the end of a no-passing zone where a Do Not Pass sign has been erected at the beginning. It shall be of the same size and color, and shall be erected in the same manner as the Do Not Pass sign.

Section 58.—Location of Warning Signs

Section 58 now includes a general provision for the advance placement of warning signs, increasing the distances previously specified in the succeeding sections. The section is revised, in its entirety, as follows:

Since warning signs are placed primarily for the protection of the driver who is unacquainted with the road, it is very important that thought and care be given to their location and erection. Although general specifications can be set up as to the distance at which the signs shall be placed in advance of the hazards warned against, there will be many instances where physical conditions will require different distances. Trial runs should be made by day and by night to determine the most effective location and erection characteristics for each installation. In cities, where speeds are relatively low, warning signs should usually be placed nearer to the points of hazard than on rural highways.

In cities, warning signs shall be erected 250 feet in advance of the hazard, and in rural areas 750 feet in advance, subject, however, to adjustment to local conditions. In rural and residence districts where no parking occurs, warning signs shall be erected not less than 6 feet nor more than 10 feet from the edge of the pavement or traveled roadway, with the lowest edge of the sign 5 feet above the crown of the roadway (fig. 1). In any location where they will obstruct sidewalks or pedestrian paths, however, they should be mounted at a height of not less than 7 feet to the bottom of the sign. In residence and business districts where parking is frequent, they shall be so set that the bottom of the sign is not less than 7

feet above the top of the curb, and the left-hand side not less than 1 foot back from the outside edge of the curb.

Signs indicating conditions that are temporary or intermittent in occurrence, such as road repairs, should be mounted on low portable standards so that they can be set up and removed as required.

Figures 5 and 6 show typical installations of warning signs.

(Change of this section will require omission of distance specifications in secs. 59, 60, 61, 62, 64, 66, 67, 69, 70, 71, 72, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 85, 87, 88, and 90.)

Section 112.—Cardinal Direction Marker (M-21)

Section 112 is changed to shorten the wording on the Cardinal Direction Marker, and to make its use mandatory under some conditions. The revised section is as follows:

The Cardinal Direction Marker shall be a plate 16½ inches by 8 inches in size, carrying the word EAST, WEST, NORTH, or SOUTH, in black letters on a white background. It shall be mounted directly above a Route Marker (M-1, M-2) or an Oversize Route Marker (M-101, M-102) to indicate the general direction of the route wherever motorists, in transferring from one route to another, might be confused as to the direction in which the intersected route might take them.



M-21
16½" x 8"

Section 116.—Street Name Sign (D-5)

To section 116 is added a reference to reflectorization. A new paragraph is added at the end of the section, as follows:

Where street illumination is inadequate for clear legibility of Street Name signs, consideration should be given to their reflectorization.

Part II.—MARKINGS

Section 126.—Reflectorization

Section 126 now makes the reflectorization of certain rural pavement markings mandatory. The section is revised in its entirety, as follows:

All rural pavement markings, if having application at night, shall be reflectorized. Reflectorizing is not ordinarily essential on well-lighted city streets, but on other streets it is generally desirable for markings that must be visible at night.

(Revision of this section will require changes in secs. 129, 134, 138, 139, and 146.)

Section 146.—Approach to Railroad Crossing

Without change in the text of section 146, figure 18 is modified to eliminate the transverse markings extending to the left of the center line.

Part III.—SIGNALS

Section 167.—Meaning of Color and Arrow Indications

Section 167 is amended to describe certain signal indications more clearly, and to recommend use of a new sign under certain circumstances. The section is changed by revising the italic side heads as follows:

For "Yellow (alone, following green)" there is substituted "Steady yellow (alone, preceding red)".

For "Red (alone)" there is substituted "Steady red (alone)".

For "Red with green arrow" there is substituted "Steady red with green arrow".

Section 167 is further revised by inserting a new paragraph at the end of the discussion of "Steady red with green arrow" as follows:

Where red is displayed with a vertical green arrow it is recommended that a sign be used with the message MOVE ON ARROW, or its equivalent.

(This will require an additional regulatory sign in part I of the manual).

Section 173.—Number of Signal Faces

Section 173 is amended to require two signal faces on each approach. The following two paragraphs are substituted for the first three paragraphs of the section:

There shall be two or more signal faces visible to traffic on each approach to the intersection.

The advantages of having at least two faces for each approach roadway are believed sufficient to warrant making this a general requirement. Trucks and buses very frequently obscure one-face installations, leaving the drivers of vehicles immediately behind uncertain of the signal indications as they approach. Two properly located faces will, at practically all intersections, provide drivers with a signal indication sufficiently in advance to insure their proper reactions to conditions at the intersection.

(This will require changes in fig. 22.)

Section 175. Location of Signal Faces at Intersections

Section 175 is changed to substitute time for distance in specifying view requirements in connection with auxiliary signals or signs, to take account of approach speeds. The last paragraph of the section is amended to read as follows:

Where physical conditions prevent a vehicle driver from having a continuous view of at least one signal indication for approximately 10 seconds before reaching the Stop line, an auxiliary signal location shall be used to provide this visibility. If physical conditions make it impossible to provide any location which can be seen for 10 seconds in advance, a caution signal (sec. 278) or a Signals Ahead sign (sec. 70) shall be erected in a suitable position to warn approaching traffic.

Section 194.—Vehicle-Clearance Interval

The change in section 194 is only a deletion of the argument for an all-way red interval. The last paragraph of the section is amended to read, in its entirety, as follows:

Some authorities feel that a short all-way red indication not to exceed about 3 seconds in duration immediately after the normal yellow clearance interval has merit at some intersections.

Section 208.—Minimum Vehicular Volume

The minimum vehicular volume warrants in section 208 are raised. The second paragraph of the section is amended to read:

The minimum vehicular volume warrants are as follows:

*In urban areas:*⁶

1. Total vehicular volume entering the intersection from all approaches must exceed 750 vehicles per hour for each of 8 hours of an average day, and
2. Total vehicular volume entering the intersection from the minor street or streets must exceed 250 vehicles per hour for the same 8 hours.

*In rural areas:*⁶

1. Total vehicular volume entering the intersection from all approaches must exceed 500 vehicles per hour for each of 8 hours of an average day, and
2. Total vehicular volume entering the intersection from the minor highway or highways must exceed 125 vehicles per hour for the same 8 hours.

Section 209.—Interruption of Continuous Traffic

In section 209, the warrants are revised, and to the urban warrants is added a qualification regarding coordinated traffic flow. The specific warrants for short-time or part-time signal control are eliminated. The first and last paragraphs of the section are retained, and for the intervening paragraphs the following is substituted:

Minimum warrants for interruption of continuous traffic are as follows:

In urban areas:

1. At an intersection on an important street, the vehicle volume along that principal street must exceed 750 vehicles per hour for each of 8 hours of an average day; and
2. The combined vehicle and pedestrian volume from the side street or streets must exceed 75 units per hour for the same 8 hours; and
3. The average⁶ vehicle speed must exceed 20 miles per hour on the principal street approaches to the intersection; and
4. The signal installation must not adversely affect coordinated traffic flow.

In rural areas:

1. At an intersection on an important highway, the vehicle volume along that principal highway must exceed 500 vehicles per hour for each of 8 hours of an average day; and
2. The combined vehicle and pedestrian volume from the side highway or highways must exceed 50 units per hour for the same 8 hours; and
3. The average⁶ vehicle speed must exceed 35 miles per hour on the principal highway approaches to the intersection.

Under some conditions there is an apparent need for signals during only brief peak periods, as at the entrance to an industrial plant or a stadium. No numerical traffic warrants can be prescribed for such installations, and their justification can be determined only on the basis of engineering experience and study of the locality.

Section 210.—Minimum Pedestrian Volume

Section 210 is changed to modify the pedestrian volume warrants. Without change in the remainder of the section, the warrants in the first paragraph are amended as follows:

In urban areas:

1. Pedestrian volume crossing the major street must exceed 250 persons per hour for each of 8 hours of an average day; and
2. Vehicular traffic entering from the major street must exceed 600 vehicles per hour for the same 8 hours; and
3. The average⁷ vehicle speed must exceed 15 miles per hour on the approaches to the intersection.

In rural areas:

1. Pedestrian volume crossing the major highway must exceed 125 persons per hour for each of 8 hours of an average day; and
2. Vehicular traffic entering from the major highway must exceed 300 vehicles per hour for the same 8 hours; and
3. The average⁸ vehicle speed must exceed 30 miles per hour on the approaches to the intersection.

Section 212.—Accident Hazard

Section 212 is changed only to raise the property-damage accident criterion in the second numbered warrant in the first paragraph. The amended warrant now reads as follows:

2. Five or more reported accidents of types susceptible of correction by a traffic control signal have occurred within a 12-month period, each accident involving personal injury or property damage to an apparent extent of \$50 or more; and

Section 270.—Warrants

Section 270 is revised to recognize the value of adult crossing guards as an alternative to police officers at school crossings. The last paragraph of the section is amended to read as follows:

In connection with signals installed for school crossings, it should be understood that the signal is not the only remedy nor is it necessarily the best solution to the perplexing problem of traffic conflicts between vehicles and school children. Brief periods during which the hazards are unusually high may often be better handled by officer control or adult crossing guards. In some circumstances, the pupils' respect for traffic signal indications may be so low as to make the installation of a signal a contributory factor in increasing rather than decreasing accidents. The obedience response to officer control or adult crossing guards is usually less uncertain. Complete facts should be obtained and studied by competent traffic engineering authorities before decisions are made on special school signal installations.

Section 272.—General Design Requirements

In section 272 the description of one type of pedestrian control signal is changed. The second approved design for pedestrian control signals is revised to read:

2. A rectangular box-type signal in which the words WALK and DON'T WALK or WALK and WAIT are properly illuminated.

H—TRAIN-APPROACH SIGNALS AND GATES (secs. 295–311)

The entire subdivision H of part III of the manual, including sections 295–311, has been reorganized to treat train-approach signals and automatic gates together, instead of separately. There is little change of substance, except the adding of new provisions for special No-Turn signals, for application where a highway adjacent to a railroad intersects a highway crossing the railroad at grade. The height

of signal lights and of gates is increased by 6 inches. The original 17 sections are reduced to 9, sections 295–303. The complete new text for these sections is as follows:

Section 295.—Railroad-Highway Grade-Crossing Protection

Signs are inadequate protection at railroad crossings where highway traffic is heavy, train movements are frequent, or visibility is seriously obstructed. At such crossings, there should be installed signals to indicate the approach and passage of trains, or gates which will extend into or across the roadway to prevent vehicles from entering upon the crossing while trains are approaching and occupying the crossing. The following sections deal only with signals and gates of the automatic type.

Section 296.—Classification and Definitions

Railroad-highway grade-crossing signals are classified as flashing-light or wigwag signals.

A flashing-light signal is a signal in which indication of the approach of a train is given by two horizontal red lights flashing alternately at predetermined intervals.

A wigwag signal is similar to the flashing-light signal except that the indication of the approach of a train is given by a swinging disk and a red light enclosed in the disk.

A railroad-highway grade-crossing automatic gate is a device which, when indicating the approach and passage of a train, presents toward the highway in both directions the appearance of an arm being lowered to or in a horizontal position, and extending over the traveled roadway a sufficient distance to cover the lanes used by traffic approaching the crossing.

A No Right Turn or No Left Turn signal is a device which, when indicating the approach and passage of a train, presents the aspect of an illuminated sign bearing the legend NO RIGHT TURN or NO LEFT TURN, surmounted by a flashing yellow marker light.

Section 297.—Warrants

Automatic signals or automatic signals and gates of the type described herein shall be installed at railroad-highway grade crossings to warn highway traffic of any approaching train where the volume of traffic of both the railroad and the highway warrants, or where physical obstructions to clear vision exist on highway approaches. These devices shall be used for no other purpose.

On a highway adjacent to and approximately paralleling a railroad, which intersects or joins another highway that crosses the railroad, a signal device displaying the legend NO RIGHT TURN or NO LEFT TURN on the approach of a train may be used to supplement the highway grade-crossing signals which are located at the crossing.

Section 298.—Types of Control

Flashing-light and wigwag signals may be controlled manually, or automatically through track circuits. The flashing-light signals shall operate until the rear of the train reaches or clears the crossing and they shall operate upon the approach of trains from either direction on the tracks for which protection is provided.

The control of No Right Turn and No Left Turn signals shall be correlated with the grade-crossing signal control.

Automatic gates may be controlled manually, or automatically through track circuits. The gates shall reach the full horizontal position before the arrival of the fastest train operated over the crossing and shall remain down until the rear of the train has cleared the crossing, and they shall operate upon the approach of trains from either direction on the tracks for which protection is provided.

Section 299.—Design

Flashing-light signals.—The following provisions relate to the design of flashing-light signals:

1. Signal lights shall be arranged to shine in both directions along the highway. They shall be mounted horizontally on 30-inch centers and preferably not less than 7½ feet, nor more than 9½ feet above the surface of the highway.

2. Electric-light units shall be in accordance with Association of American Railroads' *Signal Section Specification 190 or 232*. Roundels and outer lenses shall be a minimum of 8⅝ inches in diameter and shall be in accordance with *Signal Section Specification 69* of the Association of American Railroads.

3. The Railroad Crossbuck sign (sec. 89) and the signal shall be mounted on the same post.

Wigwag signals.—The following provisions relate to the design of wigwag signals:

1. A wigwag signal shall consist of a disk 20 inches in diameter, in the center of which a lamp with red lens or roundel is provided for night indication.

2. The disk shall be supported by a pivoted rod and the length of stroke of the swinging light in the disk measured horizontally between extreme positions shall be 30 inches.

3. Lenses or roundels shall be a minimum of 5 inches in diameter, and shall be in accordance with *Signal Section Specification 69* of the Association of American Railroads.

4. The Railroad Crossbuck sign (sec. 89) and the signal shall be mounted on the same post.

Automatic gates.—The following provisions relate to the design of automatic gates:

1. An automatic gate used for the protection of highway traffic at a railroad-highway grade crossing, when indicating the approach of a train, shall present toward approaching highway traffic the aspect of an arm equipped with red lights being lowered across the lane or lanes used by traffic approaching the crossing, or at rest in the horizontal position across the lane or lanes.

2. An automatic gate, when installed, shall serve as an adjunct to a highway crossing signal. It should be mounted on the same assembly as the flashing-light signal; however, where conditions require it may be mounted on an independent pipe post or pedestal located between the signal and the track.

3. The bottom of the gate arms, when in the horizontal or lowered position, shall be not less than 3½ feet nor more than 4½ feet above the crown of the roadway and, when not indicating the approach of a train, shall neither obstruct nor interfere with highway traffic.

4. Each gate arm extending over the highway shall have three red lights shining in both directions along the highway. The light nearest the tip shall burn steadily and the other two lights shall flash alternately.

5. The gate arms shall be painted on both sides with 16-inch alternate diagonal stripes of white and black.

6. Lenses shall be in accordance with *Signal Section Specification 69* of the Association of American Railroads.

Insofar as practicable, the mechanisms should be so designed that if the arms, while being raised or lowered, strike or foul an object, they will readily stop and, upon removal of the obstruction, assume the position corresponding with the control apparatus.

No Right Turn and No Left Turn signals.—The following provisions relate to the design of No Right Turn and No Left Turn signals:

1. The aspect shall be that of an illuminated sign bearing the legend NO RIGHT TURN or NO LEFT TURN surmounted by a flashing yellow marker light.

2. The sign shall be in accordance with Association of American Railroads' *Signal Section Specification 231*.

3. The marker light shall be in accordance with Association of American Railroads' *Signal Section Specification 190 or 232*, except to display yellow and be arranged for fastening to a bracket.

Section 300.—Location

One signal or one signal and gate shall be placed on each side of the track, except in the cases of established one-way streets, where the installation shall be made on the approach side. Signals and gates shall preferably be placed on the right of approaching traffic.

The location of signals and automatic gates for railroad-highway grade-crossing protection should be determined after inspection and study at the site. In addition to providing for adequate clearances, consideration should be given to the type of highway, angle of crossing, and visibility to drivers approaching the crossing.

The No Right Turn or No Left Turn signal, when used, should be placed to the right of the parallel highway approaching the crossing and as close to the intersection as practicable.

Section 301.—Installation

Signals and gates shall be installed in accordance with the standards and practices recommended in *Railroad-Highway Grade Crossing Protection Bulletin No. 4* (or subsequent issue), Association of American Railroads, Joint Committee on Grade Crossing Protection (now Train Operation, Control, and Signals).

Section 302.—Operation

Automatic crossing signals used to indicate the approach of trains shall so indicate for not less than 20 seconds before the arrival of the fastest train operated over the crossing. Circuits for the operation of automatic gates shall be so arranged that the gate arm shall start its downward motion not less than 3 seconds after the signal lights start to operate. The gate arm shall reach full horizontal position before arrival of the fastest train operated over the crossing and shall remain in that position until the rear of the train has cleared the crossing.

Local conditions may require an operating time longer than 20 seconds before arrival of the train, but too long an operation by slow trains is undesirable. Uniform time control for all train speeds is the most desirable arrangement, and at crossings where there is considerable difference between high and low train speeds and where travel on the highway is heavy, provision for a type of circuit control that will insure equal or approximately equal timing should be considered.

Electric lamps in the flashing-light type of signals shall flash alternately. The number of flashes of each electric lamp per minute shall be 30 minimum, 45 maximum. Electric lamps shall each burn approximately the same length of time. Total burning time of both electric lamps shall be practically the entire operating time.

Flashing-light unit shall have range in accordance with *Section Specification 190 or 232 of the Association of American Railroads.*

With the wigwag type of signal, movement of the swinging disk from one extreme to the other and back constitutes a cycle. The number of cycles per minute shall be 30 minimum, 45 maximum.

The electric-light unit of the wigwag signal, when the disk is suspended vertically, shall have a range, at night, of 1,500 feet through a total angle of not less than 20 degrees when a 10-watt lamp rated at 1,000 hours is burned at rated voltage. The lamp shall burn while the disk is swinging.

The No Right Turn and No Left Turn signal sign shall be legible only when the crossing signal indicates the approach of a train. It shall be illuminated without flashing during the period that the crossing signals are operating, and the yellow marker light shall flash in synchronism with the crossing signals.

Section 303.—Maintenance

Automatic signals and gates shall be kept well painted and in a good state of efficiency. The surfaces of lenses on signal and gate-arm lights shall be kept free from such deposits as soot or other materials, since these will seriously affect their efficiency.

Sections 304-311.—Automatic Gates

Former sections 304-311 have been combined with the revised sections 296-303 and are no longer in the manual.

Part IV.—ISLANDS

Section 312.—Functions of Islands

Section 312 is amended to refer to the policies of the American Association of State Highway Officials for guidance in highway design. An additional paragraph is inserted following the first paragraph of the section, as follows:

This manual is not intended as a design manual for highway engineering and construction. While it suggests minimum standards for certain types of islands, it deals with islands as a traffic-control device rather than as an element of highway design. For guides to highway design, reference is made to *A Policy on Geometric Design of Rural Highways*, 1954, adopted by the American Association of State Highway Officials, and published by the Association.

Section 313.—General Engineering Requirements

In section 313 a reference to parking has been added. An additional paragraph is inserted following the first paragraph of the section, as follows:

It is usually necessary to provide additional street width for traffic movement when an island is installed. This can often be accomplished by the simple expedient of prohibiting parking adjacent to and in the immediate vicinity of the island. As a general rule, parking adjacent to an island is undesirable and unsafe, as its effect is to destroy the geometric pattern for which the island is designed.

Section 328.—Direction of Flow

To section 328 is added a suggestion that left turns are an element to be considered in determining whether traffic may pass to the left of loading islands. The second paragraph of the section is revised as follows:

The requirement that automobiles and trucks shall pass to the right of the loading island may virtually eliminate one traffic lane. However, on streets where parking is permitted the restrictive effect may be minimized by adoption and enforcement of the provision in Act V of the Uniform Vehicle Code (sec. 112) which prohibits parking alongside the islands and for proper distances beyond their ends. In locations where the traffic of transit vehicles stopping alongside loading islands is light and other traffic is fairly heavy, it is usually desirable to permit the general traffic to pass on either side of the island. If the island is at an intersection where left turns are frequent, also, it may be advantageous to allow traffic to pass on the left of the island to avoid a crossing conflict between left-turning and transit vehicles at the far end of the island. Allowing other than transit vehicles to pass to the left of the island, however, may delay streetcars and buses in reaching the island, with consequent loss of time to passengers and derangement of transit schedules.

Section 336.—Designation of Area

Section 336 is amended to include jiggle bars as a means of designating refuge islands. The first sentence of the section is changed to read as follows:

Refuge islands are in practice designated by platforms, markings, mushroom buttons, or jiggle bars (figs. 28, 40-45).

(This will call for corresponding changes in the "summary specifications," p. 189).

Section 337.—Continuous Median

Section 337 is revised to avoid the implication that certain features of a continuous median are disadvantages. The section now reads as follows:

In roadways requiring median islands at each intersection, consideration should be given to the alternative of a continuous median between intersections. Such a median will obviate the expense of buffers and other approach-end protection at each intersection, minimize weaving between intersections, and afford other advantages of a divided highway. The desirability of barring vehicles on one side of the street from direct access to alleys, filling stations and other business facilities, and residences on the other side must be weighed on the basis of local circumstances.

Section 338.—Dimensions

Section 338 is changed to provide for a greater length for refuge islands. The first paragraph of the section is revised as follows:

Length and width.—Refuge islands shall be at least 4 feet and preferably at least 6 feet wide. The length along the roadway shall not be less than 10 feet nor less than the width of the cross walk, with additional length as required for visibility and end protection.

Section 341.—Side Protection

Section 341 is changed by adding jiggle bars as a means of protection. The section is amended to read as follows:

When part of the refuge island is kept at pavement level, as recommended in section 336, mushroom buttons, jiggle bars, or more substantial protection should be provided at any corners which might otherwise be encroached upon by turning vehicles.

Section 346.—Functions

To section 346 is added a fifth function with reference to the separation of auxiliary lanes. A fifth numbered item is added to the first paragraph of the section as follows:

5. At the edge of the traveled way, to separate through traffic from that slowing down or stopping on an auxiliary lane such as a bus stop or median lane.

Section 351.—Curbs

Section 351 is changed to avoid controversial matters of specific curb design, and to refer to current policies of the American Association of State Highway Officials. The section is amended to read, in its entirety, as follows:

Different conditions call for different types of curbs bounding traffic islands. In all cases they should be designed in accordance with the needs of the situation, giving consideration to such elements as speeds, median widths, and pedestrian safety. At some locations relatively low mountable curbs are desirable. Barrier curbs, to confine vehicles to the pavement or to particular lanes, may be required elsewhere. At cross walks or adjacent to heavy pedestrian traffic, relatively low curbs will minimize the danger of falls.

For a discussion of curb design, reference is made to *A Policy on Geometric Design of Rural Highways, 1954*, American Association of State Highway Officials.

Section 352.—Approach-End Treatment

Section 352 is amended to omit any specific dimension for the nose of a divisional island, and to make reference to policies of the American Association of State Highway Officials. For the last paragraph of the section, the following is substituted:

At the beginning of a divisional island constituting a median, the island nose should be offset to the left, as faced by approaching traffic, the right curb of the island forming a diverging taper to deflect traffic toward the right. Where a divisional island is introduced between two lanes of traffic moving in the same direction, similar offsets may be used on each side of the nose to direct traffic into the separate roadways. At cross-road openings in divisional islands the island nose may be made semicircular or of a tapered and rounded shape for left-turning movements, consistent with the island width.

For detailed recommendations on curb design for approach-end treatment, reference is made to *A Policy on Geometric Design of Rural Highways, 1954*, American Association of State Highway Officials.

Section 361.—Dimensions

Table 3 is brought up to date, in accordance with the current recommendations of the American Association of State Highway Officials in *A Policy on Geometric Design of Rural Highways, 1954*.

Table 3.—Design width of pavements for turning roadways

	Case I: One-lane one-way operation—no provision for passing			Case II: One-lane one-way operation—with provision for passing a stalled vehicle			Case III: Two-lane operation—either one-way or two-way		
	A	B	C	A	B	C	A	B	C
PAVEMENT WIDTH FOR DESIGN TRAFFIC CONDITION ¹ —									
Radius on inner edge of pavement:									
50 feet.....	16	17	20	21	24	27	30	33	37
75 feet.....	15	18	18	20	22	25	28	31	34
100 feet.....	14	18	17	19	21	24	27	30	33
150 feet.....	13	15	16	18	20	23	26	29	31
200 feet.....	13	15	16	18	20	22	26	28	29
300 feet.....	12	15	15	17	19	21	25	27	28
400 feet.....	12	14	15	17	19	21	25	27	28
500 feet.....	12	14	15	17	19	21	25	27	28
Tangent.....	12	14	14	16	18	20	22	24	24
WIDTH MODIFICATION ACCORDING TO TREATMENT OF EDGE OF PAVEMENT									
No stabilized shoulder.....	None			None			None		
Mountable curb.....	None			None			None		
Barrier curb:									
One side.....	Add 1 foot			None			Add 1 foot		
Two sides.....	Add 2 feet			Add 1 foot			Add 2 feet		
Stabilized shoulder, one or both sides.	None			Deduct shoulder width; minimum pavement width as under case I.			Deduct 2 feet where shoulder is 4 feet or wider.		

¹ Traffic condition A.—Predominantly passenger vehicles but some consideration for single-unit trucks.
 Traffic condition B.—Sufficient single-unit vehicles to govern design, but some consideration for semi-trailer vehicles.
 Traffic condition C.—Sufficient semitrailer vehicles to govern design.