

National Conference on Street and Highway Safety

Honorable ROBERT P. LAMONT

Secretary of Commerce, *Chairman*



MANUAL ON STREET TRAFFIC SIGNS, SIGNALS AND MARKINGS

As prepared by

AMERICAN ENGINEERING COUNCIL

For the National Conference on Street and Highway Safety in 1928-1929, with
modifications based on experience of the past year and approved by the
Third National Conference on Street and Highway Safety,
May 27-28-29, 1930



WASHINGTON, D. C.

September 15, 1930

**Associations cooperating with the Department of Commerce
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NATIONAL AUTOMOBILE CHAMBER OF COMMERCE
NATIONAL BUREAU OF CASUALTY & SURETY UNDERWRITERS
NATIONAL SAFETY COUNCIL
RUBBER MANUFACTURERS ASSOCIATION

The Automobile Club of Southern California made substantial contributions to the staff work on the Uniform Vehicle Code and Model Municipal Traffic Ordinance (1925-30). The National Research Council contributed substantially to financing the work of the Committee on Causes of Accident (1925-26). The American Engineering Council conducted and financed the development of the Report on Street Traffic Signs, Signals and Markings (1927-30).

FOREWORD

The work of the National Conference on Street and Highway Safety had shown as early as 1926 that a valuable public service could be rendered by the establishment of greater uniformity in the use of street traffic signs, signals and markings. American Engineering Council in that year offered to make a national survey of the existing conditions and to prepare a recommended practice. This offer was accepted, and the Council then appointed a Committee on Street Traffic Signs, Signals and Markings. To this committee was assigned the task of obtaining the fundamental facts, compiling and analyzing them, and drafting a recommended practice.

The personnel of American Engineering Council's committee was made a part of the committee of the National Conference on Street and Highway Safety organized in 1927 to draft a model municipal traffic ordinance, and thus the closest contact and fullest coordination between the work of the two committees were maintained. After the work had been begun, the personnel of the Council committee was enlarged to function as a Sectional Committee on Traffic Signs, Signals and Markings according to the procedure of the American Standards Association.

In the preparation of the Manual detailed data were collected and analyzed regarding existing practices in more than 100 cities in 35 States and having a total population of more than 33,000,000. The Manual prepared on the basis of this survey was thus believed to cover all conditions and methods of traffic control. At the same time it has been made to harmonize with the Manual of U. S. Standard Road Markers adopted by the American Association of State Highway Officials for use on rural highways.

Since the completion of the Manual of Street Traffic Signs, Signals and Markings early in 1929 a substantial number of cities and towns have adopted it, and there has thus been developed considerable experience with its actual operation. Early in 1930 it was reviewed in the light of this experience—first, by the Council Committee as a subcommittee of the National Conference Committee on Uniform Traffic Regulation; second, by the latter Committee in conjunction with its review of the Uniform Vehicle Code and the Model Municipal Traffic Ordinance; and finally, by the Third National Conference on Street and Highway Safety held on May 27-28-29, 1930.

Prior to the Conference the Manual had been widely distributed and comments had been solicited and carefully considered by the committees. As presented to the Third National Conference it embodied a number of important changes from the original draft. The Third National Conference, which was participated in by delegates from nearly every State

in the Union, including official representatives appointed by the Governors of forty-two States, considered the revised draft in detail and, after making certain further changes, unanimously approved the Manual as here presented, and recommended it for adoption by municipalities.

The Manual affords technical standards for traffic control devices, the legal significance of which is prescribed in the Model Municipal Traffic Ordinance.

ROBERT P. LAMONT,
Secretary of Commerce.

Washington, D. C.
September 15, 1930.

This manual is a revision of and supersedes the "Report of the Committee of American Engineering Council on Street Traffic Signs, Signals and Markings, 1929."

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The Committee on Street Traffic Signs, Signals and Markings expresses its sincere appreciation to the local committees of engineers who assisted in obtaining data as to local practices, automobile associations, chambers of commerce, safety councils and engineering societies, as well as to traffic directors, chiefs of police, consulting engineers and others who have given so generously of their time and experience in the development of the fundamental data upon which this report is based; and to the American Automobile Association, Cleveland Railway Company, National Automobile Chamber of Commerce, and Pittsburgh Railways Company, which assisted in providing the means to carry on the study.

Recommended Practice

Some of the outstanding tendencies which this survey discloses justify an emphatic word of warning. It is clearly obvious that some cities are making two fundamental errors in installing street traffic signs, signals, and markings. These errors are:

1. Placing traffic control devices without adequate study of the conditions which their use is intended to improve, or of the evil effects produced at several and other intersections resulting from the attempt to correct undesirable conditions at one particular intersection.

2. Operating traffic control devices at places and times not justified by the conditions.

If these tendencies continue, the inevitable result will be a public recognition of the errors and a consequent neglect or unfriendliness toward street traffic signs, signals, and markings. This neglect will lead to the ultimate defeat of useful and effective methods of traffic control. Such fundamental errors can be avoided by obtaining expert engineering advice before any system of street traffic signs, signals and markings is established. A method of procedure for this purpose, which is now successfully employed in some cities, is outlined in the report of the Committee on Metropolitan Traffic Facilities of the National Conference on Street and Highway Safety, and provides for the creation of a traffic commission with a technical staff.

The study shows clearly that there is wide variation in the practice of placing the official responsibility for the selection, placement, and maintenance of traffic signs, signals, and markings. The practice is so diverse that no general statement relating to it can be made. In most cities the responsibility is placed upon some branch of the police department. No standard official organization handles questions relating to traffic signs, signals, and markings, and this defect is perhaps one of the most serious features of the present condition.

As there is great variation in the State laws regarding signs and signals, it is obviously impossible to make recommendations that can be universally adopted until many such laws are amended. Consequently some municipalities may have to permit some deviations from these recommendations so as to make them conform to the requirements of State laws.

A vast amount of the equipment now in use does not conform to the recommendations here made, but most of such equipment can be made to conform substantially with the recommendations without excessive cost. Whenever new equipment is purchased or replacements are made because of the need of repairs or because of obsolescence, strict adherence to the preferred standards should govern the selection.

Section 1. Street Traffic Signs

Adequate signs are great aids to the drivers of vehicles and are therefore important means of safeguarding and expediting traffic. To be adequate every traffic sign should be so thoughtfully designed and so carefully placed as to convey its message quickly and clearly at the exact time and place it is needed. These requirements mean simple wording; standard shape, color, lettering, and location; announcement of the official authority if that is legally required; and the removal of every unofficial sign that in any way conflicts with the requirements. No matter how effectively traffic signs may be designed and placed, the results desired will not be realized until the messages conveyed are carefully observed by drivers and the regulations implied are zealously enforced. With these facts in mind the committee has formulated and here submits some basic essential recommendations concerning the design, location, and use of street traffic signs.

RECOMMENDATION 1.—*Material and Finish.*

(a) Select sign material and finish first for durability, second for economy.

(b) Use cast metal (either iron or aluminum), sheet metal (either steel or aluminum), or wood; *here named in the order of preference.*

(c) For all signs use the specifications proposed by the Joint Board on Interstate Highways of the Bureau of Public Roads, the American Association of State Highway Officials, and the United States Bureau of Standards. (See Appendixes A and B.)

(d) Use non-corrosive screws and washers for attaching sign to its support in order to avoid discoloration.

RECOMMENDATION 2.—*Shapes and Dimensions.*

The following shapes shall be used for the purposes indicated:

Railroad Crossing	Cross Buck
Railroad Advance Warning...	Circular
Stop.....	Octagonal
Slow	Diamond
Caution.....	Square
One Way and Detour.....	Arrow, or Arrow on Rectangle
Information	Rectangular
Restriction	Rectangular

All signs should be made in the dimensions hereafter specified if possible, but existing equipment that varies somewhat from the specifications may be used provided the general proportions are the same. Most of these dimensions are smaller than those given in the code of the American Association of State Highway Officials, because vehicles generally move more slowly in city traffic than on rural highways, and signs may be seen at shorter distances in cities; also because smaller signs occupy less space and do not so seriously interfere with the vision of pedestrians if placed below their average height.

RECOMMENDATION 3.—*Colors.*

The combinations of colors here specified shall be used for the purposes indicated (See Appendix B for paint specifications):

Railroad Crossing.....	Black letters on white background
Railroad Advance Warning..	Black letters on yellow background
Stop.....	Red letters on yellow background
Slow.....	Black letters on yellow background
Caution.....	Black letters on yellow background
One Way and Detour.....	Black letters on white arrow
Information.....	Black letters on white background
No Parking.....	Red letters on white background
Limited Time Parking.....	Green letters on white background
Pedestrian Restriction.....	Blue letters on white background
Other Restrictions.....	Black letters on white background

The colors recommended above for Stop signs combine a yellow background with red for the word "Stop," in conformity with the generally recognized meaning of that color in traffic control devices of other types. This combination avoids the disadvantage of black letters on a yellow background, recommended by the Joint Board of Interstate Highways, in which the black letters cannot be made luminous at night, a disadvantage that has led to the modification of the sign by the introduction of a black band across the sign on which is imposed the word "Stop" in white letters, making a three-color combination. The American Association of State Highway Officials has recently adopted the combination of red letters on a yellow background as an approved alternative to its original standard of black on yellow.

The stop signs recommended above avoid the disadvantage of white letters on a red background, proposed by the Traffic Signal Color Code Committee, in which the red background is not clearly visible at night and the letters if illuminated appear white instead of red.

RECOMMENDATION 4.—*Lettering and Wording.*

The lettering, wording, and arrangement here specified shall be used for each type of traffic sign, but symbols may be added or equivalent words may be substituted if the standard size and arrangement are maintained. Suitable wording in small letters expressing local authority shall be placed on the bottom of all signs when specified by law or regulation.

Letters and figures used on signs recommended in this manual are of standard proportions based on the alphabets issued by the U. S. Bureau of Public Roads. Full size drawings of these letters for sizes covering from 2 to 8 inches, and for Series A to F in width, can be obtained by application to the Bureau.

RECOMMENDATION 5.—*Illumination.*

All important traffic signs shall be clearly visible day and night. Signs

that affect the safety of night driving should be adequately illuminated. Certain important directional signs that are intended primarily to facilitate traffic may be illuminated at night. In this report signs that require illumination at night are specifically mentioned. This illumination shall be provided by one of the methods listed below, *named in the order of preference*:

- (a) Attached lamps flooding the face of the sign.
- (b) Illuminated by light within or behind sign.
- (c) Signs so located as to be illuminated adequately by street lights.
- (d) Reflecting letters illuminated by headlights of vehicles.

Method (a) provides a positive means of illumination. Method (b) is less positive because of the possible accumulation of dust on the translucent lenses. Method (c) is subject to varying distances from the street lights, improper angles, swinging branches and other interferences. Method (d) is limited in use as indicated under Recommendation 7.

If beacon lights are used in conjunction with signs, the color of the beacon lights should conform to the code of the color meanings for Beacon Signals given on page 32.

RECOMMENDATION 6.—*Maintenance.*

All traffic signs shall be continuously kept in good order and clearly legible.

RECOMMENDATION 7.—*Height and Location.*

Traffic signs shall be located with due regard to the character of the message to be conveyed in order to obtain the maximum observance. The location of a sign giving warning of a hazard just ahead may be quite different from that of a sign giving an order to be obeyed at a particular point.

For the locations indicated below the signs shall be at the heights specified:

- (a) The center of a sign on a fixed post back of the curb shall be 8 feet above the road pavement, and no part of the sign shall be closer to the curb line than 12 inches.
- (b) The center of a sign on a movable post in the roadway shall be 4 feet above the pavement.
- (c) The center of a reflecting sign used to mark an obstruction in the roadway shall be 3 feet above the pavement.
- (d) Signs should not unnecessarily be placed on or within ten feet of poles which have to be climbed.

The location of curb signs at a standard height of eight feet is required in order to insure their visibility above pedestrians and vehicles. For the illumination of such signs, dependence cannot be placed on headlights alone.

RAILROAD CROSSING AND RAILROAD ADVANCE WARNING SIGNS

It is recommended that the following specifications for railroad crossing and railroad advance warning signs be used as standards where they do not conflict with State laws, and that State laws which do conflict be amended.

RECOMMENDATION 8.—*Railroad Crossing.*

- (a) A railroad crossing sign shall be made of two arms mounted across each other in inclined positions to form a crossbuck.
- (b) The sign shall be placed not more than 15 feet from the railroad crossing.
- (c) The letters shall be black on a white background.
- (d) In case of multiple tracks, there shall be mounted below the crossbuck arms a sign indicating in black letters on a white background the number of tracks.

RECOMMENDATION 9.—*Railroad Advance Warning.*

- (a) A railroad advance warning sign shall be circular, 24 inches in outside diameter, and shall have a bead border around the edge.
- (b) The sign shall be divided into quadrants by one horizontal and one vertical line $2\frac{1}{2}$ inches wide.
- (c) A letter R, 5 inches high by $3\frac{3}{4}$ inches wide, shall be placed in each of the upper quadrants.
- (d) The sign shall be placed 100 feet or more from the railroad crossing.
- (e) If there is a street intersection within 100 feet, an additional sign or signs shall be so placed as to warn traffic approaching the crossing from each intersecting street.
- (f) The sign shall be clearly illuminated at night.
- (g) The letters shall be black on a yellow background. (Some States require white instead of yellow.)

STOP SIGNS

RECOMMENDATION 10.—*General Specifications.*

- (a) A stop sign (Figure 1) shall be octagonal, 18 inches or 24 inches between parallel sides, as may be best suited to the location. The octagon shall be mounted with two sides horizontal and shall have a bead border around the edge.
- (b) The word "Stop," in 5-inch Series D letters on the 18-inch sign and in 6-inch Series E letters on the 24-inch sign, shall be centered on the horizontal center line of the octagon. (Figure 1.)
- (c) The upper and lower spaces may contain specific messages in 2-inch Series B letters on the 18-inch sign and in 3-inch Series B letters

on the 24-inch sign, as indicated in Recommendations 11 to 16. If, however, a reflecting, fixed or automatic illuminating device is introduced into the sign the outline, size, margin and color scheme as well as the height, shape and spacing of lettering of the principal words shall be retained and the design otherwise adjusted to fit the particular installation.

(d) The stop sign shall be placed at the point where the message is to be obeyed. At intersecting streets this point is on the property line of the protected street, or in special cases at a line marked on the pavement for this purpose.

(e) A stop sign shall be clearly illuminated at night and shall be visible for a distance of 100 feet.

(f) The letters shall be red on a yellow background.

RECOMMENDATION 11.—*Through Traffic Street.*

A stop sign (Figure 1) bearing the words "Through" and "Traffic," or equivalent terms, in the message space, shall be used at every intersection on a through traffic street except those controlled by signals.

RECOMMENDATION 12.—*Dangerous Intersection.*

At dangerous intersections where a stop is mandatory use the stop sign (Figure 1a) bearing the words "Danger" and "Corner" in the message space.

RECOMMENDATION 13.—*Railroad Crossing.*

At a railroad crossing where a stop is mandatory, use the stop sign (Figure 1) bearing the words "Rail" and "Road" in the message space.

RECOMMENDATION 14.—*Dead End Street.*

At the end of a street which has no outlet use the stop sign (Figure 1) bearing the words "Street" and "End" in the message space. This sign is not to be used at "T" or "L" street intersections. (See Recommendation 24.)

RECOMMENDATION 15.—*Street Closed.*

To close a section of a street temporarily use the stop sign (Figure 1) bearing the words "Street" and "Closed" in the message space.

RECOMMENDATION 16.—*Signs for Other Locations.*

For all other locations at which vehicles are required to stop before proceeding farther, use the stop sign (Figure 1) bearing a descriptive message; for example: "Car Line."

SLOW SIGNS

RECOMMENDATION 17.—*General Specifications.*

(a) A slow sign (Figure 2) shall be a diamond formed by placing one diagonal of an 18-inch square in a vertical position. The sign shall have a bead border around the edge, and the corners shall be rounded for safety, using a radius of $1\frac{1}{2}$ inches.

(b) The word "Slow" may be placed in 2-inch Series B letters at the top, or a flashing yellow beacon light may be used in the center of the upper space.

(c) Any specific message, such as is indicated in subsequent recommendations, shall be placed approximately in the center of the diamond, but if a symbol is used the message shall be above the center line with the symbol below.

(d) In order to give adequate warning of a hazard a slow sign shall be placed sufficiently in advance of the point where the potential danger begins.

(e) The letters shall be black on a yellow background.

RECOMMENDATION 18.—*Safety Zone.*

(a) The slow sign (Figure 2), with the words "Safety Zone" in $3\frac{1}{2}$ -inch Series C letters in two lines in the message space and a horizontal arrow pointing to the right below the words shall be used at every safety zone where traffic is prohibited from passing to the left. Where traffic is allowed to pass on both sides, a double-headed arrow shall be used on such a sign. (Figure 2a.)

(b) The sign shall be placed at the end of the zone that the traffic approaches. (See section on Safety Zones, p. 37.)

(c) The sign shall be illuminated at night.

RECOMMENDATION 19.—*Dangerous Intersection.*

(a) The slow sign (Figure 3), with the word "Slow" in 2-inch Series B letters at the top and the words "Dangerous Corner" in 3-inch Series B letters in two lines in the message space shall be placed at every crossing which is especially hazardous and requires unusual caution but does not warrant a stop sign.

(b) The sign shall be illuminated at night.

RECOMMENDATION 20.—*Street Car Crossing.*

(a) The slow sign with the words "Car Line," in $3\frac{1}{2}$ -inch Series C letters in two lines in the message space, shall be placed at every crossing that is sufficiently hazardous to require special caution. (Figure 3a.)

(b) The sign shall be illuminated at night.

RECOMMENDATION 21.—*Hill.*

(a) At the beginning of a down grade of 6 per cent or more use the slow sign (Figure 4), with the word "Hill" in 6-inch Series C letters centered on the center line in the message space.

(b) For grades exceeding 10 per cent the word "Hill" shall be placed somewhat above the center of the sign and the words "Steep Grade" (Figure 4a) shall be placed below it in 2-inch Series B letters.

(c) The sign shall be illuminated at night.

RECOMMENDATION 22.—*Curve.*

(a) At every curve having a radius of from 200 to 600 feet where the conditions require a reduction of speed, use the slow sign bearing the word "Curve" in 5-inch Series C letters on the center line in the message space and a curved arrow in the lower space indicating the direction of the curve. (Figures 5 and 5a.)

(b) The sign shall be illuminated at night.

RECOMMENDATION 23.—*Reverse Curve.*

(a) At any irregular series of curves where conditions require a reduction of speed, use the slow sign bearing the word "Curves" in 5-inch Series B letters and an arrow shaped so as to indicate the direction of curves. (Figures 6 and 6a.)

The direction of the entering curve should be indicated properly on the sign. Figure 6, reading from the bottom of the sign, indicates that the initial turn is to the right followed by a turn to the left. At any irregular series of curves the symbol may be varied provided the direction of the entering curve is properly indicated. Figure 6a shows a possible design of a symbol indicating more than two curves. This symbol can be revised or changed to fit conditions.

(b) The sign shall be illuminated at night.

RECOMMENDATION 24.—*Turn.*

(a) At a turn having a radius of less than 200 feet use a slow sign bearing the word "Turn" in 5-inch Series C letters on the center line in the message space and an arrow bent at right angles in the lower space indicating the direction of the turn. (Figures 7 and 7a.)

(b) At a "T" intersection, the directions that may be followed shall be shown by a double-pointed arrow indicating both directions.

(c) The sign may be used at the approach to a regular street intersection where the main flow of traffic makes a sharp turn.

(d) The sign shall be illuminated at night.

RECOMMENDATION 25.—*Other Locations.*

Use slow sign with descriptive message for all other conditions that re-

quire vehicles to proceed at reduced speed. For example, "Narrow Bridge," "Viaduct Approach" and "Street Repair."

CAUTION SIGNS

RECOMMENDATION 26.—*General Specifications.*

(a) A caution sign (Figure 8), shall be an 18-inch square mounted with the sides in horizontal and vertical positions. This sign shall have a bead border around the edge and the corners shall be rounded for safety.

(b) The word "Caution" may be placed in 2-inch Series D letters at the top, or a flashing yellow beacon light may be used in the center of the upper space.

(c) Any specific message, such as is indicated in subsequent recommendations, shall be in 5-inch Series B letters and shall be placed approximately in the center of the square, if only one line is used.

(d) If a symbol is used in addition to the word message smaller letters should be used and the words so placed as to provide ample space for the symbol below the words.

(e) In order to give adequate warning of a hazard which is intermittent, a caution sign shall be placed sufficiently in advance of the point where the potential danger begins.

(f) The letters shall be black on a yellow background.

RECOMMENDATION 27.—*School Zone.*

At each end of a school zone use the caution sign (Figure 8), with the words "School Zone" in 3½-inch Series C letters in the message space.

RECOMMENDATION 28.—*Playground Zone.*

At each end of a playground zone use the caution sign (Figure 8a), with the words "Play" and "Ground" in 3½-inch Series C letters in the message space.

RECOMMENDATION 29.—*Cross Street.*

(a) The caution sign with the words "Cross Street" in 3½-inch Series C letters in two lines in the message space (Figure 9) shall be placed at every crossing which is hazardous and requires caution but does not warrant a stop or slow sign.

(b) The sign shall be illuminated at night.

RECOMMENDATION 30.—*Other Locations.*

At every place where vehicles should proceed cautiously use the caution sign bearing a descriptive message. Examples, "Theatre Exit," "Church Zone" (Figure 8b), "Men Working."

ONE-WAY AND DETOUR SIGNS

RECOMMENDATION 31.—*General Specifications.*

(a) A one-way sign (Figure 10) shall be arrow-shaped, 30 inches long by 6 inches high, or rectangular, 36 inches long by 8 inches high, with an arrow 30 inches long by 6 inches high on a black background. In either case the arrow shall be white with black letters.

(b) The message words, in 3½-inch Series C letters, shall be centered on the center line of the arrow.

(c) Care shall be taken to fix the sign so firmly that it cannot be turned in the wrong direction.

RECOMMENDATION 32.—*One-Way Street.*

(a) On all four corners of every street intersection where one-way traffic regulations are in force, use a one-way sign (Figure 10), with the words "One-Way" on the face of the arrow.

(b) If the traffic at the intersection is controlled by an automatic signal the one-way sign shall be made a part of the signal, or attached to it.

(c) On a very narrow one-way street the arrow may be placed on only two corners of the street.

(d) The sign shall be illuminated at night.

RECOMMENDATION 33.—*Detour.*

(a) A one-way sign (Figure 8), with the word "Detour" on the face of the arrow, shall be placed at the point where a detour begins and at all intersections and other points where any question might arise as to the course of the detour.

(b) At the point where a detour begins a temporary direction sign or route marker placed immediately below the detour sign is recommended to indicate the various destinations that are to be reached by following the detour instructions.

(c) The sign shall be illuminated at night.

INFORMATION SIGNS

RECOMMENDATION 34.—*General Specifications.*

(a) An information sign shall be rectangular, with both dimensions multiples of 6 inches, and shall have a bead border around the edge, and the corners may be rounded for safety.

(b) The horizontal dimension shall be less than the vertical dimension unless otherwise specified.

(c) The letters shall be black on a white background.

RECOMMENDATION 35.—*Keep to Right.*

A sign (Figure 11) measuring 12 inches by 18 inches and bearing the

words "Keep to Right," in 3-inch Series C letters, shall be placed at the point where the message is to be obeyed.

RECOMMENDATION 36.—*No Turn.*

(a) A sign (Figure 12) measuring 12 inches by 18 inches and bearing the words "No Turn" or "No Left Turn" or "No Right Turn," in 3-inch Series D letters, shall be placed at the point where the message is to be obeyed.

(b) If the intersection is controlled by an automatic signal, the sign forbidding the turn shall be attached to the signal and illuminated at night. The dimensions may be reduced to fit the signal housing, but the letters shall not be smaller than 2-inch Series C letters.

(c) The sign shall be illuminated at night.

RECOMMENDATION 37.—*Dead End Street.*

(a) A sign (Figure 11) measuring 12 inches by 18 inches and bearing the words "Dead End Street," in 3-inch Series C letters, shall be placed on each side at the entrance to a street having no outlet.

RECOMMENDATION 38.—*Direction.*

(a) A sign indicating direction, measuring 18 inches by 24 inches, or proportionately larger if necessary to carry the message required, shall be so placed that it will be seen by a driver before he reaches the point at which he should take the direction to be followed. Such a sign is not intended to replace a standard highway route marker.

(b) The important items of the message shall be given in the largest letters possible and explanatory items in equal or smaller letters, not smaller than 2-inch Series C, the size depending upon the number of words used.

(c) An arrow shall be placed in line with, and on the side of, the message in the direction to be taken. (Figure 13.) If two or more places are indicated, a separate arrow should be used for each.

(d) The sign shall be illuminated at night.

RECOMMENDATION 39.—*Speed Limit.*

(a) A sign (Figure 14) 30 inches high by 24 inches wide, or a sign 24 inches high by 18 inches wide, shall be used to indicate the speed presumed to be lawful at the beginning of the zone for such speed. The larger sign shall be used at all entrances to cities, the smaller at other selected places within the city. Where used to restrict speed on a street within a city, speed limit signs shall be placed at intervals required by law or regulation. At the end of a speed zone there shall be a sign (Figure 15) 24 inches by 18 inches in size, bearing the words "End—Speed Limit."

On this special sign the word "End" and the numerals indicating the speed shall be 5-inch Series B and the words "Speed Limit" shall be in 4-inch Series D letters.

(b) On the regular speed limit sign (Figure 14), the words "Speed Limit" in two lines 3½-inch Series E letters on the 30 by 24-inch sign and 3-inch Series D letters on the 24 by 18-inch sign, shall be placed at the top, the limit in 8-inch or 6-inch Series F numerals respectively, slightly below the center, and the word "Miles" in 3-inch Series D letters at the bottom.

(c) The sign shall be illuminated at night.

RECOMMENDATION 40.—*Quiet Zone.*

At each end of a quiet zone use a sign measuring 18 inches high by 18 inches wide with the word "Hospital" in 4-inch Series B letters slightly above the center and the word "Quiet" in 3-inch Series B letters below it.

RECOMMENDATION 41.—*Other Information.*

(a) Information signs shall be used to convey any other necessary information, in conformity with the general specifications for information signs. Their dimensions shall be 12 inches by 18 inches, if possible.

RESTRICTION SIGNS

RECOMMENDATION 42.—*General Specifications.*

(a) A restriction sign (Figure 16), shall be rectangular, 12 inches wide by 18 inches high, with the principal words in 2½-inch letters at the top, and any necessary explanatory words below in equivalent or smaller letters, the size of the letters depending on the number and length of words used. The sign shall have a bead border around the edge and the corners may be rounded for safety.

(b) The sign shall be placed at the point where the message is to be obeyed.

(c) Where the restriction is to apply continuously for a considerable distance, the signs shall be placed at intervals of about 100 feet.

(d) The wording shall indicate the extent of the application; for example, "In This Block."

(e) Colors shall be:

- (1) No Parking (No Standing, No Stopping) . . . red letters on a white background;
- (2) Limited Time Parking, green letters on a white background;
- (3) Pedestrian Restriction, blue letters on a white background;
- (4) Other restriction signs, black letters on a white background.

A reversal of the colors for background and lettering is permissible provided the code meaning of the colors is retained; namely, red for prohibited parking and green for permitted parking.

RECOMMENDATION 43.—*No Parking.*

In places where parking is to be forbidden use a restriction sign (Figure 16) with the words "No Parking" at the top and with time limits or other qualifications, if any, below.

RECOMMENDATION 44.—*Street Intersection.*

(a) At a street intersection use a restriction sign (Figure 16) with the words "No Stopping" at the top and the words "Here to Corner," in 2-inch letters, below.

To avoid the erection of an additional post, a sign reading "No Stopping Within — Feet of Corner" affixed to an existing pole or tree may take the place of this sign. In such a case the point beyond which stopping is prohibited shall be indicated on the pavement or curb.

RECOMMENDATION 45.—*Fire House Zone.*

In a fire house zone use a restriction sign (Figure 16) with the words "No Stopping" at the top and the words "Fire House" in 2-inch letters below.

RECOMMENDATION 46.—*Loading Zone.*

In a loading zone use a restriction sign (Figure 16) with the words "No Parking" at the top and the words "Loading Zone" in 2-inch letters below.

RECOMMENDATION 47.—*Passenger Zone.*

(a) In a passenger zone use a restriction sign (Figure 16) with the words "No Standing or Parking" at the top and the words "Passenger Zone" in 2-inch letters below.

The limits of a zone may be indicated better by curb markings than by a sign at each end of the zone, especially if zones are close together. (See code of colors in Rec. 75 on Curb Markings, p. 34.)

RECOMMENDATION 48.—*Other No Parking Signs.*

For any other conditions that require restrictions applicable to the parking of vehicles use the restriction sign (Figure 16) with the appropriate prohibitive words at the top and other necessary explanatory words below. Examples, "Taxi Stand," "Bus Stop." The letters shall be red on a white background.

RECOMMENDATION 49.—*Limited Time Parking.*

(a) To indicate the time limit of parking, use the restriction sign (Figure 17), with the time limit (for example, "One Hour") at the top and the word "Parking" and other qualifications below.

- (b) The letters shall be green on a white background.

Angle parking is better indicated by pavement markings than by signs. (See Rec. 73.)

RECOMMENDATION 50.—*No Pedestrian Crossing.*

(a) Where there is exceptional danger to pedestrians use the restriction sign with the words "No Crossing," in 2½-inch letters, at the top and any necessary explanatory words below in 1 or 2 inch letters, the size depending upon the number of words used.

(b) The sign shall be so placed as to apply solely to pedestrians. For example, the sign may be suspended between short posts and arranged parallel or approximately parallel to the curb line.

(c) The letters shall be blue on a white background.

This sign is not intended to prohibit pedestrians from crossing streets generally throughout a large area. Educational work against so-called jay walking may be done better by posters than by permanent signs.

RECOMMENDATION 51.—*Additional Restriction Signs.*

Additional restriction signs may be needed for special purposes and shall conform to Recommendation 42.

Section 2.—Street Traffic Control Signals

REASONS FOR THE INSTALLATION OF SIGNALS

The principal reasons why signals to control street traffic should be installed are: (a) to increase the safety of pedestrians and vehicles at congested intersections; (b) to facilitate the movement of traffic with a minimum of delay at congested intersections; (c) to provide for the continuous movement of traffic throughout a heavy route; (d) to interrupt a heavy traffic stream at intervals so as to afford opportunity for cross traffic to move.

The most generally effective mechanical device used to increase safety and to facilitate traffic at intersections on city streets is the automatic traffic control signal, but there is a tendency to use traffic control signals unnecessarily. Some are installed indiscriminately, without a thorough analysis of the conditions and of the probable effects of their installation. Many are installed and operated where and when their use is not justified. The unnecessary use of signals produces serious results. For example:

(a) Impatient and reckless drivers disregard an unnecessary "Stop" signal, and their habit threatens the usefulness of all traffic control signals, the value of which depends upon the public confidence based upon their supposed general observance.

(b) There is likely to be a general diversion of traffic from main thoroughfares to unsignaled side streets, which would increase the volume of traffic and the danger of accidents there, especially to children.

The adoption of minimum limits will save the time of city authorities in making elaborate studies and debating with interested parties the installation of signals at points where they are obviously not desirable. Where the volume exceeds the established minimum, the authorities should still examine carefully the characteristics of the vehicular and pedestrian traffic, including type of vehicle, speed, turning movements, and the physical conditions of the intersection. No signal should be installed unless there is a practical certainty that the delays or hazards will be less after installation than before. Where expedition of traffic rather than safety is the paramount consideration care must be taken in installing traffic control signals, because an unwise regulation will retard rather than expedite traffic. Some traffic control signals that are installed to control the peak traffic, such as exists at certain hours of the day, or on Sundays and holidays, should not be operated at other times when the volume of traffic does not warrant such control.

The foregoing discussion is based upon the use of the customary type of automatic control mechanism which provides continuously a regular, pre-arranged cycle. Obviously, such a fixed program for an independent

signal will not always prove efficient in time utilization. Sometimes traffic on one street will be held when no traffic is using the "Go" interval on the other street.

The ideal condition would be for the signal to change in exact accord with traffic demands from minute to minute. If traffic on one street is approaching the signalized intersection and no traffic is using or about to use a "Go" interval on the other street, the signal should change to give the "Go" indication to the approaching traffic.

To accomplish this result, types of control apparatus have been developed by which traffic approaching the intersection actuates the signal control mechanism. Such mechanisms are called "traffic-actuated" controls.

On page 27 there is presented a discussion of the use of this type of control.

DEFINITION OF TERMS

The following definitions are used in this manual and their general use is recommended for avoidance of confusion.

RECOMMENDATION 52.—*Traffic Control Signal.*

A signal shall be defined as comprising all signal lights that are operated together to control traffic at an intersection, whether the signal is mounted in one unit or more.

RECOMMENDATION 53.—*Types of Housing.*

The types of housing shall be defined as follows:

- (a) Vertical.....Lights one above another
- (b) Horizontal.....Lights side by side
- (c) One-Way.....Lights visible in only one direction
- (d) Two-Way..Lights visible in two directions, either opposite or at angles.
- (e) Three-Way.....Lights visible in three directions
- (f) Four-Way.....Lights visible in four directions
- (g) Multi-Way...Lights visible in more than four directions at various angles.

RECOMMENDATION 54.—*Types of Support.*

The types of support shall be defined as follows:

- (a) Post—Housing supported on top of a post or pedestal.
- (b) Bracket—Housing supported on a bracket projecting from the side of a pole.
- (c) Mast Arm—Housing suspended from a mast arm projecting from the side of a pole.
- (d) Cable—Housing suspended over the roadway by one or more cables.

RECOMMENDATION 55.—*Methods of Operating Traffic Control Signals.*

The methods of operating traffic control signals shall be defined as follows:

- (a) Manual.....Direct control by a hand switch
- (b) Automatic...Control by motor, clock work, or other mechanism
- (c) Combined...Automatic control that can also be operated manually
- (d) Traffic Actuated.....Controlled by mechanism actuated by impulse derived from vehicle or pedestrian.

CLASSIFICATION OF TRAFFIC CONTROL SIGNALS

Traffic control signals and systems are herein classified according to the character of the traffic movement resulting from the signal or system rather than the type of apparatus employed.

RECOMMENDATION 56.—*Types of Systems.*

Traffic control signals and systems shall be classified as follows:

(a) *Flexible Progressive.* All signals are so inter-related that the total time period at each intersection is the same, but the period may be varied to meet traffic conditions at each intersection, and in addition the system is designed to provide for the continuous movement of traffic after it has entered the area controlled.

(b) *Alternate.* Adjacent signals or groups of signals show opposite colors in the same direction at the same time, thus allowing a measure of progressive movement.

(c) *Simultaneous.* All signals show the same color in the same direction simultaneously.

(d) *Independent.* A signal not interconnected with or related in its operation to any other signal.

SELECTION OF CONTROL METHOD

Where the traffic conditions require the installation of traffic control signals at a number of neighboring intersections along a main thoroughfare or on a number of adjacent streets, so that each signal will relate the traffic flow to the others, it is essential to select some control system. To aid in such selection the outstanding features of those now commonly used are here described *in the order of preference.*

FLEXIBLE PROGRESSIVE SYSTEM

The flexible progressive system is the best for the coordination of signals along a single street and is the only one that is well adapted to

the control of signals on a number of adjacent streets that form a district having similar traffic characteristics. The complete cycle of changes must be of the same time duration for all of the intersections, and all signals must be kept in their proper time relation. There are several mechanical and electrical methods for accomplishing these results.

In one method, the operation of signals throughout the system is controlled from one central location. This plan permits a maximum of flexibility, since all adjustments can be made at the one point.

A second method in more general use involves secondary controllers or "receivers" at each intersection, with a master or supervisory controller at some central location. The master controller insures that the secondary controllers keep in step. By changes at the master controller, the total time period can be varied throughout the system. This system gives considerable flexibility, and is generally less costly than the method first mentioned. Under this plan, however, change of the proportionate division of the time period at any signal must be made at that signal.

A third method involves the use of synchronous motors, actuated from a common source of electric current. In this method, as long as no trouble occurs, a common total time period and proper relationship between controllers are maintained. With the usual equipment provided for this method the cycle length cannot be varied. Moreover, if there is trouble and the controllers get "out of step," there may be difficulty with the usual equipment in re-establishing the proper relationship between controls. However, a fair degree of flexibility can be attained with the synchronous motor system by simple hand wheel adjustments at the timing controllers at each intersection.

The flexible progressive system has the following advantages:

- (1) It permits the continuous movement of traffic at approximately a predetermined speed on both through and cross streets.
- (2) It discourages speeding, because it forces the driver of a vehicle to make frequent stops if he exceeds the speed determined for the system.
- (3) It makes possible the adjustment of the timing of each signal to the variations in the flow of traffic at the particular intersection controlled by that signal.
- (4) It permits modification of the cycle length throughout the system to adjust it to the differences in traffic conditions at different hours of the day.

ALTERNATE SYSTEM

The alternate system is an adaptation of the simultaneous system obtained by so changing the wiring of adjacent signals or groups of signals that each signal or group as seen from the same direction shows the color having the meaning opposite to that conveyed by the adjacent signal or group. Under the conditions for which this system is satisfactory it has the following advantages:

(1) It permits the continuous movement of traffic on a single street at approximately a predetermined speed, subject to the limitations stated in paragraph (3) below.

(2) It discourages speeding, because a vehicle is forced to make frequent stops if it exceeds the speed for which the system is arranged.

It has the following disadvantages:

(1) It is not well adapted to a street having blocks of unequal length.

(2) It requires equal time intervals for through traffic and for cross traffic, so that too much time is devoted to cross traffic on a street where there is a greater volume of through traffic.

(3) If the signals are grouped it reduces the capacity of the street between points where the color changes, because only the vehicles that enter the first intersection of a group during the first part of the green interval can move continuously.

SIMULTANEOUS SYSTEM

The simultaneous system is simple, but it has the following disadvantages:

(1) It necessitates the stopping of all traffic simultaneously in one direction, so that the continuous movement of vehicles is impossible and the overall speed and the average speed are low.

(2) It encourages speeding in order to pass as many intersections as possible before a change of signals.

(3) The timing is based on the flow of traffic at the most congested intersection, and as the timing at all intersections must be the same, the traffic at the other intersections is unnecessarily delayed.

(4) On streets traversed by electric railways, it increases the peak power load, because of the simultaneous starting of many street cars.

INDEPENDENT SIGNAL

The independent signal is used at isolated intersections as a safeguard to intersecting lines of vehicular traffic where the traffic is heavy on each line. Independent signals can often be used effectively, at intervals of several blocks, as interruptive devices to break the flow of traffic on a heavily traveled thoroughfare, in order to enable pedestrians and vehicular traffic on side streets to cross in safety.

TRAFFIC-ACTUATED CONTROL

Traffic-actuated control can be used for any independent signal, and is especially worthy of consideration at multiple intersections, at intersections with variable traffic, or where conflicting movements should be handled separately, if any signal control is warranted.

As traffic becomes heavier and more uniform on the intersecting streets,

the advantages of the selective principle of traffic-actuated control over fixed time signals are diminished.

Where properly used, traffic-actuated control mechanisms to a considerable extent eliminate objections to independent traffic control signals, because unnecessary stops are reduced to a minimum and there is less tendency for traffic to avoid signalized intersections. The objection to twenty-four hour operation of signals is also removed by the minimizing of delays and thus the safety element of continuous operation is retained.

Applications of this method of control can also be made at points where pedestrians cross a heavy traffic stream, by providing push buttons for their use.

RECOMMENDATION 57.—Main Thoroughfare Traffic Control.

(a) Where traffic is controlled continuously for a considerable distance, each intersection of a main thoroughfare with a cross street shall be protected.

(b) If the traffic on the cross street is heavy, the protection shall be by traffic signal.

(c) If the traffic on the cross street is light, the protection shall be by "Stop" sign. (See Rec. 11.)

Under certain conditions it may be desirable to install traffic signals at intervals, even if traffic on the intersecting street is not particularly heavy, to break the traffic into platoons and to insure effective progressive movement.

USE OF COLORS

The general practice in traffic control systems in the United States is to use three colors, although in some cities only two colors are used.

RECOMMENDATION 58.—Color System.

The three-color system is recommended, as provided for in the Model Municipal Traffic Ordinance.

RECOMMENDATION 59.—Three-Color System.

(a) In a three-color system the colors shall be displayed in the order *red, green, yellow*.

The display of yellow after red is *not recommended* because it is likely to be interpreted by the waiting driver as an invitation to start before the green appears. Therefore, the red should be shown until the change is made to green and the yellow should be displayed after the green.

To minimize the effect of color blindness among street and highway users, the tones of color for signal lenses should be based upon the specifications for colors contained in "Colors for Traffic Signals" approved by the American Standards Association.

RECOMMENDATION 60.—*Meaning of Colors in Three-Color System.*

In a three-color system the colors shall be interpreted respectively as follows:

(a) Red means Stop before entering the intersection and remain standing until green is shown.

(b) Green means permission to Go, subject to the safety of others or to the specific directions of a police officer.

(c) Yellow after green means stop before entering the intersection unless when yellow first appears the vehicle is so close to the intersection that it cannot be stopped with safety.

The determination whether or not a vehicle can be safely stopped before entering an intersection after the appearance of a stop signal should be based upon normal braking distances as defined in the National Code on Brakes and Brake Testing.

(d) Yellow alone shall not be used in traffic control systems as a special period for the turning of vehicles or the movement of pedestrians.

Pedestrians, due to their much slower speed, are often unable to complete their crossing of a street before the signal changes, causing either hazard to themselves or delay to vehicles.

Two distinct signal control methods dealing with this problem are in use.

One method is the allotment of a time interval for exclusive pedestrian use of the intersection. This may be necessary at some intersections where pedestrian movement in all directions is heavy, especially if combined with heavy or complicated vehicular turns. Various signal indications are being tried to signify the pedestrian period, as for instance, the use of a special color or the combination of yellow and red, as is now provided by state law in Massachusetts, whenever a pedestrian interval is used.

The second method is based upon the principle of informing pedestrians when there is no longer time to cross the street before traffic on the intersecting street is given its "Go" signal. Several means of giving pedestrians this information are possible. In Detroit a special pedestrian sign bearing the necessary instructions is lighted at the proper instant. In Pittsburgh, when there is no longer time for the pedestrian to cross, the yellow lens is lighted *with* the green, after which the yellow appears alone to indicate the usual clearance period for vehicles.

RECOMMENDATIONS 61.—*Two-Color System.*

(a) If a two-color system is used, the colors shall be red and green, and the red shall be displayed simultaneously in all directions for the change period.

It is *not recommended* that the change period be indicated by a dark interval, during which no lights are shown.

RECOMMENDATION 62.—*Meaning of Colors in Two-Color System.*

In a two-color system the colors shall be interpreted as follows:

(a) Red means Stop before entering the intersection and remain standing until green is shown unless when the red appears the vehicle is so close to the intersection that it cannot be stopped with safety.

(b) Green means permission to Go, subject to the safety of others or to the specific directions of a police officer.

RECOMMENDATION 63.—*Removal of Confusing Colored Lights.*

All lights of such a color and location as to be confused with traffic control signals should be removed.

RECOMMENDATION 64.—*Right and Left Turns.*

(a) A turn either to the right or the left should be prohibited while the red is shown and permitted only while the green is shown.

(b) There may be reasons for making exceptions to this rule in certain places, but such exceptions should be avoided if possible. In such places, an auxiliary green arrow should be displayed pointing in the direction in which traffic is permitted to turn while red is shown on regular signal to stop through traffic.

GENERAL SPECIFICATIONS

RECOMMENDATION 65.—*Signal Specifications.*

(a) The visible diameter of a signal lens shall be not less than 8 inches.

(b) The illuminating lamp shall be of not less than 60-watt capacity.

(c) The optical system shall be so designed that each lens shall be illuminated independently of any other lens.

(d) The lens, reflector, and visor shall be of such design as to minimize the effect of all phantom light and to render the signal light plainly visible for a distance of 300 feet under all conditions.

(e) The relative position of the colors shall be:

(a) Vertical: Top, red; middle, yellow, if used; bottom, green.

(b) Horizontal: Left, red; middle, yellow, if used; right, green.

(f) The housing shall be painted such color as to contrast with the colors of the signal lights.

RECOMMENDATION 66.—*Location of Signals.*

(a) All traffic control signals shall be so placed that the lights are plainly visible to the drivers of the traffic to be regulated.

(b) The type and location of signals most suitable for any particular locality or condition shall be chosen from the following:

Four-way signals on posts or brackets on each corner.

Three, two or one-way signals on posts or brackets on each corner.

Four-way signal suspended over center of intersection.

Four-way signals on posts or brackets at diagonally opposite corners.

The desirable number and direction of faces of traffic signals located on each corner depend upon density and other conditions of motor and pedestrian traffic and also vary with the location of the signals. Four-way signals give maximum visibility. Three, two and one-way signals are somewhat less expensive and are adequate under many conditions. Three-way signals should ordinarily be placed so as to omit the light toward the nearest building. Two-way signals on near corners should have lights at 180 degrees facing in the direction of the traffic on the street and on far corners should have lights at 90 degrees facing the intersection. One-way signals should be located only on far corners.

The four-way signal suspended over the center of the intersection is suitable where considerations of economy prevent installation of signals on each corner.

Signals at diagonally opposite corners can be used for economy, although they present non-uniform location from the viewpoint of drivers approaching on different streets. They should be placed near the curb lines of the street carrying the heavier traffic. Signals on the other two corners can be added when finances permit.

The following types and locations are not recommended:

Signals on pedestals within intersections (except for unusual conditions).

Signals on mast arms.

Signals on pedestals within intersections would ordinarily obstruct traffic and introduce hazards. The unusual conditions justifying such installations are usually wideness and irregularity of the intersection, particularly with a multiplicity of entering streets.

RECOMMENDATION 67.—*Height of Signals.*

(a) All traffic control signals shall be placed at such height as to be plainly visible to drivers in approaching traffic at a distance of 100 feet from the intersection.

(b) The bottom of the housing shall be 7 to 10 feet above the pavement if it is inside the curb line and at least 14 feet above if it is supported on brackets or cables over the roadway.

RECOMMENDATION 68.—*Time Periods.*

(a) A total period of 40 to 80 seconds should be used for the control of ordinary traffic.

(b) Changes in total periods for rush hours may be advisable. Consequently timers (or controllers) should have flexibility of adjustment through a wide variation of time periods.

(c) Traffic control signals should not be operated at times when the volume of traffic is too light to justify their operation. They should be so arranged that when they are not in operation that fact will be clearly indicated by a flashing yellow light on the signal.

The length of the total time period should be determined by a careful consideration of all the factors involved in the regulation, such as volume of through and cross traffic, turning movements, distances between intersections, average speed obtainable at different hours, classes of vehicles, street-car speeds and loading times, number of lanes available, requirements of pedestrians, and any irregularity in the shape of the intersection. In general, short time periods are more effective than long ones, and proper timing on short time periods encourages the observance of the regulations by pedestrians.

OTHER SIGNALS

RECOMMENDATION 69.—*Train Approach Signals.*

Two well recognized types of signals are now used to indicate the approach of a train at a grade crossing. They are equally visible, and either may be used, namely:

- (a) A wigwag signal with a swinging target and red light.
- (b) A flashing light signal with two red lights in a horizontal line 30 inches apart, flashing alternately.

Regular street traffic control signals are sometimes used at railroad crossings particularly within city limits. Their use is enforceable under city ordinances but they should be used instead of the foregoing standard signal only if operated manually, or by combined automatic and manual control under supervision. If not operated continuously the standard train approach signal should be used when the traffic control signal is not in operation.

RECOMMENDATION 70.—*Beacon Signals.*

Beacon signals shall conform to the following specifications:

- (a) Flashing red means stop and proceed when safe.
- (b) Flashing yellow means proceed with caution.
- (c) Beacon supports in the roadway shall be illuminated.

Beacon signals have been used extensively and for many purposes in regulating traffic. They should be used to mark permanent street obstructions, such as safety zones, bridge structures, posts, and abutments, and also to mark danger points, such as the end of a street, either at a dead-end or at a cross street, the beacon to be placed on the curb of the cross street opposite the center of the terminating street. They may also be used in connection with stop and cautionary signs. The location of beacon signals at points where they will obstruct traffic is not recommended. (See Section 1 on Signs.)

RECOMMENDATION 71.—*Illumination of Traffic Officers.*

Traffic officers stationed in roadways shall be illuminated at night, by flood lights if necessary, in the interest of safety.

Section 3—Street Traffic Markings

The use of markings on obstructions in streets is absolutely necessary. Markings on pavements and curbs are of great assistance to a driver, because they do not divert his attention from the control of the vehicle. Their use, however, is subject to very definite limitations. In wet weather they can not be clearly seen, especially at night; and in those parts of the country where snow falls they may often be entirely covered by the snow. Markings on pavements are quickly worn off by traffic and must be renewed often, at considerable expense. Markings should be so placed that they may be seen easily, and the observance of the message which they convey should be rigidly enforced.

RECOMMENDATION 72.—*Types and Purposes of Markings.*

The following are approved kinds of markings:

- (a) Lines on pavement.
- (b) Colors on curbing.
- (c) Words on pavement or curbing.
- (d) Cross-hatching or checkerboard squares on obstructions.

RECOMMENDATION 73.—*Pavement Lines.*

The following are approved uses of lines on pavements:

- (a) Center line of a street.
- (b) Center line on a curve having a radius less than 600 feet.
- (c) Center line at and approaching hill crests.
- (d) Traffic lanes on streets wide enough for three or more lanes.
- (e) At all signalled intersections and especially opposite safety zones.
- (f) Traffic lanes for turning at street intersections.
- (g) Stop line at entrance to through traffic street.
- (h) Street-car clearance limits at turning points.
- (i) Boundaries of pedestrian crosswalks.
- (j) Parking-space limits.
- (k) Stalls for parking other than parallel.
- (l) Directional lines consisting of series of arrows in center of traffic lane.
- (m) Warning of approach to a railroad crossing.

Lines to mark center lines of streets are desirable where there is considerable traffic in each direction. Additional lines marking traffic lanes are desirable in streets wide enough and with sufficient traffic to carry two or more well defined streams of traffic in one or both directions. On signalled streets, even where continuous longitudinal lines are not justified, lines extending from 50 to 75 feet each way from each signalled intersection are desirable to aid in holding stopped traffic to the right side of the street.

Center lines should be used to hold traffic to its proper side on curves of less

than 600-foot radius, and also on hill crests where the view ahead is insufficient to permit overtaking and passing in safety. Lines on hill crests should extend down the hills far enough to discourage attempting to pass when it cannot be accomplished before traffic approaching over the hill top might block the way.

The marking of crosswalk boundaries is one of the most important uses of pavement lines, and should be used extensively wherever there is considerable pedestrian movement. Such lines encourage pedestrians to obey traffic signals and indicate to motorists where they may look for pedestrians and where they must stop when facing "Stop" signs or signals. Such crosswalks are particularly essential at irregular intersections where otherwise neither the pedestrian nor the motorist can determine the proper place for the pedestrian to cross.

Traffic lanes for turning at street intersections are desirable to expedite safe turning movements, and the marking of street-car clearance limits serves a similar purpose.

The marking of parking space limits tends to prevent dangerous encroachment on fire hydrant zones, intersection areas, and the like. The marking of parking stalls for angle parking enables all operators to park at the same angle with a minimum of waste space.

Special directional lines can sometimes be used effectively to route traffic in a manner that could not easily be indicated by any other means. A directional line shall be short and shall have an arrow head on one end to indicate direction.

RECOMMENDATION 74.—*Railroad Crossing Pavement Markings.*

Pavement markings should be employed as a supplementary advance warning of approach to railway grade crossings on hard surfaced, heavy traveled highways where rail traffic is fast or frequent. The standard form approved by the American Association of State Highway Officials (see Figure 18) should be used.

RECOMMENDATION 75.—*Curb Markings.*

Curb markings are used principally to show the regulations applying to vehicles stopping or standing next to the curb. They are most effective if different colors are used to distinguish different regulations.

The colors given below shall be used for the purposes shown:

Prohibited stopping	Red
Passenger zone (loading and unloading of passengers only) ..	White
Loading zone (passengers and material)	Yellow
Limited time parking	Green

This code is intended for use in places where there are frequent variations in the regulations in a comparatively short distance. Where a single regulation applies to a long distance, signs should be used instead of curb markings.

RECOMMENDATION 76.—*Wording on Pavement or Curb.*

(a) A message on a pavement or a curb shall be brief and clear.

If it is not, the driver of a vehicle will not have time to read or to comprehend it. Although such messages are effective under certain conditions, they should be used sparingly.

RECOMMENDATION 77.—*Round Inserts.*

(a) A round insert shall be made of aluminum, non-rusting steel, monel metal, brass, or other material that will show a bright contrasting surface under the action of traffic.

(b) The diameter of the insert shall be not less than 4 inches.

(c) Inserts shall be spaced about 12 inches on transverse lines and about 18 inches on longitudinal lines.

(d) The insert shall be attached to the pavement by anchor bolts or a similar device.

(e) It shall not project above the level of the pavement more than half an inch.

(f) It shall have a rounded surface so that it will present a smooth contour to the wheels of vehicles.

RECOMMENDATION 78.—*Rectangular Inserts.*

(a) A rectangular insert that is made of brick, stone, rubber, metal, or other material shall be of a permanent color different from that of the pavement.

(b) The inserts shall be set to form lines, either continuous or broken.

(c) They shall be embedded in the pavement so that their upper surfaces are flush with the level of the pavement.

RECOMMENDATION 79.—*Paint.*

(a) A painted line shall be not less than 4 inches wide.

(b) A line painted on a bituminous pavement shall be white or yellow; one painted on concrete shall be black or white.

(c) A painted line shall be frequently renewed in order to insure its plain visibility at all times.

RECOMMENDATION 80.—*Canvas.*

(a) Canvas markings shall be attached to the pavement with cement so firmly that the lines will remain true under all conditions of use and in all kinds of weather.

(b) Their color shall be white or yellow.

RECOMMENDATION 81.—*Mushroom Buttons.*

(a) Large mushroom buttons that project several inches above the pavement shall not be used at any point where they may interfere with traffic.

If a mushroom button projects several inches above the pavement it forms a hazard even if it is illuminated. Such buttons may be satisfactorily used to mark non-traffic spaces in a wide pavement.

RECOMMENDATION 82.—*Flexible Sign Markers.*

A flexible sign marker may be used as an alternative for words painted on the surface of the roadway. Such a marker shall be made of rubber or similar flexible material that will stand upright under normal conditions but that will bend flat on the pavement when it is hit by the wheels of a vehicle, so that it will neither offer resistance to the free passage of the vehicle nor damage it or the marker. Such a marker shall be not larger than 8 inches in height and 30 inches in length and shall comply with the standard colors for signs used for identical purpose. The base of the marker shall be attached to the pavement in such a way that it may be readily removed either for replacement or, in winter, to avoid its destruction by snow ploughs.

RECOMMENDATION 83.—*Obstructions.*

(a) If an obstruction must remain in the roadway it shall be clearly marked either by alternate black and white lines, 3 to 6 inches wide, sloping at an angle of 45 degrees, or by black and white checkerboard squares, each 6 to 12 inches on a side.

(b) Additional protection from an obstruction shall be provided by the use of a flashing yellow beacon light and/or by the use of a yellow reflecting sign, set 3 feet above the pavement, that will be illuminated by the headlights of approaching vehicles.

RECOMMENDATION 84.—*Railroad Crossing Gates.*

(a) Gates protecting railroad grade crossings shall be marked with alternate stripes of black and white, of 12 inch minimum width, placed at an angle of 45 degrees with the horizontal, when the gates stand across the highway, and sloping downward toward the center of the highway.

(b) Both sides of the gates shall be painted alike.

The foregoing standards for crossing gates have been adopted by the American Railway Association.

Section 4.—Safety Zones

Safety zones are used principally at street car loading points in heavy traffic streets. A less frequent use is in cross walks at or near the centers of wide streets, to afford protection to pedestrians when they are unable to proceed safely across the entire street without stopping.

Safety zones of the former class, if of the approved type, are a great protection to car riders, affording them opportunity to enter and leave street cars in safety. Furthermore, when used on streets carrying any considerable number of street cars and wide enough to afford adequate space for vehicle traffic alongside them, they greatly expedite that traffic, enabling it to continue in motion while the street car is loading, whereas without such protection for the car rider the most approved traffic regulations require the vehicle traffic to stop and remain standing until the passengers reach a place of safety.

RECOMMENDATION 85.—*Positions of Safety Zones.*

(a) Safety zones should be established at street car stops where the traffic is heavy and where at least one adequate traffic lane is available between the safety zone and the street curb.

(b) Safety zones should be established in crosswalks on wide heavily traveled streets or at any hazardous intersection.

RECOMMENDATION 86.—*Types of Safety Zones.*

Of the several types of safety zones the following are recommended in the order of preference:

(a) A raised platform of concrete or wood, adequately protected against collision at the end approached by the traffic.

(b) A marked space without platform, adequately protected at the end and along the sides.

A third type of safety zone consists of a space on the pavement without a platform, marked at the ends and along the side by portable signs and permanent marks. The signs are mounted either on heavy pedestals or on posts set in sockets in the pavement. This type is *not recommended for general use*. It may be used on streets where congestion of pedestrians occurs only at certain times of the day and where at other times, especially at night, it is expedient to give the use of the entire roadway to vehicles by removing the portable signs.

In some communities a safety zone is indicated by merely marking a space by lines on the pavement. This type of so-called safety zone is dangerous and is *not recommended*.

RECOMMENDATION 87.—*Traffic Lane.*

(a) A traffic lane not less than 9 feet 6 inches wide shall be provided between the edge of the safety zone and the curb.

(b) The traffic lane shall be kept clear by prohibiting stopping, standing, and parking along the curb throughout the length of the zone and for a distance of not less than 30 feet beyond each end.

RECOMMENDATION 88.—*Raised Safety Zones.*

(a) All raised safety zones shall be not less than 5 nor more than 7 inches high on the side toward the curb.

(b) Safety zones other than those provided for street-car stops shall be not less than 3 feet wide and 6 feet long.

(c) Those used for street car stops shall be at least 4 feet wide and shall be long enough to provide adequate access to car entrances for the number of cars ordinarily stopped at the zone at one time.

Because of the difference in widths of cars, no standard distance from the rail can be established. Platforms should be built to accommodate properly the narrowest car. If any cars are operated which would overhang the edge of the safety platform, warning of this fact should be given by a line marked at a safe clearance distance.

RECOMMENDATION 89.—*Protection of Safety Zones.*

(a) Safety zones of the approved types (See Rec. 86, a, b) shall be protected at the end the traffic approaches by substantial obstructions, either posts or abutments, extending approximately $3\frac{1}{2}$ feet above the surface of the pavement.

(b) The posts shall be made of heavy timber, reinforced concrete, or iron filled with concrete.

(c) They shall be placed at the corners or around the end of the zone, forming a curve.

(d) Above this protection there shall be placed a flashing yellow beacon signal.

(e) A "safety zone" sign shall be mounted either on the posts or on the beacon support. (See Rec. 18.)

(f) Posts or other protective obstructions shall be marked in accordance with the specifications for markings. (See Rec. 83.)

(g) Both the obstructions protecting the safety zone and the zone itself shall be adequately and separately illuminated at night.

(h) At a safety zone having no platform to define its boundaries, the side of the zone next to the traffic lane shall be protected by posts 5 inches in diameter, spaced at intervals not exceeding 8 feet for the entire length of the zone.

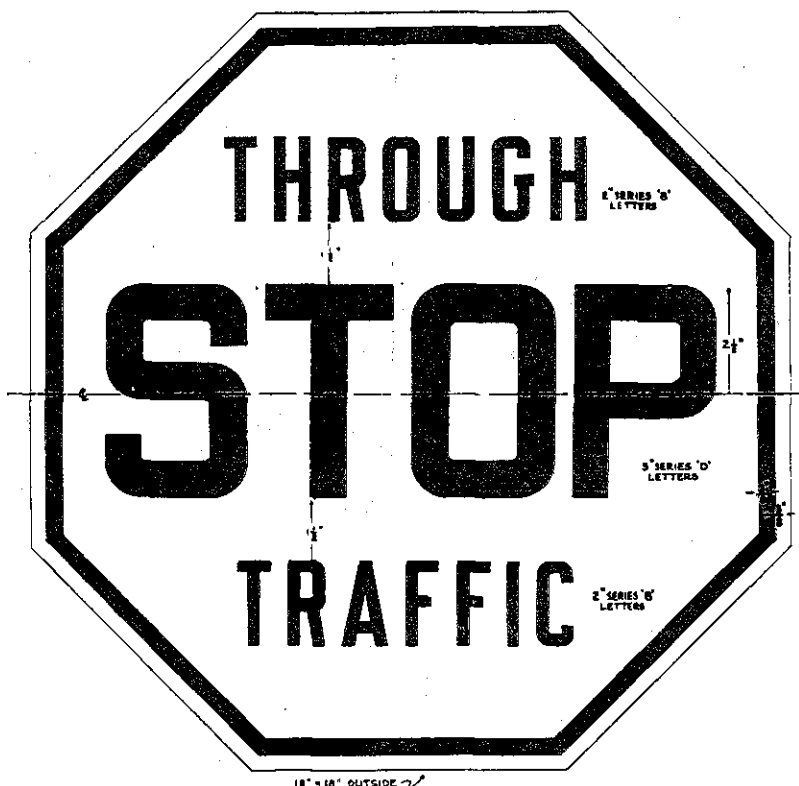


Figure 1: Stop Sign—Through Traffic Street
Letters and border, solid red
Background, federal yellow
(See Recommendations 10-15)

(Note: When a sign 24" by 24", as provided in Recommendation 10-a, is used the word "Stop" shall be in 6" Series E letters, and the message words in 3" Series B letters.)



Figure 1a: Stop Sign—Dangerous Corner.
(Note: This and succeeding signs showing black and white on the same page with colored signs will be of the same dimensions and colors.)
(See Recommendation 12)



Figure 2: Slow Sign—Safety Zone
 Letters, arrow and border, solid black
 Background, federal yellow
 (See Recommendation 18)



Figure 2a: Slow Sign—Safety Zone. (With two-headed arrow to permit passage either to right or left.)



Figure 3: Slow Sign—Dangerous Intersection
Letters and border, solid black
Background, federal yellow
(See Recommendation 19)



Figure 3a: Slow Sign—Car Line.
(See Recommendation 20)



Figure 4: Slow Sign—Hill
 Letters and border, solid black
 Background, federal yellow
 (See Recommendation 21)



Figure 4a: Slow Sign—Hill.
 (For grade of 10 per cent or
 steeper.)
 (See Recommendation 20)

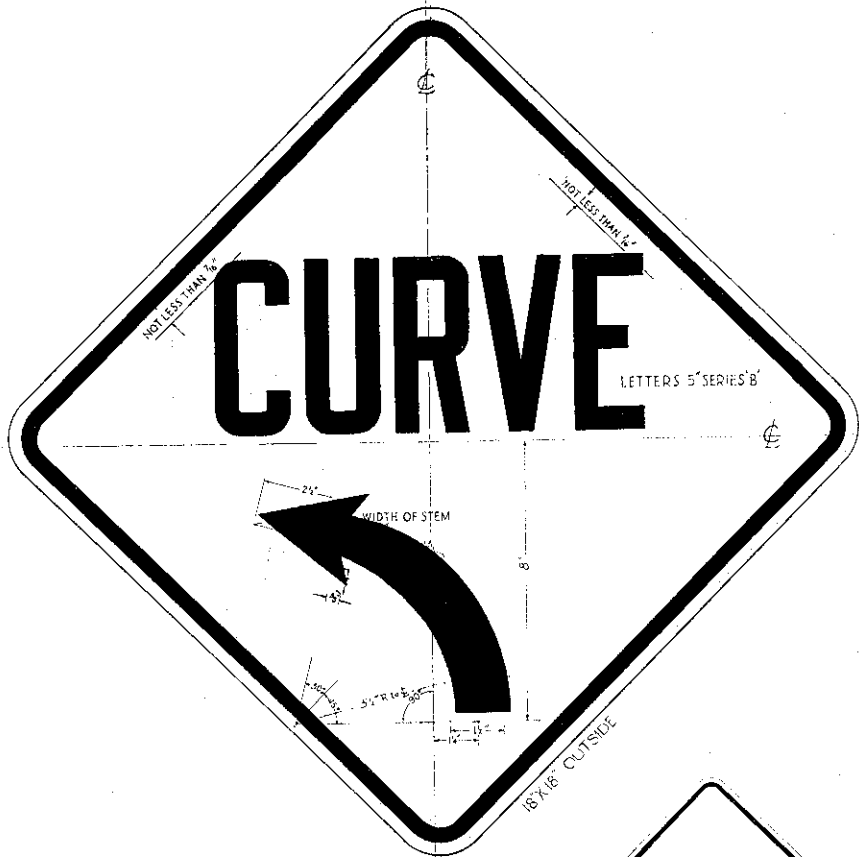


Figure 5: Slow Sign—Curve
 Letters, symbols and border, solid black
 Background, federal yellow
 (See Recommendation 22)



Figure 5a: Slow Sign—Curve.
 (See Recommendation 22)

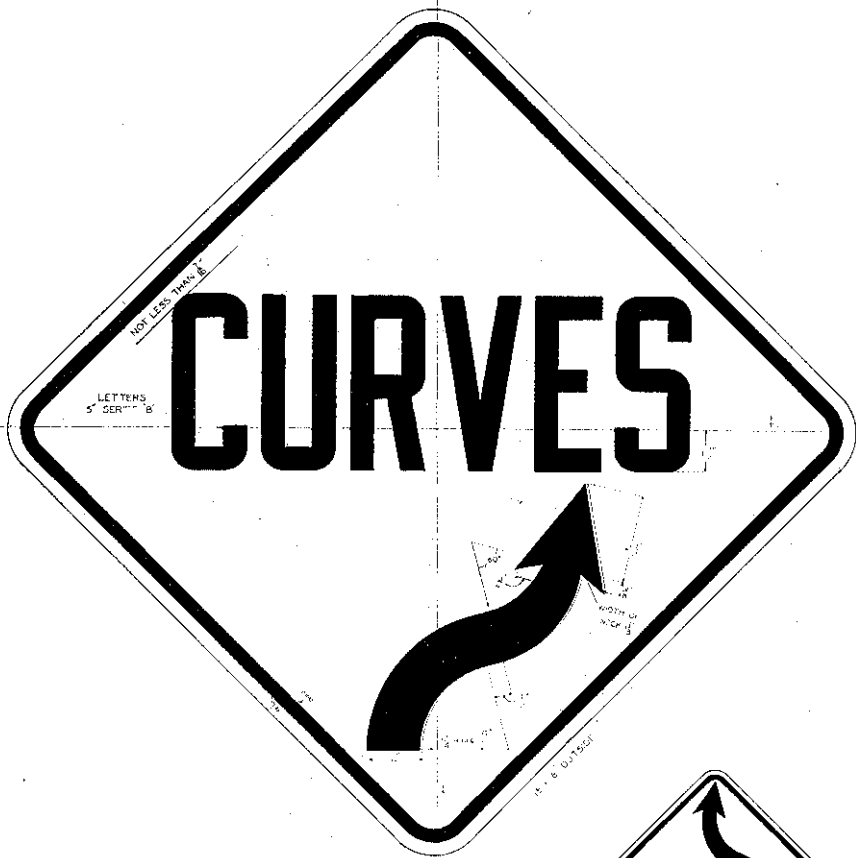


Figure 6: Slow Sign—Reverse Curve
 Letters, symbols and border, solid black
 Background, federal yellow
 (See Recommendation 23)

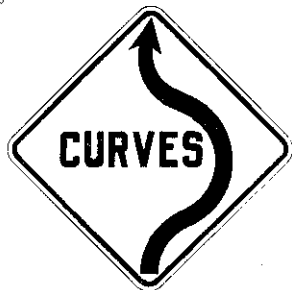


Figure 6a: Slow Sign—Multiple Curves.
 (See Recommendation 23)



Figure 7: Slow Sign—Turn
 Letters, border and symbols, solid black
 Background, federal yellow
 (See Recommendation 24)



Figure 7a: Slow Sign—Turn
 (See Recommendation 24)



18" X 18" OUTSIDE

Figure 8: Caution Sign—School Zone
 Letters and border, solid black
 Background, federal yellow
(See Recommendation 27)



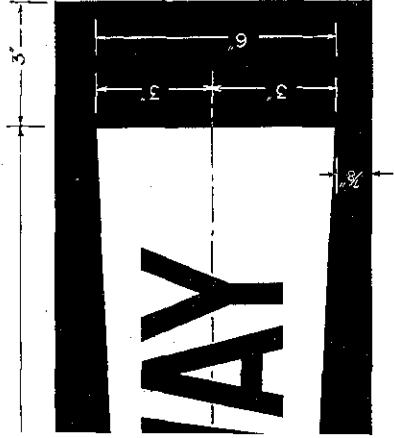
**Figure 8a: Caution Sign—
 Playground Zone.**
(See Recommendation 28)

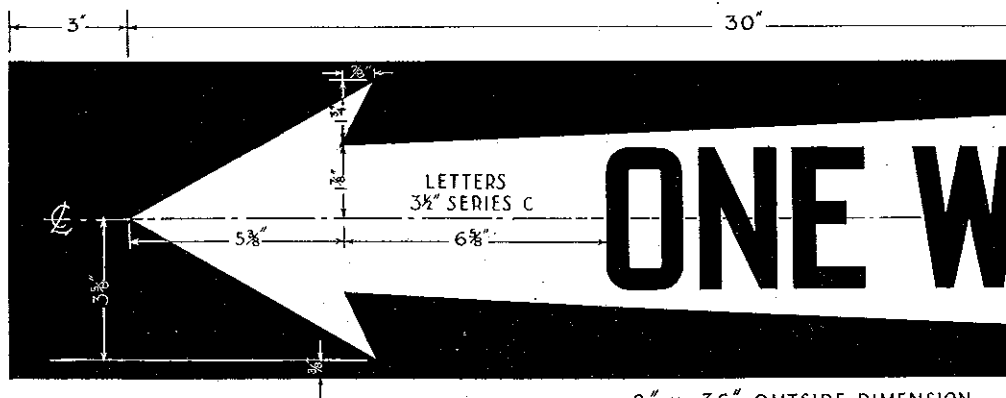


**Figure 8b: Caution Sign—
 Church Zone.**
(See Recommendation 30)



Figure 9: Caution Sign—Cross Street
Letters and border, solid black
Background, federal yellow
(See Recommendation 29)





8" x 36" OUTSIDE DIMENSION

Figure 10: One Way and Detour Sign
 Letters and background, solid black
 Arrow, white
 (See Recommendations 31-33)



Figure 12: Information Sign—No Turn
Letters and border, solid black
Background, white
(See Recommendation 36)

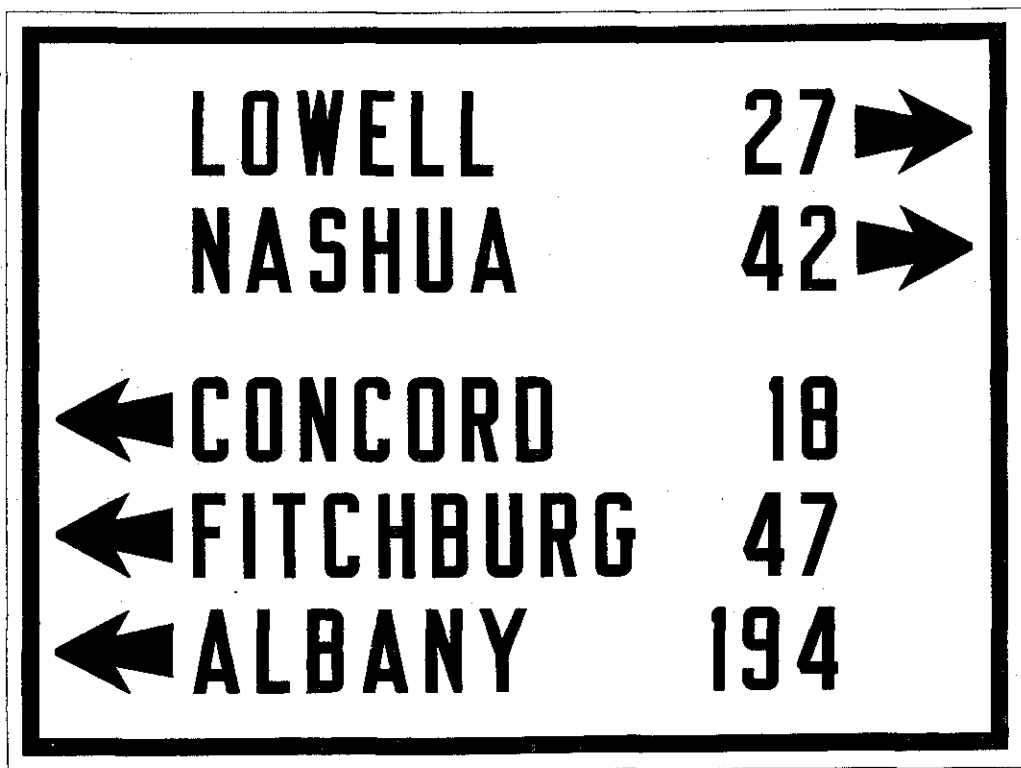


Figure 13: Information Sign—Direction
Letters and border, solid black
Background, white
(See Recommendation 38)

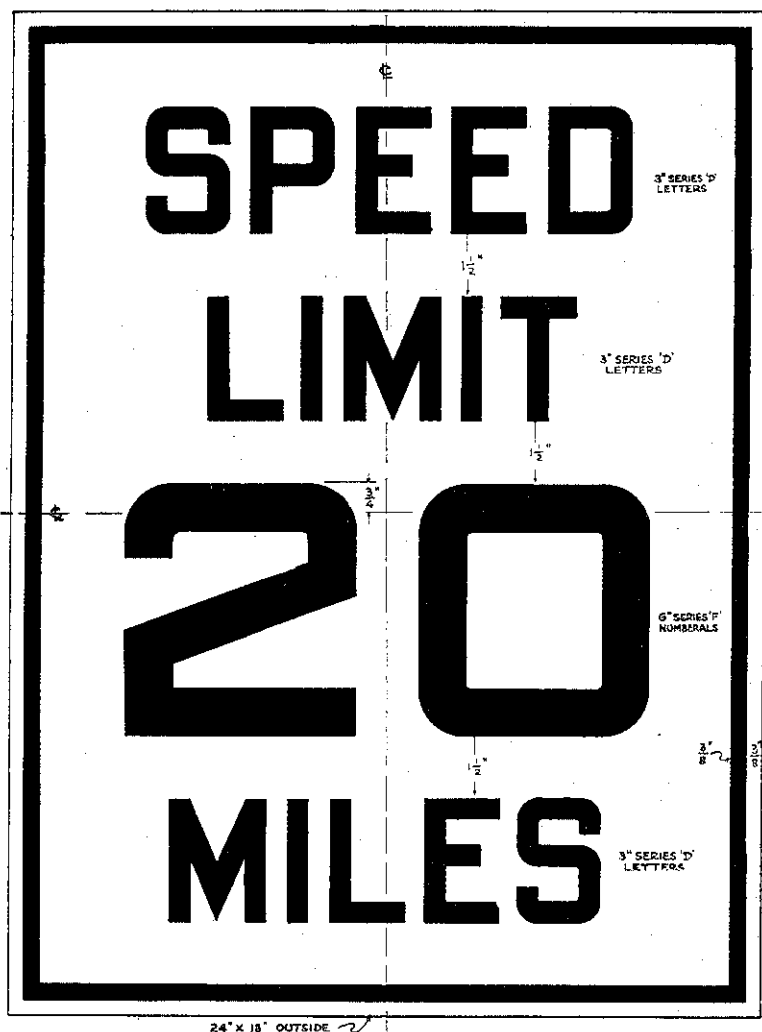


Figure 14: Information Sign: Speed Limit—Miles
 Letters, numerals and border, solid black
 Background, white
 (See Recommendation 39)

(Note: When a sign 30" by 24", as provided in Recommendation 36-a, is used the words "Speed Limit" shall be in $3\frac{1}{2}"$ Series E letters, the numerals shall be in 8" Series F letters, and the words "Miles" in 3" Series D letters.)

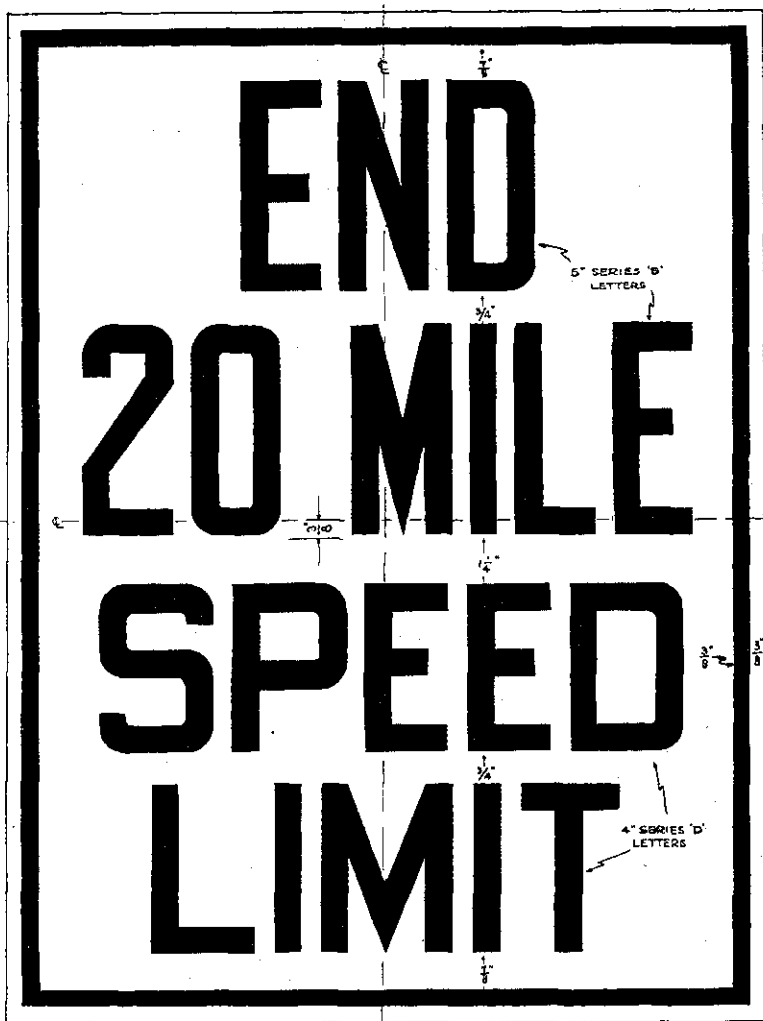


Figure 15: Information Sign: End of—Mile Speed Limit
Letters and border, solid black
Background, white

(See Recommendation 39)

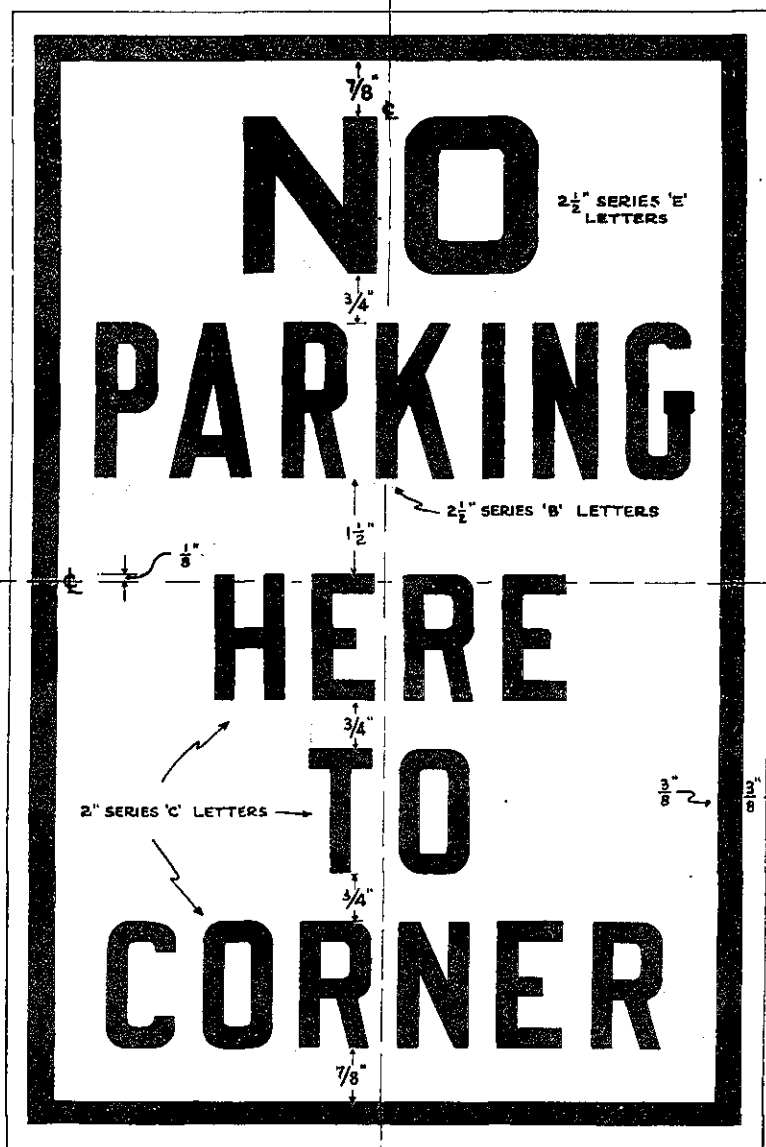
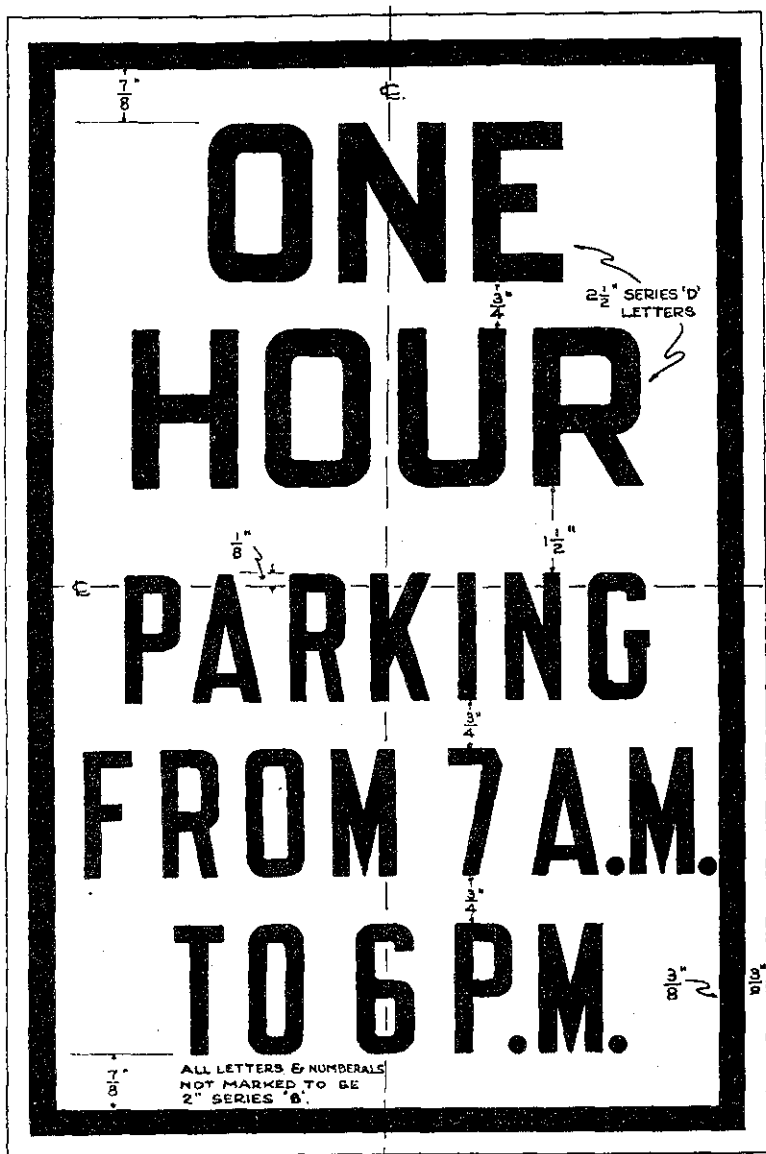


Figure 16: Restriction Sign—No Parking
 Letters and border, solid red
 Background, white
 (See Recommendations 42-48)



12" x 18" OUTSIDE

Figure 17: Restriction Sign—Limited Time Parking
 Letters and border, green
 Background, white

(See Recommendation 49)

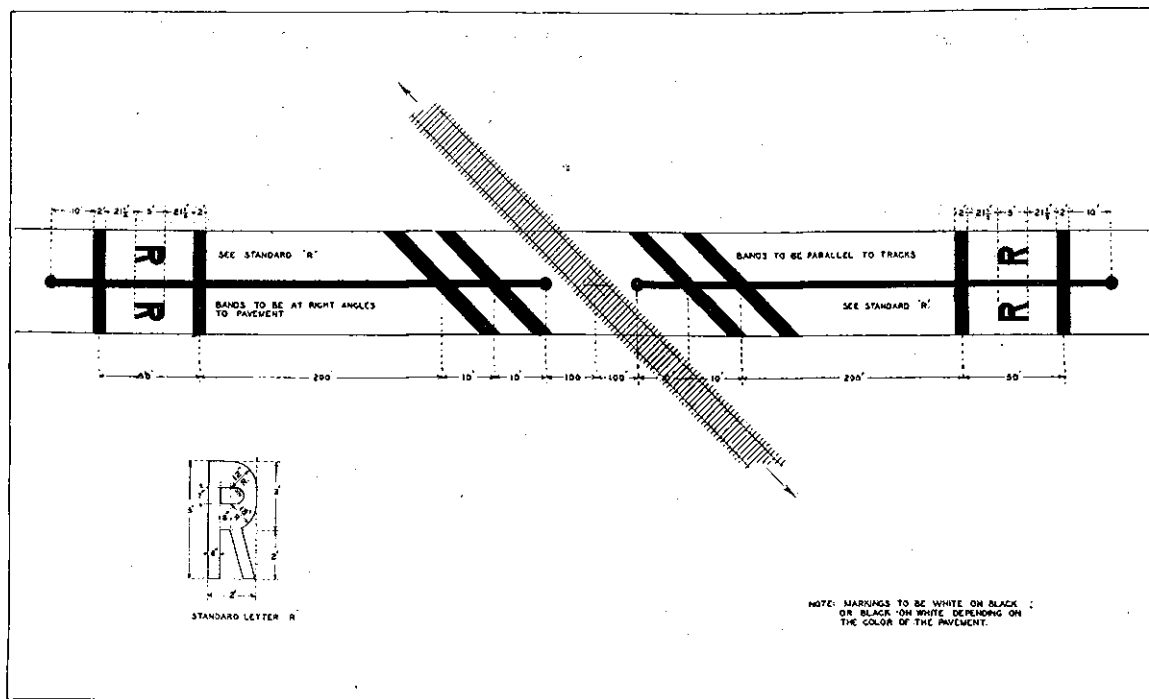


Figure 18: Railroad Crossing Pavement Markings
 Black on light colored pavement
 White on dark colored pavement

APPENDIX A

SPECIFICATIONS FOR SIGN MATERIALS

INTRODUCTION

The Joint Board on Interstate Highways of the Bureau of Public Roads has proposed the following specifications for the material, fabrication, and finishing of road signs in wood, embossed metal, cast iron, cast steel, cast aluminum, or vitrified enamel, in accordance with the standard working drawings approved by the Association of State Highway Officials, and with these specifications.

MATERIALS

The materials to be used for the sign shall be designated by the purchaser and shall conform to the following specifications:

The wood shall be yellow poplar, redwood, white pine, yellow pine, fir, cypress, kiln dried, grading one face clear, other side free from wane, loose knots, or large pitch pockets, as may be designated and approved by the purchaser.

The sheet metal used for embossed signs or for the base of vitrified enamel signs shall conform to the following requirements, at the option of the purchaser.

(a) The total amount of carbon, phosphorus, sulphur, manganese, and silicon shall not exceed 0.7 per cent. If the total of these five elements equals or exceeds 0.2 per cent, the metal shall contain not less than 0.17 per cent of copper, and not more than 0.06 per cent of sulphur. If the total of these five elements is less than 0.2 per cent, the presence of copper is optional and sulphur shall not exceed 0.04 per cent.

(b) The metal shall be in commercial flat sheets.

The cast iron used shall conform to the American Society for Testing Materials Standard Specifications, Serial Designation A 47-24 or A 48-18 and subsequent amendments to date of contract, as may be indicated by the purchaser. Where adequate foundry control methods are enforced, special tests for physical properties of the separate heats used will not be required.

The cast steel used shall conform to the American Society for Testing Materials Standard Specifications, Serial Designation A 88-24 (semi-steel) and subsequent amendments to date of contract. Where adequate foundry control methods are enforced, special tests for physical properties of the separate heats used will not be required.

The cast aluminum used shall conform to the American Society for Testing Materials Standard Specification, Serial Designation B 26-21, Alloy E, and subsequent amendments to date of contract.

The paint used for metal signs, both for background and design colors, shall be of the enamel type, of a quality and character to permit baking, and shall produce a true color tone and a surface that is smooth, tough and without cracks or other blemishes. The yellow color tone, as indicated by reflected white light, shall show a dominant wave length of not less than 580 nor more than 588 millimicrons, a purity of not less than 80 per cent, and on integral reflection of pigment of not less than 35 per cent. A liquid color sample conforming to this specification will be furnished by the purchaser if demanded.

The enamel used for vitrifying shall either be a colored glass or shall have a glass base or carrier with pigment in suspension, so compounded that upon fusion it will produce glass of the required color.

The paint used on wooden signs, both for background and design colors, shall consist of pure linseed oil and of pigments of the best grade, together with pure gum turpentine and dryer. It shall produce a true color tone that will not change under exposure and a surface smooth, tough and without cracks or other blemishes. The yellow color tone as seen by reflected white light shall conform to the same standards that are specified for paint for metal signs.

FABRICATION

Variation.—All working drawings shall show finished signs, and die and pattern makers must make such allowances as may be required by the processes of manufacture. For wood signs the overall dimensions are nominal. For sheet metal the overall dimensions of finished signs may vary from the drawings by not more than one-sixteenth inch per foot for draw in embossing. For cast iron, cast steel and cast aluminum the overall dimensions of finished signs may vary from drawings not more than one-eighth inch per foot.

Wooden Signs.—Signs made of wood shall have tongue-and-groove glue joints parallel with the grain of the wood, the grain to run in the direction of the longer overall dimension of the finished sign; shall be thoroughly glued with a high-grade waterproof glue; and shall be reinforced with two battens securely fastened to each separate member of the sign. Sign boards and battens shall be of 1 inch stock, surfaced on all sides. Face of board when finished shall be a smooth plane surface.

Sheet Metal Signs.—Signs made of sheet metal shall be embossed or shall have a vitrified finish; and when embossed the details of the design shall be raised from the background of the design not less than 0.100 nor more than 0.125 of an inch. The finished embossing or vitrifying shall conform to the lines of the working drawings and shall be clear and even in outline and free from cracks or tears. The entire sign shall be free from wind, twist, or buckle, and the background shall be a substantially plane surface. Unless otherwise specified by the purchaser, all signs shall be of 18 guage metal, U. S. Standard. If so specified, signs having a dimension of more than 22 inches lateral to the finished design shall be of 16 guage metal, U. S. Standard.

Cast Iron or Steel Signs.—Signs of cast iron or steel shall be true to line and finish as specified under specifications for material. The background shall be not less than 0.160 of an inch in thickness, and the design shall be raised not less than 0.100 nor more than 0.125 of an inch. If the thickness of background is to be greater than the minimum specified above that fact shall be stated by the purchaser.

Cast Aluminum.—Signs of cast aluminum shall be true to line and gage and free from holes and coarse, pitted, or porous areas. The background shall be not less than 0.200 of an inch in thickness, and the design shall be raised not less than 0.100 nor more than 0.125 of an inch. If the thickness of the background is to be greater than the minimum specified above, that fact shall be stated by the purchaser.

FINISH

Background Color

(a) Wooden signs shall have a primer coat, dipped, brushed or sprayed; a second coat dipped, brushed or sprayed; and a finish coat, brushed or sprayed.

Each coat shall be thoroughly dry before the next coat is applied. The finish coat, after drying, shall produce a semi-gloss finish and shall be free from brush marks, blisters, wrinkles or other blemishes.

(b) Embossed metal signs shall have one primer coat, dipped or sprayed, and at least one additional coat on the back and two additional coats on the face. The last coat shall be brushed or sprayed, and after the last background coat has been applied the sign shall be baked for not less than one and one-half hours at a temperature of 175°F. to 325°F., according to the requirements of the pigment and the carrier oils. The baking temperature and the rate of increase of temperature shall be so controlled as to produce a tough, flexible coating, not visibly darkened and entirely free from cracks, shrinkage, wrinkles, blisters, or other blemishes. Each background coat may be separately baked, but separate baking is not required.

(c) Vitrified enamel signs shall have a background finish consisting of a "slush," "grip," or "ground" coat, separately fused to the base metal. On this shall be applied the succeeding coats necessary to produce the design desired. All coats shall be so fused as to produce in the finished sign a single integral coat of enamel.

(d) Cast iron and steel signs shall have the background coat applied in the manner specified for embossed metal signs.

(e) Cast aluminum signs may be finished as bright castings without further treatment, or they may receive a coat of aluminum paint if the color code of the standard design specifies white. Baking will not be required for aluminum paint, but if the background color is applied with paint of the enamel type, the process used shall be that specified for embossed metal signs.

Design Color

(a) The design color on wooden signs shall be applied by hand or by process and shall dry to an even glossy black. The finished design shall be clear cut and sharp and the lines of all letters and details shall be true, regular and free from waviness, unevenness, furry edges or lines, and from all cracking, scaling, pitting, blistering, or blemish of any kind.

(b) The design color on embossed metal signs shall be applied by means of a roller or other suitable device until the equivalent of at least two wet coats has been applied. It shall then be baked in the manner required for the background color. The design color on vitrified enamel shall be applied as may be necessary to produce the desired colors and fused as required above. The finished design shall be clear cut and sharp, the lines of all letters and details shall be true, regular, and free from waviness, unevenness, furry edges or lines and from all cracking, scaling, pitting, blistering, or blemish of any kind.

(c) The design color on cast metal signs may be applied in the manner specified for embossed metal signs or may be built up with brushing or spraying lacquers that will bond thoroughly with the metal surface or the background coats.

APPENDIX B

UNITED STATES BUREAU OF STANDARDS SPECIFICATIONS FOR PAINT¹

General requirements.—Mixed paint shall be well ground, shall not settle badly or cake in the containers, shall be readily broken up with a paddle to a smooth uniform paint of good brushing consistency, and shall dry within 18 hours to a full oil gloss without streaking, running, or sagging. Its hiding power shall be equal to that of a sample mutually agreed upon. The color shall conform to the specifications for metal signs. All these paints are good on wooden signs for three years before repainting and under favorable conditions will last even longer than this.

White priming coat.—The following is the formula for a gallon of white lead paint, which is sufficient to cover about 600 square feet.

Formula for One Gallon of White Paint

White lead in oil (B. S. Circular 84).....	lbs.	11
Raw linseed oil.....	pints	4
Turpentine	pints	1 2/3
Drier	pints	1/9

White finishing coat.—The following formulas are taken from Bureau of Standards Circular 215, to which reference is made for further particulars.

Formula for Pigment of White Paint

<i>Ingredients</i>	<i>Per cent</i>	
	<i>Maximum</i>	<i>Minimum</i>
Titanium pigment		50
Zinc oxide		40
Extending pigments	10	
Matter soluble in water.....	0.8	

The pigment shall contain no lead and no sulphur in the form of sulphide.

The titanium pigment shall contain 25 per cent titanium oxide, the remainder of it to be blanc fixe (precipitated barium sulphate).

Formula for White Paint

<i>Ingredients</i>	<i>Per cent</i>	
	<i>Maximum</i>	<i>Minimum</i>
Pigment	62	58
Liquid (containing at least 85 per cent linseed oil)	42	38
Water	0.5	
Coarse particles and "skins" (total residue retained on No. 325 sieve)	1.2	

The weight per gallon shall not be less than 14 pounds. This paint will retain its whiteness longer than paint in which white lead is used for the finish coats.

¹ These specifications are intended to apply to paint used for street signs, and not for street markings.

Black paint.—The following formula is abstracted from Bureau of Standards Circular 94, to which reference is made for further particulars.

Pigment for black paint.—The pigment shall consist of carbon, lead oxide, insoluble mineral material, and, at the option of the manufacturer, oxide of iron. The pigment shall show on analysis not less than 20 per cent of carbon and not less than 5 per cent of lead oxide calculated as PbO_2 . The total of lead oxide, iron oxide, insoluble mineral material, and loss on ignition shall not be less than 90 per cent.

Formula for Black Paint

<i>Ingredients</i>	<i>Per cent</i>	
	<i>Maximum</i>	<i>Minimum</i>
Pigment	32	28
Liquid (containing at least 80 per cent linseed oil)	72	68
Water	0.5	
Coarse particles and "skins" (total residue retained on No. 325 screen)	1.5	

The weight per gallon shall not be less than 9 pounds.

Yellow paint.—The pigment shall be composed of chrome yellow (chemical precipitates of normal or basic lead chromates or mixtures of these with or without admixture of other insoluble compounds of lead), zinc oxide, and extending pigments.

Formula for Pigment of Yellow Paint

<i>Ingredients</i>	<i>Per cent</i>	
	<i>Maximum</i>	<i>Minimum</i>
Total lead weighed as $PbSO_4$		50
Zinc oxide	40	
Extending pigments	Remainder	

Formula for Yellow Paint

<i>Ingredients</i>	<i>Per cent</i>	
	<i>Maximum</i>	<i>Minimum</i>
Pigment	50	45
Liquid (containing at least 90 per cent linseed oil)	55	50
Water	0.5	
Coarse particles and "skins" (total residue retained on No. 325 sieve)	2	
Iodine number of fatty acids prepared from paint, according to B. S. Circular 89 (Wijs method). 175.		

The pigment shall contain no sulphur in the form of sulphide.

Green pigment.—The pigment shall be a chrome green containing about 23 per cent of color (sum of lead chromate and insoluble Prussian blue), about 10 per cent of magnesium silicate, aluminum silicate, or similar siliceous material, and about 67 per cent of barium sulphate. It should be made by precipitating the color on the proper base rather than by mixing the individual materials. It must yield on analysis the percentages indicated on page 62 of the materials specified:

Ingredients	Per cent	
	Maximum	Minimum
Color (total lead chromate and insoluble Prussian blue).		20
Lead compounds other than lead chromate (calculated as PbSO ₄).....	5	
Material soluble in water, including Prussian blue.....	0.2	
Acid-soluble or water-soluble calcium in any form (calculated as CaO).....	0.5	
Material other than color and barium sulphate.....	15	

The remainder must be barium sulphate.

Green paint.—The liquid in the mixed paint shall contain not less than 90 per cent of pure raw linseed oil, the remainder to be combined drier and thinner. The thinner shall be turpentine, volatile mineral spirits, or a mixture thereof. The paint shall be well ground, shall not settle badly or cake in the container, shall be readily broken up with a paddle to a smooth, uniform paint of good brushing consistency, and shall dry within 18 hours to a full oil gloss, without streaking, running, or sagging. The weight per gallon shall be not less than 12 pounds. The paint shall consist of the following ingredients:

Ingredients	Per cent	
	Maximum	Minimum
Pigment	55	50
Liquid (containing at least 90 per cent linseed oil).....	50	45
Water	0.5	
Coarse particles and "skins" (total residue retained on No. 200 screen based on pigment).....	0.5	

Red water-resisting enamel.—The following specifications are abstracted from Bureau of Standards Circular, United States Government Standard Specifications, No. 66.

General composition.—Pure high-color strength toluidine red toner (meta-nitro-paratoluidine-azo-betanaphthol), free from any base or substratum, and the best water-resisting long oil spar varnish. The color and hiding power, if specified, shall be equal to those of a sample mutually agreed upon by buyer and seller. The enamel must conform to the following specifications:

Weight per gallon: Not less than 7½ pounds.

Pigment: Not less than 6 per cent by weight.

Coarse particles and skins (total residue retained on No. 325 sieve): Not more than 0.5 per cent.

Non-volatile matter: Not less than 60 per cent by weight.

Set to touch: In not less than 18 hours.

Dry hard and touch: In not more than 48 hours.

Working properties: Must have good brushing, flowing, covering and leveling properties and must not cake in container.

Water resistance: The dried film must withstand cold water for 18 hours and boiling water for 15 minutes without whitening, dulling or changing in color.

Toughness: The enamel must pass a 50 per cent Kauri reduction test of 24 degrees C. (75 degrees F.)

PUBLICATIONS ON STREET AND HIGHWAY SAFETY

**Available on Request to National Conference on Street
and Highway Safety, 1615 H Street N.W.
Washington, D. C.**

Ways and Means to Traffic Safety—a summary of all recommendations of the National Conference on Street and Highway Safety, including the final report and resolutions adopted at the Third National Conference, May 27-28-29, 1930.

Committee reports submitted to Third National Conference, 1930:

- Traffic Accident Statistics
- Protection of Railway Grade Crossings and Highway Intersections
- Maintenance of the Motor Vehicle
- Measures for the Relief of Traffic Congestion
- Uniform Traffic Regulation, accompanied by
- Uniform Vehicle Code, consisting of
 - Uniform Motor Vehicle Registration Act
 - Uniform Motor Vehicle Anti-Theft Act
 - Uniform Motor Vehicle Operators' and Chauffeurs' License Act
 - Uniform Act Regulating Traffic on Highways
- Model Municipal Traffic Ordinance
- Manual of Street Traffic Signs, Signals, and Markings

Reports of former committees and conferences:

1924	1926
Statistics	Statistics*
Traffic Control	Uniformity of Laws and Regulations*
Construction and Engineering	Enforcement
City Planning and Zoning	Causes of Accidents*
Insurance	Metropolitan Traffic Facilities
Education	Public Relations
The Motor Vehicle	Second National Conference
Public Relations	
First National Conference	

In addition to the foregoing the National Conference has available for distribution publications relative to these subjects issued by participating organizations.

*Out of print.