STATE OF NEW JERSEY

A STANDARD CODE

FOR

Traffic Control Signal Installation and Operation

NEW JERSEY TRAFFIC COMMISSION

RUSSELL S. WISE, *Chairman*
HAROLD G. HOFFMAN
HUGH A. KELLY
JOSEPH CRAWFORD
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J. FRED MARGERUM,
Secretary

ARNOLD H. VEY,
Traffic Engineer

TRAFFIC CODE No. 1

1931

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INTRODUCTION

THE most generally effective mechanical device used to facilitate traffic and to increase safety 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 not only causes considerable inconvenience and delay resulting in economic losses to the public, but produces serious results, as 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 unsignalled side streets which would increase the volume of traffic and the danger of accidents there, especially to children.

The function performed by traffic control signals is highly specialized and it is recognized that their utility depends upon their use in accordance with sound engineering principles. The most important of these principles is that of a reasonable degree of conformity in design, location, and operation.

The New Jersey Legislature recognized these basic principles in the passage of Chapter 281, Laws of 1928, entitled "An Act Providing for the Regulation of Traffic on Public Roads," Article 13 of which deals with traffic signals; and further in the passage of Chapter 148, Laws of 1930, entitled "Traffic Commission Act." This latter act gives to the

For the convenience of the reader, statutory provisions relating to traffic control signals as contained in Chapter 148, Laws of 1930, and Chapter 281, Laws of 1928, are included in the appendix.

Traffic Commission power to regulate and control the placing and operation of all traffic signals or signaling devices upon the streets, highways and public places in the State, or cause the removal of traffic signals determined to be unnecessary and to cause the removal of all colored lights so located as to be confused with traffic signals.

It is pursuant thereto that Traffic Code No. 1 is issued; the other provisions of the Traffic Commission Act are treated in separate codes which may be issued from time to time.

The code is designed for two purposes; *first,* to inform municipal officials of the engineering principles controlling the successful installation and operation of traffic control signals; and *secondly,* to set forth the uniform standards and practices which the Commission will require for the approval of any traffic control signal installation. The standard code deals primarily with elementary principles of design and operation and leaves to local authorities as much discretion as is consistent with sound practice and basic conformity.

Approvals for signal installation and operation will be based primarily upon the code contained herein. All installations will be required to conform to its specifications.

The code is based upon special engineering principles; upon the "Report of the American Engineering Council Committee on Street Traffic Signs, Signals and Markings," and upon the requirements as set forth in the Traffic Act, Chapter 281, Laws of 1928, of the State of New Jersey.

This latter factor is of considerable importance as it has been the desire in drafting specifications of the code to make only certain departures from current general practice as might be required by reasonable uniformity and sound engineering principles.

It was also the desire of the Commission to give to officials of every municipality in the State and other interested parties an opportunity to discuss and comment upon the provisions of the Code.

A conference was, therefore, held on November 25th, at which time the Code was informally discussed and several

amendments and additions were presented by representatives attending.

All of the discussions were later considered by the Commission and the Code was then prepared in its present form and formally adopted by the Commission.

The procedure for obtaining approval of traffic signals and rules and regulations relating thereto is outlined in the following:

(1) Formal application for traffic signal installation approval must be made upon forms supplied by the Commission and as illustrated in the appendix of this code. It should be noted that the application must be accompanied by traffic count figures presented on forms supplied by the Commission.

(2) Approval of traffic signal installations shall be made in writing on forms illustrated in the appendix.

(3) Changes in approved apparatus must be submitted to the Commission for approval.

(4) Approvals are revocable after notice.

It is the hope of the Commission that the code will further assist municipalities in the State to effectively regulate traffic and to aid in the adoption of a slogan recommended in the January, 1928, Report of the New Jersey Traffic Commission, "Expedition with Safety." It is the intention of the Commission to administer the code in such a manner as to be of the greatest service to municipalities of the State and to continue constant studies in order that effective regulation may be varied to meet with the ever-changing conditions.

(Signed) RUSSELL S. WISE, *Chairman*
HAROLD G. HOFFMAN
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New Jersey Traffic Commission

A STANDARD CODE FOR TRAFFIC CONTROL SIGNAL INSTALLATION AND OPERATION

ARTICLE I

Definitions

Section 1. When the following terms are used in this code, they shall have the meanings ascribed to them in this section, and their general use is recommended for avoidance of confusion.

Traffic Control Signal. A device comprising all signal lights that are operated together to control traffic at an intersection, whether the signal is mounted in one unit or more.

Signal Installation. One or more traffic control signal devices so located and operated as to afford traffic control at a given intersection.

Signal System. Two or more signal installations operating in co-operation.

Signal Unit. A housing containing one or more faces, capable of giving traffic control indications.

Signal Face. That part of a signal unit capable of giving traffic control indications in a single direction.

Total Time Period. The length of time necessary in any signal installation to accommodate once, all of the intervals required to start and stop each flow of traffic at the intersection.

Time Interval. The length of time required to accommodate one of the divisions of the total time period.

Manual Control. The operation of signals by hand.

Automatic Control. The operation of signals by a timing mechanism.

Combined Control. A method whereby signals may be operated either automatically or manually.

Traffic Actuated Control. The operation of signals controlled by mechanism actuated by impulse derived from vehicle or pedestrian.

Independent Control. A signal not interconnected with or related in its operation to any other signal.

Simultaneous Signal Control Systems. All signals in the system change signal indications simultaneously.

a. *Direct Simultaneous.* All signals show the same color in the same direction simultaneously.

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

Progressive Signal Systems. Signal indications of all signals in the system change in accordance with a timing schedule to permit continuous traffic movement:

a. *Flexible Progressive.* All signals are interconnected to a master controller which maintains the same total time period at each intersection and by which the period may be varied to meet changing traffic conditions. The master controller automatically insures that all signals be continually kept in their proper time relation. In addition, a different division of the period can be made at each intersection.

b. *Limited Progressive.* Signals are operated by individual synchronous motors at each intersection. All signals have the same total time period, which cannot be readily varied, but a different division of the period can be made at each intersection.

Intersection. The area embraced within the prolongation of the lateral curb lines, or, if none, the lateral boundary lines of two or more highways which join one another at an angle, whether or not one such highway crosses another.

Roadway. That portion of a street or highway between the regularly established curb lines, or, if no such lines are established, then that part devoted to vehicular traffic.

Stop Line. An extension of the street boundary line crossed by a vehicle in entering an intersection, unless otherwise marked.

Business District. The territory contiguous to a highway when fifty per centum or more of the frontage thereon for a distance of 300 feet or more is occupied by buildings in use for business.

Residential District. The territory contiguous to a highway not comprising a business district, when the frontage of such highway for a distance of 300 feet or more, is mainly occupied by dwellings, or by dwellings and buildings in use for business.

ARTICLE II

Standards of Utility

Section 2. Installation and Operation Limited to Necessity. Signals may be installed or operated only where and when conditions warrant their use.

(Note for Section 2.) The utility of traffic control signals lies primarily in their ability to regulate the flow of traffic at points where traffic is delayed. The necessity for a traffic control signal increases in ratio to the amount of delay experienced in the absence of regulation. Under conditions necessitating the alteration of the flow of traffic streams, signals may perform a highly efficient service with greater regularity, visibility and economy than the same service can be performed by a police officer. Under such conditions, a traffic control signal may increase safety as well as improve the movement of traffic. On the other hand, if the volume of traffic is not sufficient to warrant control for the reduction of delay, there is a strong presumption against the installation. In the first place, accidents may be increased due to a lowered obedience resulting from the unreasonableness of the signal control; and in the second place, drivers of vehicles are unnecessarily delayed. Signals unnecessarily installed are a waste of initial investment, maintenance and operating costs, and incur a continual charge in delays and in added hazards.

It is for this reason that the code specifies traffic conditions, under which signal installations may be approved. Dangerous intersections with traffic conditions below the volume stated may be best protected by devices other than traffic control signals.

Section 3. Conditions Required for Approval of Signal Installation and Operation.

Signals may be installed and operated only where and during such times when one or more of the following conditions exist.

Conditions must be established by traffic counts and other information as requested in the Commission's form of application. All counts must be made from 7 A. M. to 12 midnight, and should represent the average traffic conditions for which it is proposed to operate the signal as a "Stop" and "Go" device.

(a) Where Vehicular Volume Warrants. The average vehicular volume warranting signaling installation and operation is described as follows:

The total vehicular volume entering the intersection from the combined major and minor street or streets must average one thousand (1,000) vehicles per hour for a period of 12 hours; of this total volume at least 25% must enter the intersection from the minor street or streets.

(b) Where Pedestrian Volume Warrants. The pedestrian and vehicular volume warranting signal installation and operation crossing the major and minor streets must equal or exceed the rate of 250 pedestrians per hour in addition to vehicular volumes as set forth in Section 3a.

(Note for Section 3b.) At intersections where the pedestrian volume equals or exceeds the rate of 250 pedestrians per hour, and the vehicular volume falls below the requirements as set forth in Section 3a, traffic control signals may be warranted based upon investigation and approval by the Commission.

(c) Where Co-ordination Requires. A traffic control installation which cannot be justified under provisions (a) and (b) may be justified as a part of a co-ordinated signal system, provided, that a majority of the signalled intersections composing the co-ordinated system comply with one or more of the said conditions and that the installation proposed adds to the efficiency of the system.

(Note for Section 3c.) Co-ordinated control as described herein occasionally necessitates, for a balanced operation of the system, the installation of control units at lightly traveled intersections. Where such conditions exist, an installation may be warranted as an improvement to the co-ordinated system, even though conditions at the particular intersection might not otherwise justify regulation.

(d) Where Other Conditions May Warrant. Traffic control signal installations which cannot be justified under provisions (a), (b) and (c) may be justified when in the opinion of the Commission other conditions necessitate control.

(Note for Section 3d.) Occasional traffic conditions as excessive speeding endangering pedestrians and vehicular movements and where desirable to separate continuous flows of traffic into groups,

traffic control signals may be justified even in the absence of an otherwise necessary volume. Such justification to be based upon investigation and approval by the Commission.

(e) Where Conditions Warrant Actuated Control. Intersections or control locations proposed for control by traffic actuated signals will be considered as special cases and the foregoing requirements may be waived upon investigation and approval by the Commission.

(Note for Section 3e.) This type of control is often well adapted to irregular intersections, particularly where more than two streets cross. Its use is also worthy of consideration at intersections with intermittent or variable traffic. However, at intersecting roadways where traffic is more or less uniform, the advantages of the selective principle of traffic-actuated control over fixed-time signals are diminished.

Application of this method of control can be made for the use of pedestrians by the installation of pedestrian push buttons.

ARTICLE III

Standards of Design

Section 4. Number of Lenses Per Signal Face. Each signal face shall have three lenses. Under special conditions, an additional lens may be used for the purpose of right or left turn arrows.

(Note for Section 4.) The only condition in which more than three lenses will be permitted is where it is necessary to provide special indications for right and left turns.

Section 5. Color and Position of Lenses. Lenses of the following colors only shall be used and shall be arranged vertically in the signal face, or when necessary, horizontally and shall conform to the following positions: (See Figs. 1 and 2.)

Red shall be located at the top.
Amber (or yellow) shall be located in the middle.
Green shall be located at the bottom.
Green right or left turning arrows when used, shall be located below the green lens.

When arranged horizontally:
Red shall be located at the left.
Amber (or yellow) shall be located in the middle.
Green shall be located at the right.
Green right or left turning arrows when used, shall be located at the right of the green lens.

(Note for Section 5.) Although the horizontal arrangement of lenses in the signal face is permitted, such practice is not recommended by the Commission and should only be used when physical conditions necessitate. The vertical position is for the purpose of assisting drivers in more readily identifying control commands, and is especially required for the assistance of color blind persons.

Section 6. Meaning of Colors. Colors in traffic control signals shall have the commands ascribed to them in this section and no other meanings, and no driver of a vehicle, or street car, or a pedestrian, shall fail to comply with said commands, and all other uses of such colored lights so located as to be confused with traffic signals shall be discontinued. (See note for Section 7.)

1. *Green* shall mean permission for traffic to go, subject to the safety of others, or the specific directions of an officer.

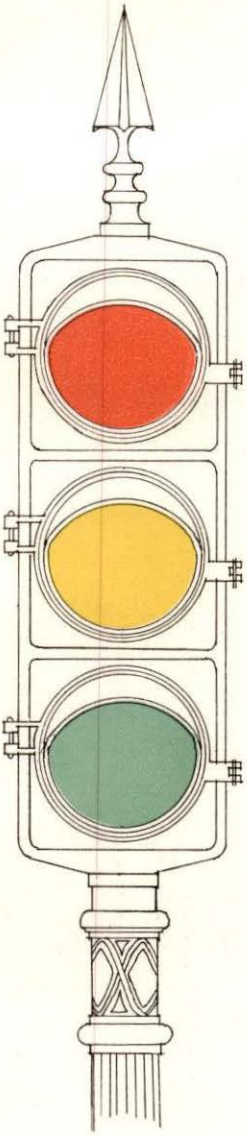
(Note for Section 6-1.) In a standard three lens signal face green lens, when illuminated, is an indication to drivers and pedestrians facing such lens that they proceed into the intersection subject to safety requirements, and pass through or turn to the right or left, unless the turning movement is specifically limited as provided in Section 6-4.

2. *Amber* (or yellow) after green shall mean traffic to stop before entering the intersection or nearest crosswalk unless when the amber appears the vehicle or street car is so close to the intersection that with suitable brakes it cannot be stopped in safety. A distance of fifty feet from the intersection is considered safe stopping distance for a speed of twenty miles an hour, and vehicles or street cars if within this distance when the amber appears and cannot be stopped with safety may proceed across the intersection or make a right or left turn, unless the turning movement is specifically limited as provided in Section 6-4.

The meaning ascribed to the *Amber*, as above, is dependent upon Legislature enacting a corresponding amendment to Article XIII, Section 2 of Chapter 281, Laws of 1928.

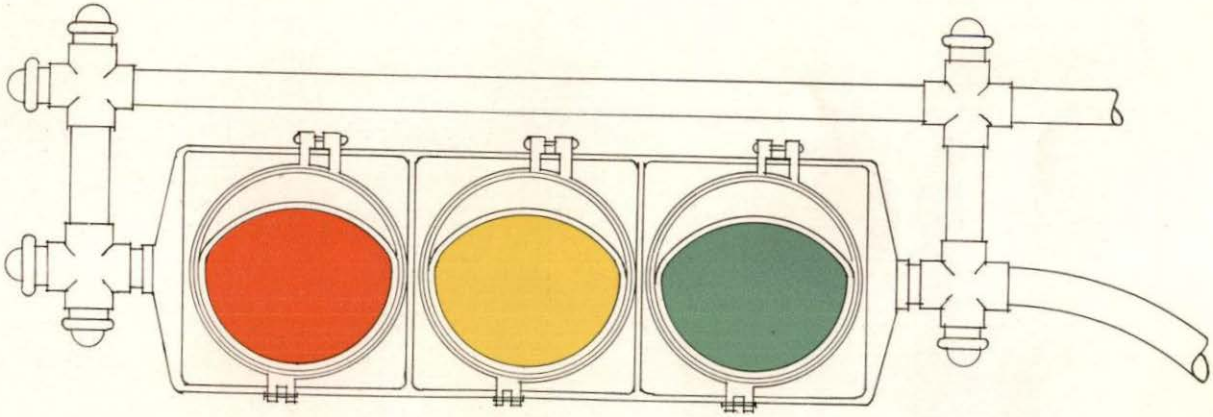
(Note for Section 6-2.) The amber lens used alone in conjunction with "Stop" and "Go" operation is indicative of a change from *green* to *red* only and is to serve as a clearance interval for moving vehicles and street cars so close to the intersection when the amber appears and before the red signal that they cannot be stopped with safety. When used in flashing operation, as provided in a following section of this Code, the amber lens shall serve as a warning, meaning "Proceed with Caution."

Amber alone shall not be for the exclusive use of pedestrians but in cases where pedestrian movements are heavy and complicated by numerous vehicular turning movements, a special pedestrian interval may be provided by the use of the red and amber lenses shown simultaneously or some other approved indication. The necessity for such a pedestrian interval and the method of indication is considered as specialized control, and should, therefore, be incorporated in traffic signal operation only upon special approval by the Commission.



STANDARD VERTICAL THREE LENS DESIGN

FIG. 1



HORIZONTAL THREE LENS DESIGN

FIG. 2

3. *Red* shall mean traffic to stop before entering the intersection or crosswalk and remain standing until green is shown.

(Note for Section 6-3.) Confusion has resulted from a lack of uniform obedience to red signal lights. The red lens should always indicate a complete stop for both vehicles and pedestrians unless specifically modified by an auxiliary indication. Permitting operators to make right or left turns, or pedestrians to move during the showing of the red lens is contrary to law. The necessity for right or left turns during the general stop period is exceptional and therefore should require a specific modification. This has been provided for in the specification of additional right or left turning arrow lenses. When such right or left turning arrows are used to permit turning movement during the interval when through movements are stopped, they should be illuminated in conjunction with the red signal which they modify and shall afford the only indication which modifies the complete stop required by the red lens. When used in flashing operations, as provided in a following section of this code, the red lens shall require drivers to come to a complete stop before entering the intersection.

4. *Green arrow lenses.* When a special right or left turn green arrow lens is incorporated in a signal, drivers facing said signal shall make a turn in the direction of such arrow only when such lens is illuminated. (See Figs. 3 and 4.)

(Note for Section 6-4.) The use of right or left turning arrow lenses is not recommended in this code unless special conditions necessitate. Such conditions are occasionally found in irregular intersections where it may be desirable to permit a continuous flow of one stream of traffic or at intersections where there is a preponderance of turning movements. It is apparent that the right or left turning arrow has no utility unless a special lane can be reserved for traffic so controlled, or unless the street into which such traffic turns is of adequate width to accommodate it in combination with any other movements simultaneously permitted. As turning arrow lenses may be used to restrict turning movements during the normal through movement interval, as well as to permit special turns during the normal stop interval, it is important that where such lenses are incorporated in a signal unit, turns should be made only when such lenses are illuminated.

Illustration: In a signal unit incorporating both right and left turning arrow lenses, permission for through movement and right and left turns simultaneously shall be given by an illumination of the normal green lens and both turning lenses.

Specialized control warrants special advice to the public. Upon the approach to a signal unit incorporating a turning lens, an illuminated sign shall be erected with the text, "Turn right (or left) only with arrow." Lanes painted in the roadway and plainly marked assist in directing special turning movements.

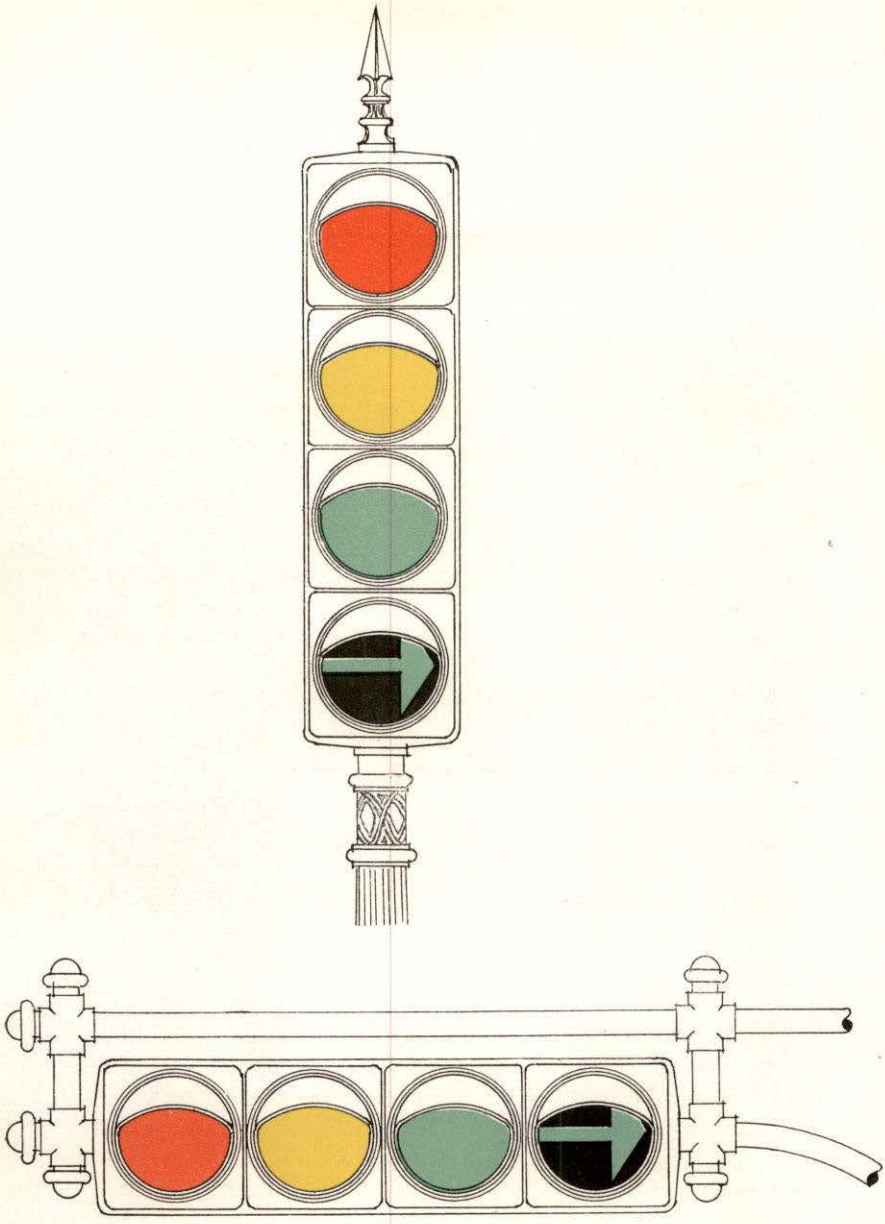
5. *Flashing red.* The red lens when illuminated with rapid intermittent flashes, shall require drivers to come to a complete stop before entering the intersection. Such flashing red shall be used only in traffic signals when not operated as "Stop" and "Go" devices to indicate the full stop required before entering a through street.

6. *Flashing amber.* The amber lens when illuminated with rapid intermittent flashes, shall indicate the presence of danger and shall permit drivers to proceed only with caution.

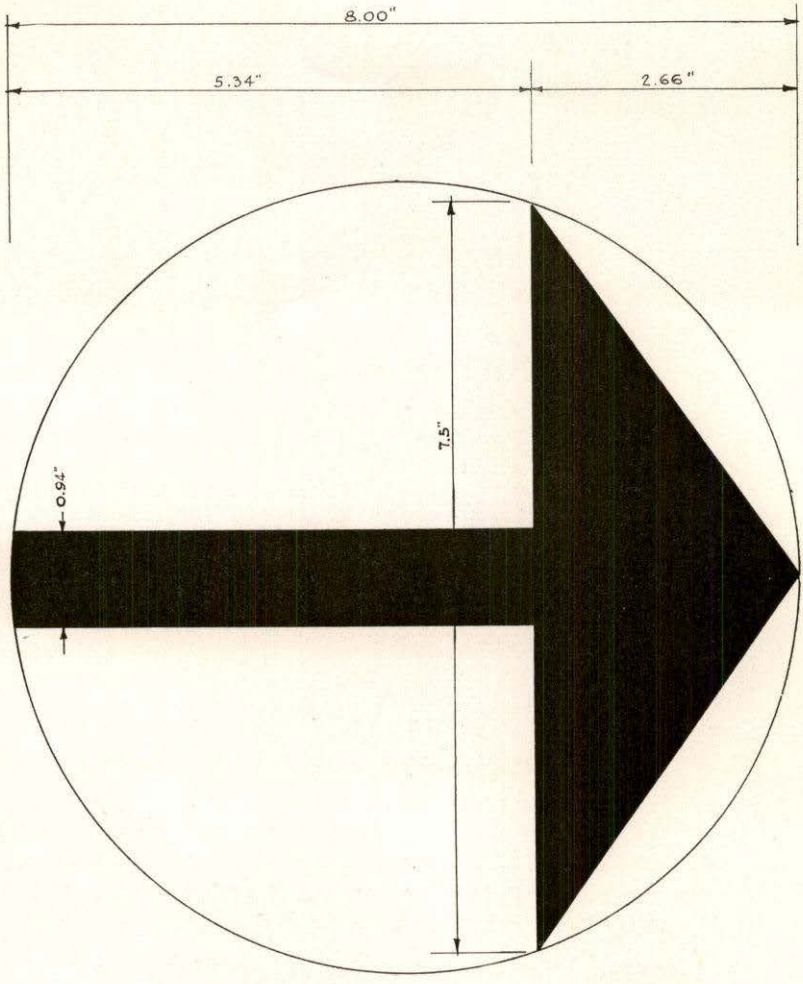
(Note for Section 6-5 and 6.) Observations have shown that flashing mechanisms operating at a rate of from 40 to 60 flashes per minute provide for a flashing signal that is definite and is not too rapid nor to slow. It is further recommended that the "on period" of the flash should be at least equal to the "off period."

Section 7. Shape and Diameter of Signal Lens. Lenses should be round and should have a visible diameter of approximately 8 inches.

(Note for Section 7.) The round lens has been recommended in conformity with general practice. Lenses of 8 inch visible diameter are recommended for the same reason, and in addition, for adequate visibility and for the elimination of confusion with street and steam railway signals which may be located upon or adjacent to the street or highway. It is recommended by the Commission that red lights designating police and fire alarm boxes be replaced by lights of royal blue color, to avoid confusion with traffic signals.



SPECIAL FOUR LENS DESIGN
(a) VERTICAL
(b) HORIZONTAL
FIG. 3



DESIGN FOR ARROW LENS

FIG. 4

Section 8. Lamp Capacity. Each lens shall be illuminated by a clear lamp or not less than 60 watt capacity, especially designed for traffic signals.

Section 9. Illumination of Lens. Each lens shall be illuminated independently of any other lens.

(Note for Section 9.) Requirements of flexible operation, visibility, uniform position of lenses and the elimination of phantom light make necessary the independent illumination of each lens.

Section 10. Visibility of Lens. The lens reflector and visor shall be of such design as to minimize the effect of a phantom light and to render each lens when illuminated clearly visible to traffic controlled by that signal at all distances to 300 feet under all light and atmospheric conditions.

(Note for Section 10.) This section provides that the control signal be so constructed as to give indication adequately visible within the necessary control range. The optical units shall be so constructed that drivers comparatively near the signals shall be able to see their indication. Inasmuch as no signal is normally to exercise control at any intersection other than the one at which it is located, it is deemed adequate that its indications should have effective visibility under the least favorable conditions for a distance not less than 300 feet.

Section 11. Lettering of Lens. Lens shall have no lettering.

(Note for Section 11.) Incorporation of lettering in signal lenses greatly reduces their visibility and is deemed unnecessary with the adoption of the uniform and specific color position and meanings contained herein.

ARTICLE IV

Standards of Installation

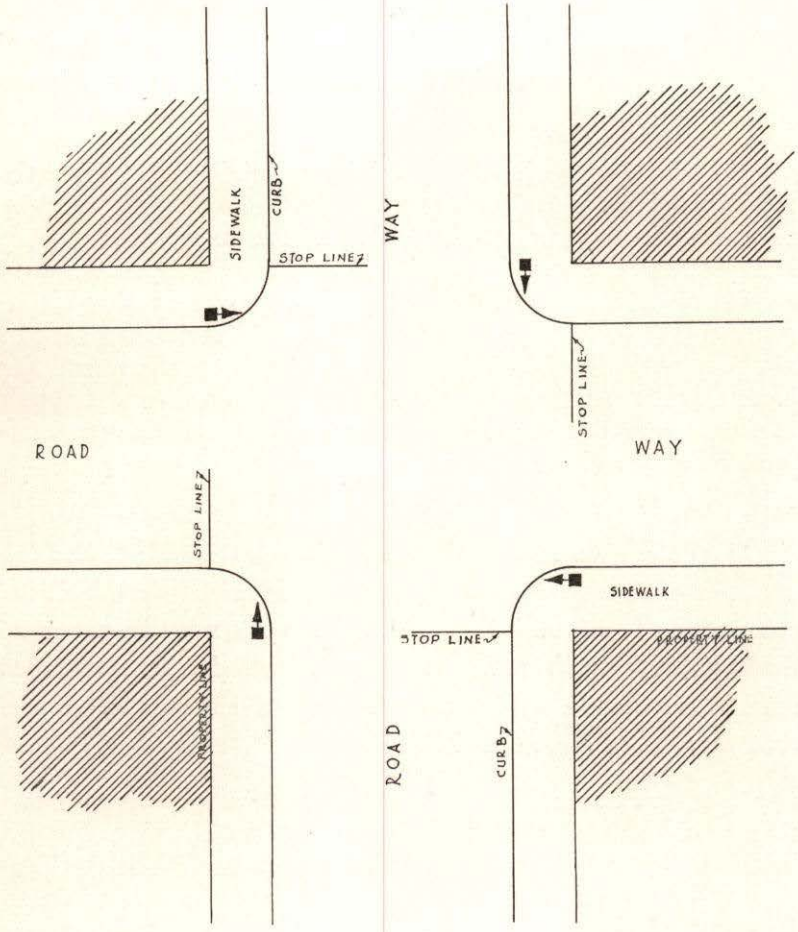
PHYSICAL REQUIREMENTS OF LOCATION

Section 12. Intersection Location. Signal units shall normally be located to give approaching traffic a control indication from the far right corner of the intersection. There must be at least one signal face for the control of each street entering the intersection. (See Figs. 5 and 11.)

(Note for Section 12.) If an intersection warrants control, it is of sufficient importance to justify the best type of control obtainable. The matter of nominal expense should not be weighed against public safety and convenience. Each flow of traffic should be given clear commands, and this can be obtained fully only by providing a specific signal face for each stream to be controlled. Detailed investigations have led to the selection of the so-called far right-corner location as standard. Departures from this normal location will be approved only under very specialized local conditions. This location is justified by the fact that a signal so placed gives the most efficient indications. It is in line with the path of where motorists look for warning and direction advice. It is sufficiently removed from the stop line of vehicles on the near side of the intersection so that it can be seen conveniently by drivers. Signals suspended on cables over the center of the intersection have the serious objection of impaired visibility because of the construction of the typical vehicle, and will not be approved.

Traffic signals shall be so located as to not obstruct the paved width of the roadway; by special approval of the Commission, pedestal mounted signals may be located within the intersection or paved portion of the roadway, provided, however, that the signal shall be installed upon a safety isle constructed in accordance with Article XII, Section 43, Chapter 281, Laws of 1928.

Section 13. Corner Locations. Each signal unit shall be located as near as possible to the intersection of the curb line of the street whose traffic it controls and the property line of the intersecting street. (See Fig. 5.)



STANDARD FAR RIGHT CORNER INSTALLATION

Two, Three or Four Way Units May be Used in Place of One Way Units

FIG. 5

(Note for Section 13.) The location specified is designed to keep the signal in line with the driver's view and to offer a minimum of obstruction to sidewalk traffic.

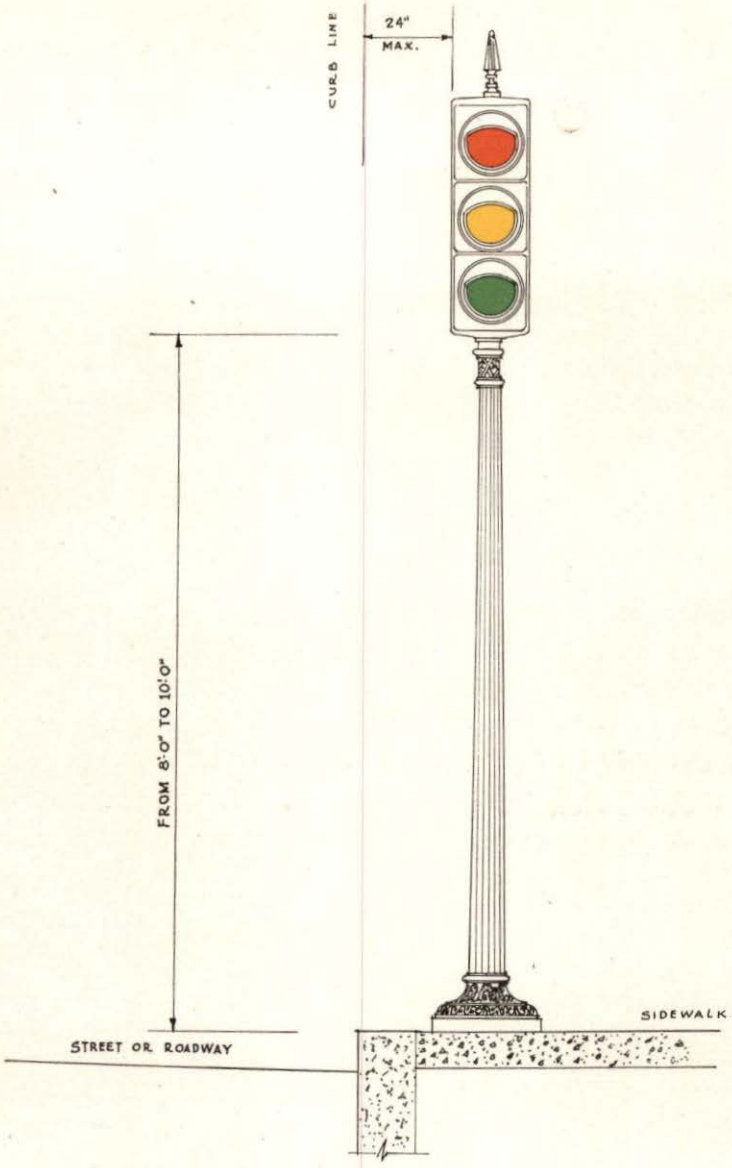
Section 14. Height of Signals. Signal units located within the curb line shall be placed at a height of from eight (8) to ten (10) feet above the pavement; if on bracket or mast arm, a signal shall clear the pavement by fourteen (14) feet. (See Figs. 6 and 7.)

(Note for Section 14.) The minimum height is to prevent the visibility of the signal from being obstructed unnecessarily by passing pedestrians or vehicles. The maximum height prescribed is to prevent the signal from being located in such a position as to be obscured by the sun visor or top of the driver's vehicle. The fourteen feet clearance required for signals mounted over the roadway is in accordance with the highway requirements for bridges and other overhead construction. Supplementary signals mounted upon the near side should always be mounted at the minimum height of eight (8) feet.

Section 15. Location With Respect to Roadway. Where signal units are placed behind the curb line, the side of the housing next to the roadway shall not be more than two (2) feet from the outer edge of such curb line. All signal units must be not more than two (2) feet from a vertical line extended from the graded outer edge of the roadway, or the travelable portion of the roadway. (See Figs. 6 and 7.)

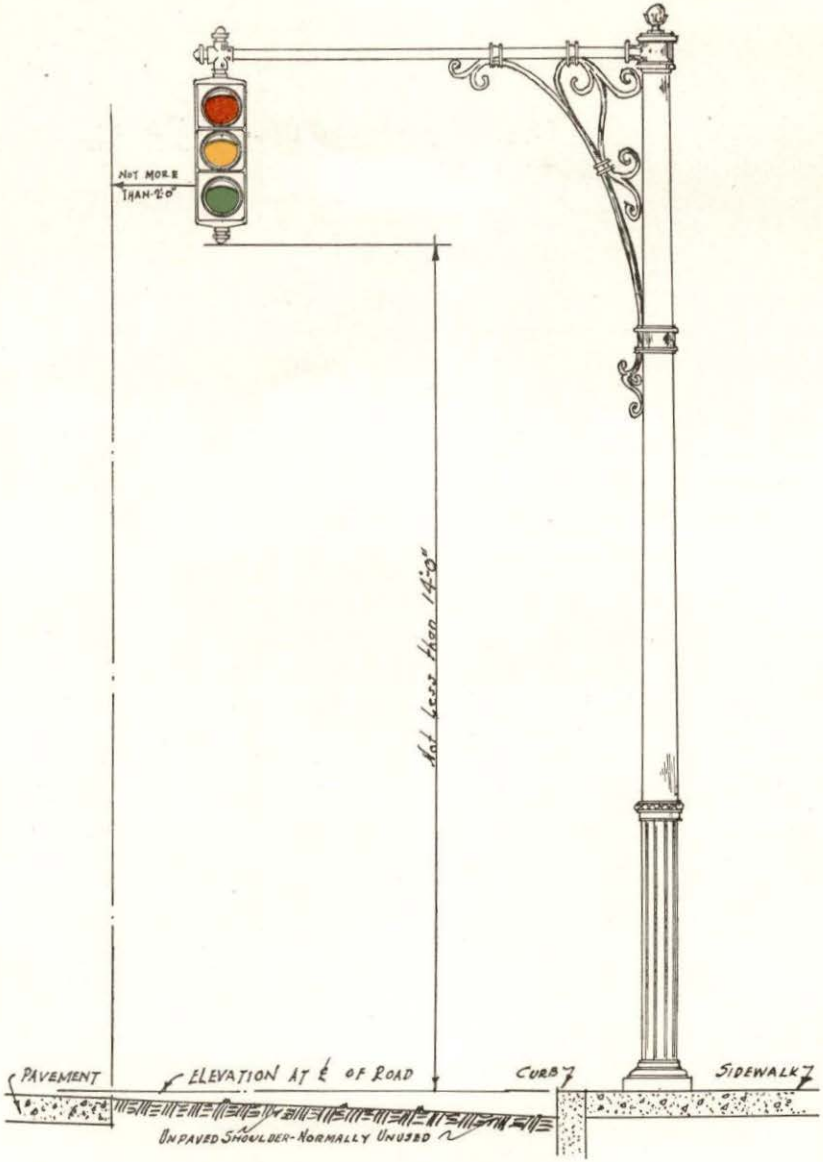
(Note for Section 15.) Numerous conditions exist in the State where only a portion of the width of the established roadway is improved for vehicular travel. Under such conditions the location of the signals in the normal position, as indicated in Section 13, would place the unit out of the normal range of vision of the driver. Under such conditions the extension of the signal unit by mast arm or bracket, to a position near the edge of the normal travelable portion of the roadway is advisable.

Section 16. Locations on State Highways. Where signals are to be located at intersections with State highways it will be necessary for the applicant to obtain such permits as may be necessary in order to conform to the regulations of the State Highway



TYPICAL POST MOUNTING

FIG. 6



MAST-ARM SUSPENSION MOUNTING

FIG. 7

Commission with respect to openings within the rights of way of State highways. Permits for any necessary openings must be obtained from the State Highway Commission before erection of the signals is started.

(Note for Section 16.) The regulations of the State Highway Commission require that every effort be made to avoid opening any portion of the paved surface of the highway. It is, therefore, suggested that applicants plan to install underground ducts by pushing them under the paved surface rather than by opening the surface. Plans submitted to the State Highway Commission with applications for openings in highway rights of way must show the locations and dimensions of proposed openings in accordance with the details shown on the typical detailed plan. If openings are to be made the nature of the surface to be opened must also be indicated. (See Fig. 8.)

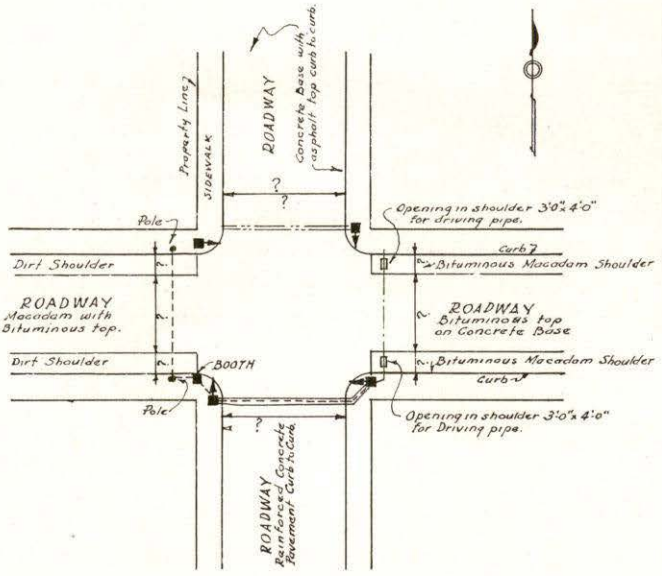
Electrical connections made overhead shall conform to the N. E. L. A. Code for clearance over the highway.

Standard application forms for permits on State highways may be obtained from the Maintenance Division of the State Highway Department, Trenton, New Jersey, upon request.

Visibility Requirements of Location

Section 17. Distance Limits. If any signal unit mounted in accordance with Section 12 is more than 100 feet distant from the stop line of the traffic which it controls, such unit shall be supplemented by an auxiliary signal unit, mounted in such a manner as to provide the required visibility.

(Note for Section 17.) Unusually wide roadways and irregular intersections would occasionally require the placing of the signal unit in accordance with the normal location point at such a distance from the established stop line that operators would have an inadequate view. The maximum distance permitted between the signal and the stop line is 100 feet. When the normal location of the signal at the far right corner of the intersection would result in exceeding this distance, such signals shall be located as required, but shall be supplemented by a near side signal or by one within the range of the required visibility.



INTERSECTION SHOWING UNDER GROUND & OVER HEAD WIRING CONNECTIONS.

Scale - 1" = 40'

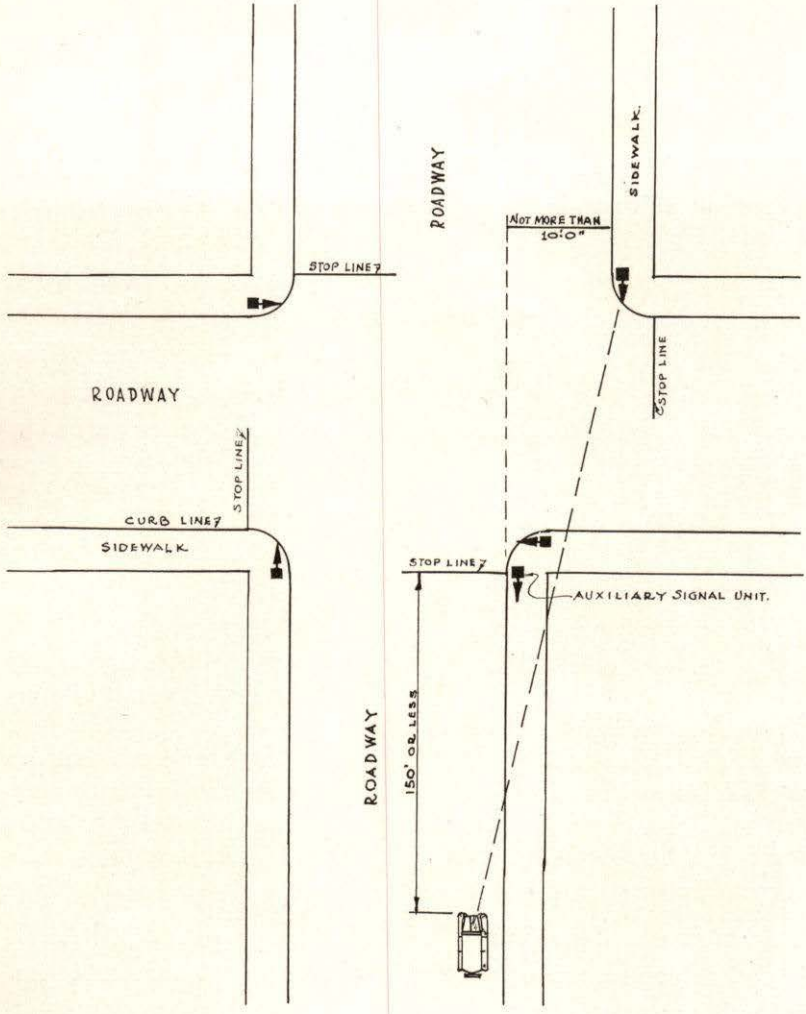
LEGEND

Existing Under Ground Duct
Cable Overhead.
Pipe Driven under Pavement
Open Pavement for Cable
Question Mark represents dimensions to be inserted.

CITY OR TOWN	COUNTY
LOCATION	
Date	SUBMITTED BY
Size of Trench	MUNICIPALITY
Size of Pipe to be Driven	Address
Over Head Cable	City or Town.
Type of Pavement	OFFICIAL SUBMITTING

TYPICAL DETAILED PLAN OF INSTALLATION

FIG. 8



OFFSET REQUIRING AUXILIARY SIGNAL

FIG. 9

Section 18. Maximum Distance From Corner. Corner signals shall not be more than 10 feet from the location specified in Section 13 unless supplemented by an auxiliary signal. (See Fig. 9.)

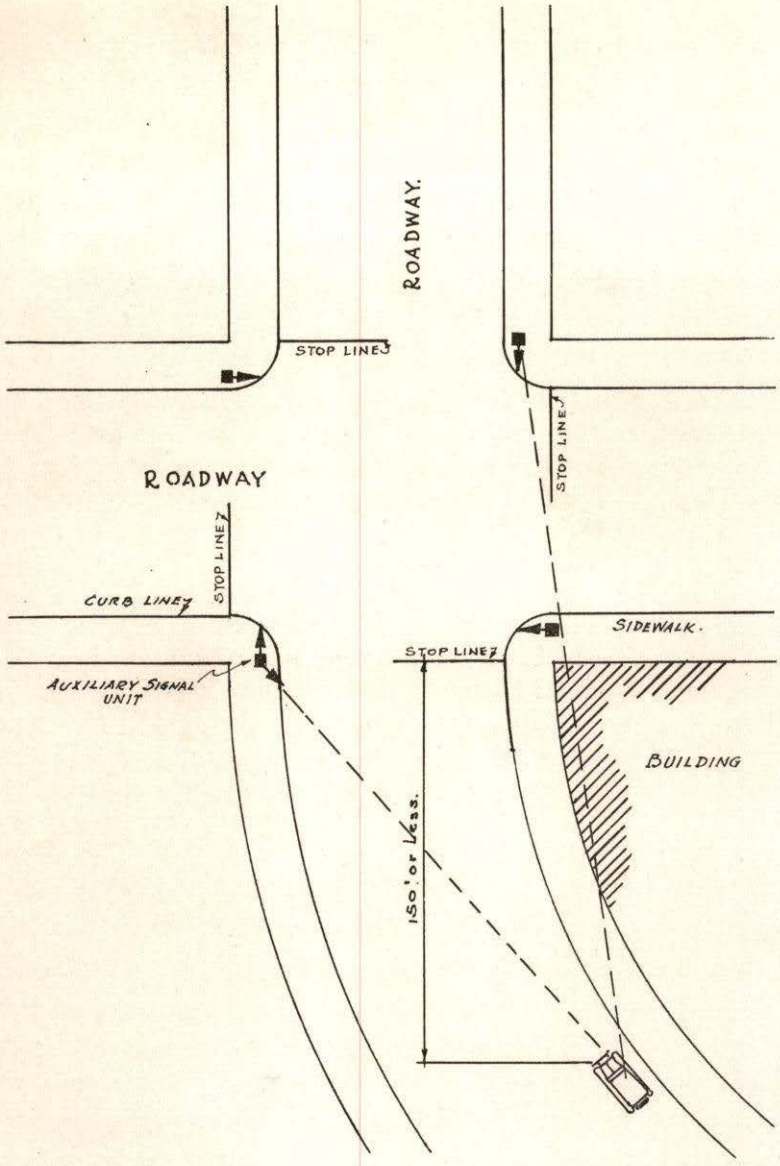
(Note for Section 18.) If physical conditions necessitate the placement of a signal more than 10 feet from the standard location specified, the visibility of such signal is deemed to be impaired to the extent of necessitating auxiliary indication.

Section 19. Line of Vision. Each signal unit must be located in all cases in such a manner that a driver shall have an unobstructed view of the signal face designed to control his actions from any point within the street for a distance of at least 150 feet upon his approach to the stop line. In addition to immovable physical obstructions, view shall be deemed to be impaired if the signal unit mounted at the far right corner of the intersection is more than ten feet to the right of a line formed by an extension of the curb line or edge of roadway of the traffic which it controls. If the visibility of any signal located in accordance with Section 12 is obstructed or impaired as described herein, an auxiliary signal unit shall be mounted in such a manner as to provide the required visibility. (See Figs. 9 and 10.)

(Note for Section 19.) A driver approaching a controlled intersection must be given reasonable warning of the control condition. The minimum distance deemed adequate is 150 feet. If the angle of the roadway entering the intersection is such that the normal far right corner location is out of line with the ordinary line of vision of the operator, or if his view is obstructed by buildings, shrubbery, or other encroachments, it is necessary that auxiliary indications be provided.

Section 20. Shielding of Signals. Each signal unit shall be so shielded by a visor or shield that an approaching driver can see only the signal face or faces intended for his direction.

(Note for Section 20.) Confusion results if signals are so located that operators may see two units, either one of which may be giving directions to the line of traffic in which he is moving. Irregular street design frequently necessitates the placing of units in such a manner as to result in a comparatively small angle between their beams. Signals must be shielded so that the driver can see only the unit designed for his control.



CURVED APPROACH REQUIRING AUXILIARY SIGNAL

FIG. 10

ARTICLE V

Standards of Operation

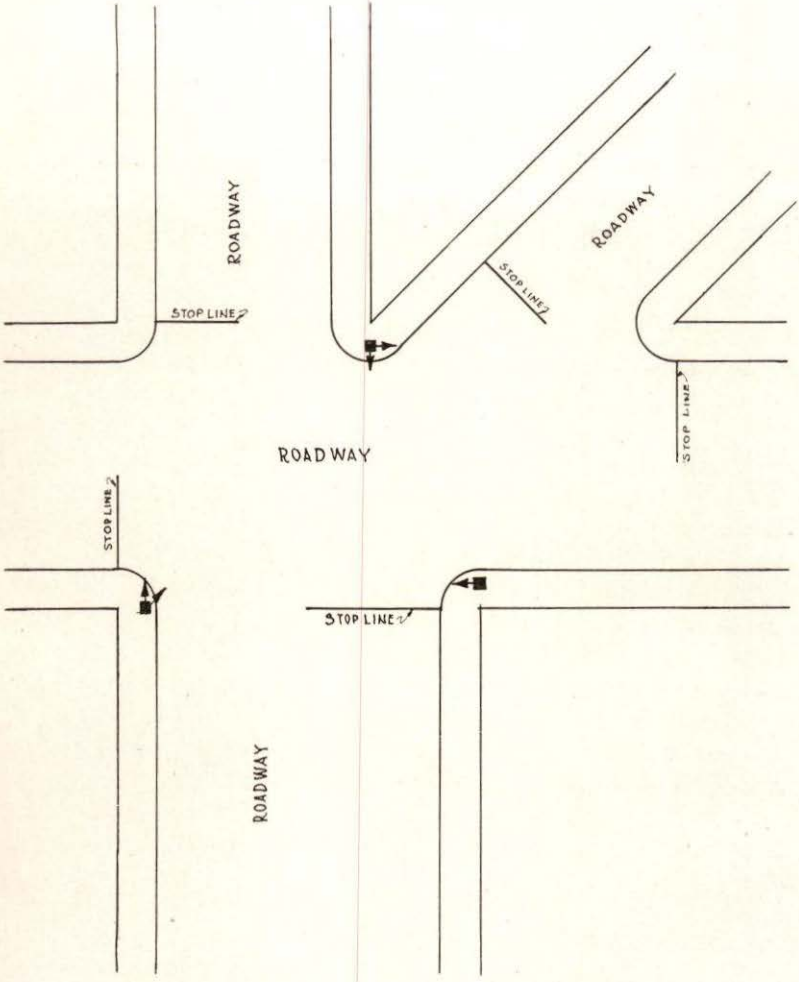
The requirements of Sections 22, 23 and 24 may be waived with the approval of the Commission in installations controlled by traffic actuated devices.

Section 21. Signal Installations Must Operate Continuously. Traffic control signals must operate at all times, either as control devices, or as warning devices. During any season or extended period when they are not in use, they must be turned, hooded, or taken down so the faces will not be visible to approaching traffic.

(Note for Section 21.) It is desirable that an operator approaching a traffic control signal should presume that it is functioning unless he is given a specific indication to the contrary. Thus, it is required that all signals be "live." When not operating as "Stop" and "Go" devices showing alternately red or green lights, the signal should be used as a flashing device. In any signal unit facing a street entering a through way, the red lens should be flashed as a substitute for the amber lens in accordance with the standard warning for through way operation. Flashing operation has a dual utility. In the first place, it indicates clearly to the operator that the signal is not alternating traffic flow, and in the second place, it warns him that he is approaching an intersection which carries, under normal conditions, a comparatively heavy traffic flow. During seasonal shut-downs, when it may not be desirable to use the flashing amber continuously, the signal units should be treated as indicated in this section, so that operators will be under no misapprehension as to their use.

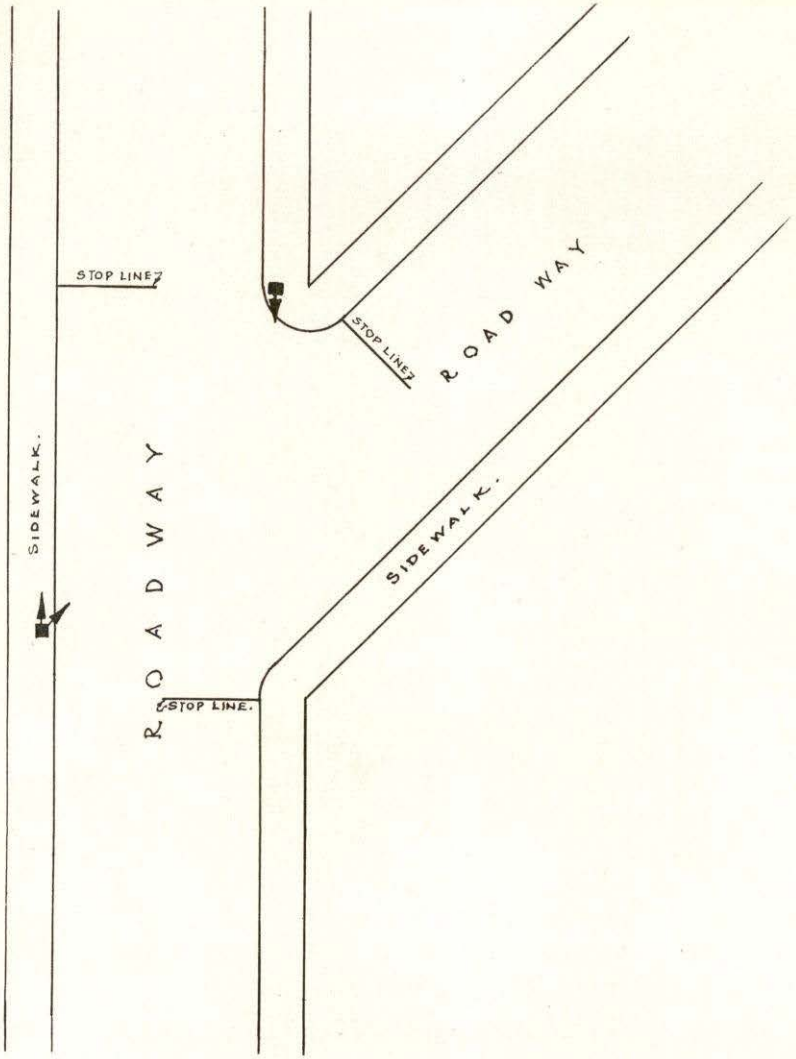
Section 22. Control Operation Limited. All traffic control signals other than progressive systems of three or more intersections located in business districts should be shut off from traffic control (Stop) and (Go) and turned on to warning operation (Flashing) when traffic conditions fall below the requirements set forth in Section 3.

(Note for Section 22.) During certain hours of the day at many intersections, traffic is so light as to not justify the "Stop" and "Go" operation of signals. Signals at such locations may



SEPARATE SIGNAL REQUIRED FOR EACH INTERSECTING ROADWAY

FIG. 11



INSTALLATION AT FORKED INTERSECTION

FIG. 12

have a high utility during the limited periods of the day, as for example, during the heavy traffic hours of the morning or afternoon. For the convenience and safety of the public, traffic signals should not operate as "Stop" and "Go" devices when conditions fall below the requirements for operation as set forth in Section 3.

Section 23. Timing of Total Time Periods. 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, number of lanes available, requirements of pedestrians and any irregularity in the shape of the intersection.

(Note for Section 23.) In general, short total periods are more effective than long ones and proper timing on short periods encourages the observance of the regulations by pedestrians. Periods of excessive length are wasteful as they necessitate unreasonable delay and result in inefficient use of the street. The ideal period is the shortest one which will accommodate the necessary movements. A total period length of 40 to 80 seconds is recommended for the control of ordinary traffic. Changes in period length for rush hours may be advisable.

Section 24. Rotation of Time Intervals Required. Every time interval provided for traffic movement shall be given once and once only during each total time period.

(Note for Section 24.) A properly designed signal timing should make it possible to care for each necessary movement at the control point within each total time period and without a duplication of movements. This requirement should not be interpreted as preventing the continuous movement of one line of traffic during several intervals of the period.

Section 25. Time Intervals Must Be In Proportion to Traffic. Total time periods shall be divided into intervals proportionate to the longest sustained hourly average volume of traffic entering the intersection from each street, with due regard to the discharge capacity of each such street. Any substantial or continued departure from the timing schedule contained in the

original approval of a signal installation must be submitted to the Commission for approval.

(Note for Section 25.) Traffic signals may be arbitrary and unfair in the control given unless the relative equities of the various lines of traffic are given adequate consideration. In fairness the time period shall be distributed among street users in general accordance with their numbers.

Section 26. Clearance Interval Required. An amber interval must be used following a green interval only, and in no case shall the amber interval be displayed between the change from red to green. The amber interval shall not be less than 3 seconds in length, nor more than a reasonable length of time necessary for the clearance of traffic. (See Fig. 15.)

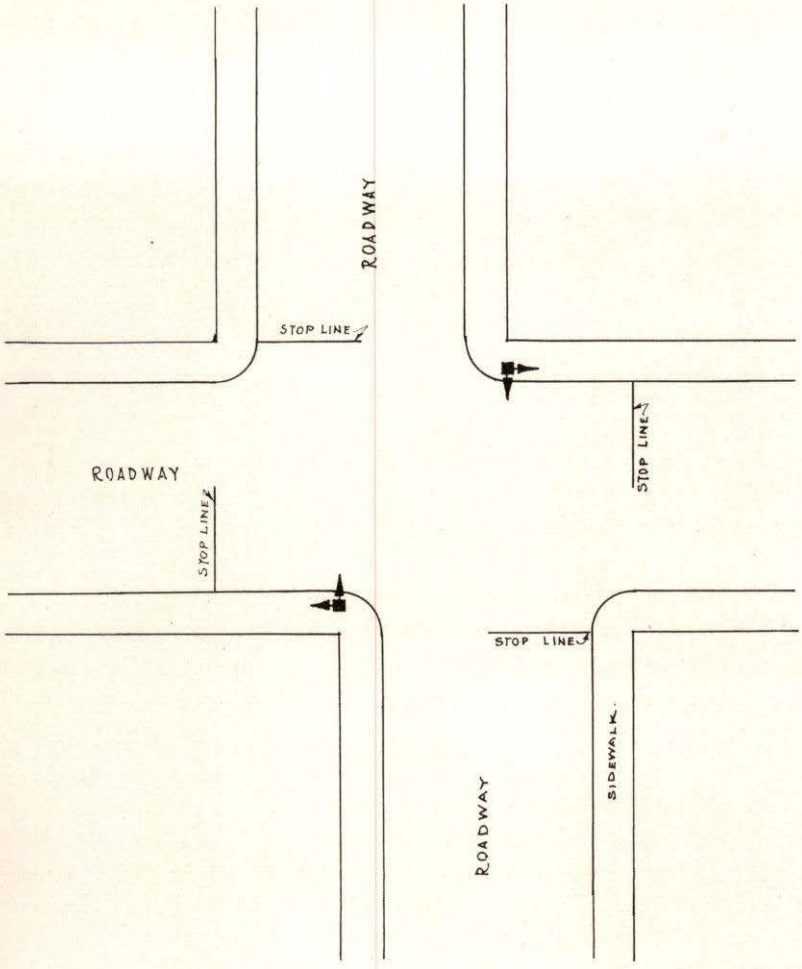
(Note for Section 26.) Experience has indicated that amber indications of less than three seconds in length are inadequate to stop approaching vehicles and to clear the intersection for movement in a cross direction, and likewise, that amber intervals in excess of five seconds in length tend to be wasteful.

Section 27. Co-ordination Required. All automatic signals within 2,000 feet of each other and controlling the same roadway must be operated under co-ordinate control, and when required by the Commission, signal installations farther apart than 2,000 feet shall be operated under co-ordinated control.

(Note for Section 27.) Great inconvenience and delay result from the independent operation of closely adjacent signal installations. Under such conditions it is only a matter of good fortune if a driver is able to pass without delay, as the signals operate without relation to one another. Practically all of this unnecessary inconvenience can be eliminated by a co-ordination of closely adjacent signals.

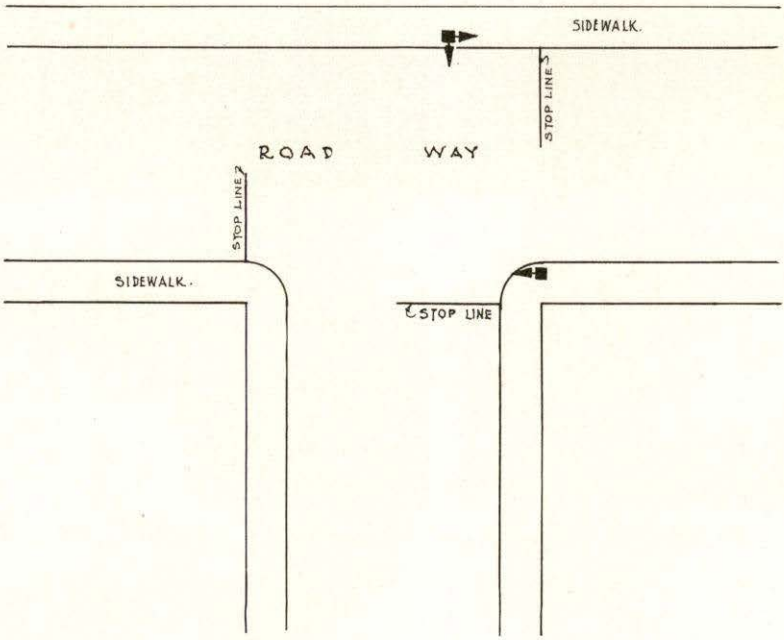
Section 28. Types of Co-ordination Permitted.

Simultaneous. Where a system is composed of not more than two installations and does not cover more than 500 feet, direct simultaneous control will be permitted, provided that traffic on



INSTALLATION AT OFFSET INTERSECTION

FIG. 13



INSTALLATION AT "T" INTERSECTION

FIG. 14

the main street is given a sufficient period to clear all the signals from a start at the first signal. Direct simultaneous control is not permitted in systems of greater length than 500 feet.

Alternate Simultaneous. Alternate simultaneous control is permitted where street blocks are of practically even length and where traffic requirements at each controlled intersection are approximately equal.

Progressive. Progressive control is permitted in any co-ordinated system.

(Note for Section 28.) Direct simultaneous co-ordination of signals is prohibited in installations of more than 500 feet in length, as it gives inadequate flexibility of movement and encourages excessive speed.

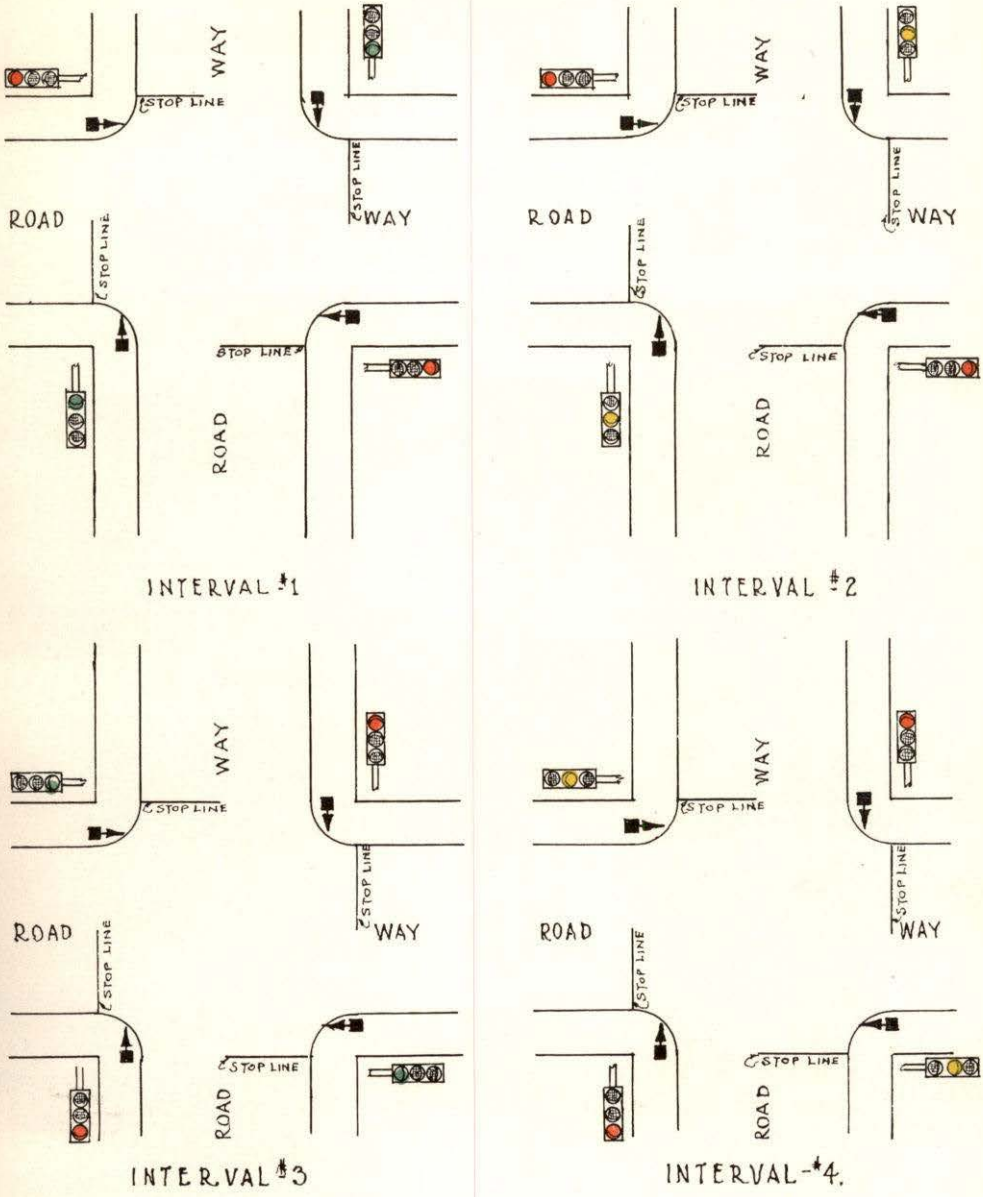
Alternate simultaneous control is inflexible in character, as it does not permit an adjustment of interval lengths at different intersections and has little or no utility unless there are equal distances between the control points. It has advantages over direct simultaneous control where blocks are of practically even length. Progressive control is strongly recommended under any co-ordinated system as providing the most efficient and flexible control system.

Section 29. Speeds for Progressive Systems. Signals operating under progressive control must be timed for speeds not less than the maximum permitted by law in the district where the signals are located except as otherwise authorized by the Commission or by Section 6 of Article IX of Chapter 281, Laws of 1928, as quoted herein, and signs must be erected indicating the speed provided.

"Local authorities shall have no power or authority to alter any speed limitations declared in this article, or to enact or enforce any rule or regulation contrary to the provisions of this act, except that local authorities shall have power by ordinance for the regulation of traffic by means of traffic officers, semaphores, or electric signaling devices on any highway where traffic is heavy or continuous, and may increase the speed which shall be prima facie lawful where said through highway is continuously controlled at each intersection by traffic signals operated on the synchronized,

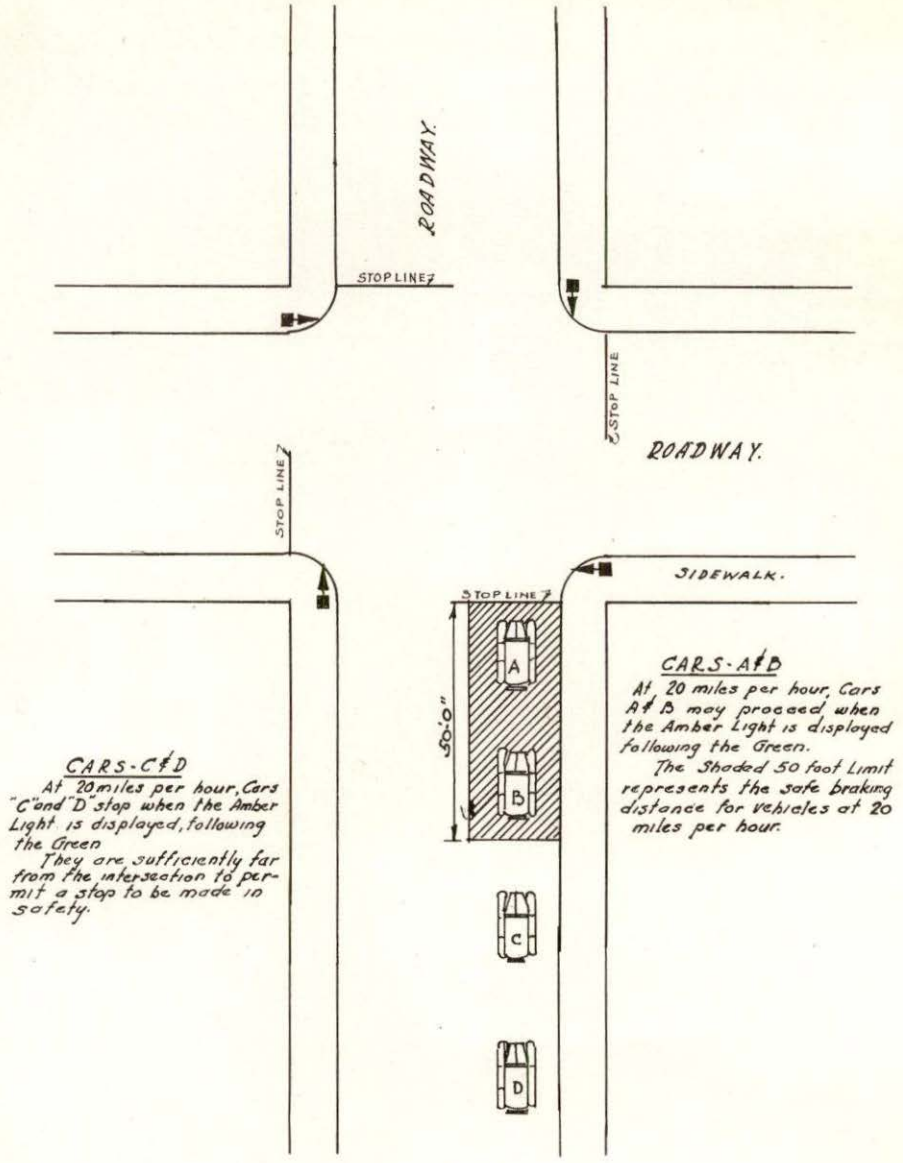
progressive or similar systems, where the timing of the lights and local conditions warrant such regulation; provided, that such increase in speed shall not exceed a maximum speed of thirty miles per hour; and provided, further, that local authorities shall first place and maintain upon all such highways upon which the permissible speed is increased, adequate signs giving notice of such special regulations."

(Note for Section 29.) It is improper for local authorities to set up control devices which place an ordinary arbitrary restriction upon the speed limit permitted by statutory provision. Thus, progressive systems must provide a timing not lower than the maximum provided by statute.



SEQUENCE OF COLOR INTERVALS

FIG. 15



OPERATION OF VEHICLES ON AMBER CLEARANCE PERIOD

FIG. 16

APPENDIX

MUNICIPALITY .....

COUNTY .....

LOCATION .....

.....

DATE .....

TRAFFIC CONTROL SIGNAL APPLICATION

To The New Jersey Traffic Commission, State of New Jersey:

The ..... of .....hereby requests approval of the following described traffic signal installation for the above location. The installation will be in strict conformity with the specifications set forth in Traffic Code No. 1.

I. LOCATION

The exact location for each signal showing the direction of each face is shown on the accompanying scaled drawings. (3 copies.)

If the location includes a State Highway, the drawings should also show the method and type of making electrical connections and two (2) additional copies submitted.

(Make drawing 40 feet to the inch.)

II. SPECIAL FEATURES

(a) Position of lenses: (1) Vertical .....

(2) Horizontal .....

(b) Special features: (1) Pedestrian period .....

(2) Turning arrows .....

(c) Special connections for: (1) Police or Fire Houses.....

(2) Railroad Crossing .....

(3) Co-ordination with other intersections .....

III. OPERATION

(a) Type of control: Manual.....Automatic.....

Combined Manual and Automatic.....

Traffic Actuated .....

If co-ordinated state type of co-ordination:

1. Simultaneous:

   (a) Direct .....

   (b) Alternate .....

2. Progressive:

   (a) Limited .....

   (b) Flexible .....

(b) Timing Schedule

(1) The length of the total time period will be ..... seconds.

(2) The number of seconds to be allotted to each street or movement is as follows: .....

.....

.....

(3) The sequence in which they are to follow is: .....

.....

.....

(c) Hours of Operation

(1) Automatic traffic control operation.....

.....

(2) Manual Operation .....

.....

(3) Flashing Operation .....

.....

(d) If traffic control signals are operating on any of the connecting highways within a distance of one (1) mile of the location in question, state approximate distance and where located.....

.....

.....

.....

IV. EVIDENCES OF NECESSITY

(a) Traffic Count:

The volume of vehicular traffic is shown on the attached sheets.

This information is required to accompany the application and must be submitted on forms supplied by the Commission. The count must be taken on a week-day if concerning only local business traffic and a week-day and Sunday if concerning local and through traffic and to be taken by half-hour periods from 7 A. M. to 12 midnight, or for whatever period the signals are to be used as control devices. If traffic is unusually heavy on Saturdays or Sundays, and the signal is planned to be used only on those days, indicate and give applicable figures.

If pedestrian traffic is unusually heavy, and special consideration is planned for a pedestrian period, pedestrian counts should accompany the traffic count.

(b) Accident Records:

A record of traffic accidents at or adjacent to the proposed signal location, occurring in the past year, showing the type, direction of vehicle or vehicles and point of collision, shall be submitted for the purpose of determining the value of the signal from the standpoint of safety.

(c) Remarks:

The following conditions are believed to justify the proposed traffic control signal installation.

If the installation is to be justified on the basis of pedestrian control, speed control, or as an adjunct to a system, indicate below.

.....

.....

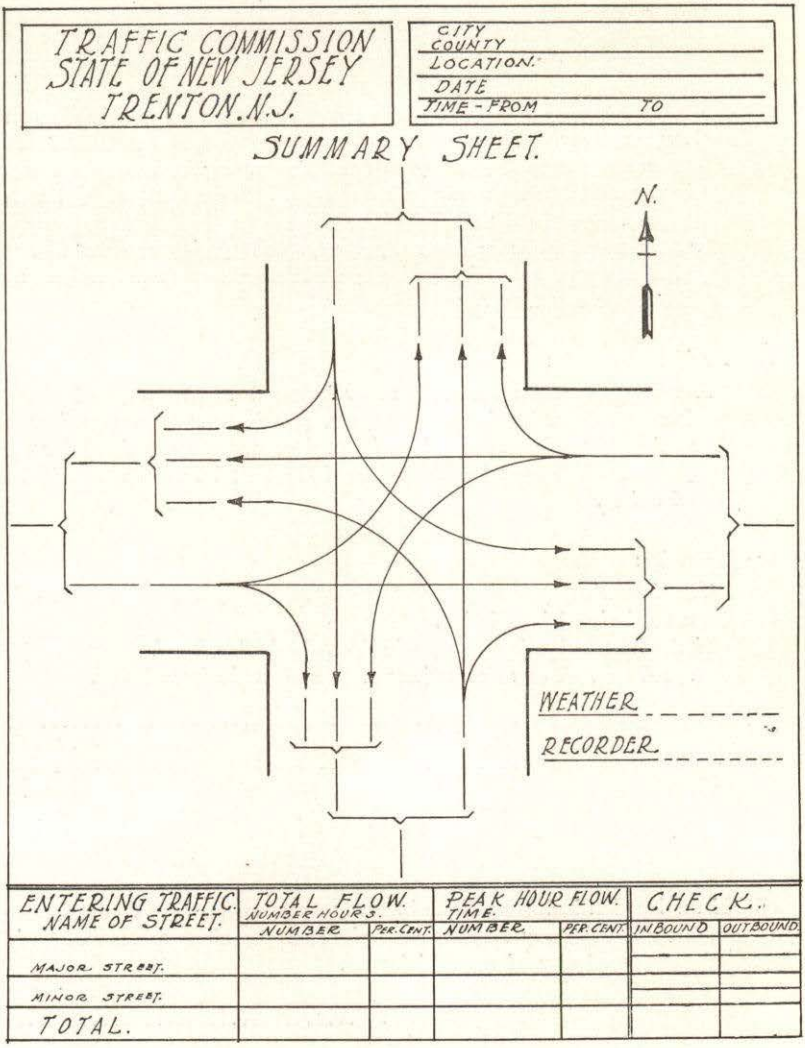
.....

.....

(d) If the location includes a State highway, approval must be obtained from the State Highway Department before any openings are made within the rights of way of State highways.

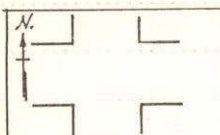
.....

Signed



TRAFFIC FLOW DIAGRAM

FIG. 17



INTERSECTION COUNT.
VEHICULAR TRAFFIC
TRAFFIC COMMISSION
STATE OF NEW JERSEY.

SHEET Nº
CITY —
COUNTY —
LOCATION
CHECKER.

TIME DAY OR NIGHT.	TRAFFIC MOVING (N.S.E.W) ON ____ ST.				
	LEFT. (1)	STRAIGHT(2)	RIGHT. (3)	TOTAL.	REMARKS.
7.00 - 7.30					
7.30 - 8.00					
8.00 - 8.30					
8.30 - 9.00					
9.00 - 9.30					
9.30 - 10.00					
10.00 - 10.30					
10.30 - 11.00					
11.00 - 11.30					
11.30 - 12.00					
12.00 - 12.30					
12.30 - 1.00					
1.00 - 1.30					
1.30 - 2.00					
2.00 - 2.30					
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8.00 - 8.30					
8.30 - 9.00					
9.00 - 9.30					
9.30 - 10.00					
10.00 - 10.30					
10.30 - 11.00					
11.00 - 11.30					
11.30 - 12.00					
TOTAL-7.00-12.00					

TABULATION SHEET

FIG. 18

MUNICIPALITY .....

COUNTY .....

LOCATION .....

DATE .....

PERMIT NO. .....

TRAFFIC CONTROL SIGNAL PERMIT

Under authority of Chapter 148, Laws of 1930, the New Jersey State Traffic Commission hereby approves the following described traffic control signal installation for the above location.

I. LOCATION OF SIGNALS

Signals shall be located and arranged in strict accordance with the attached drawing.

II. DESCRIPTION OF APPARATUS

Signals shall be in strict accordance with Traffic Code No. 1. No special arrangements will be permitted unless listed under this heading.

III. OPERATION OF SIGNALS

(a) Type of control.....

(b) If co-ordinated, state type.....

(c) Timing schedule

(1) Length of total time period ..... seconds.

(2) Time allotted to each street or movement.....

.....

.....

(d) Hours of operation

(1) Traffic control operation.....

(2) Flashing operation .....

This permit is granted for the specific signal installation described herein and for operation of such signal installation in accordance with Part III of this permit. Any material alteration of the physical equipment, or any continued or substantial departure from the timing schedule or hours of operation must be submitted to the Commission for approval with data sufficient to justify the modification. Failure to comply with these requirements may result in revocation of this permit.

.....

New Jersey Traffic Commission

STATUTORY PROVISIONS RELATING TO TRAFFIC CONTROL SIGNALS

Legal requirements relating to traffic control signals are contained in the following Sections of Chapter 148, Laws of 1930, and Chapter 281, Laws of 1928, and amendments or supplements thereto:

Chapter 148, Laws of 1930

Section 10. The Commission shall investigate traffic conditions, means for the improvement thereof, and the enforcement of laws and regulations relating to traffic, including pedestrian travel upon the public streets and highways and shall report annually to the Governor and the Legislature the results of its investigations, together with its recommendations; it shall have power to regulate and control the PLACING and OPERATION of all traffic signals or signaling devices upon the streets, highways and public places in the State, or cause the removal of traffic signals determined to be unnecessary, and it shall be its duty to see that the laws with respect to such signals and signaling devices are enforced; it shall investigate the manner of enforcing the laws with regard to parking the vehicles on public highways; the use of streets by pedestrians, to investigate the location of "Stop Street" signs and to cause the removal of those installed which in the opinion of the Commission are in violation of chapter two hundred and eighty-one of the laws of one thousand nine hundred and twenty-eight, and the acts amendatory thereof and supplemental thereto; to cause the removal of all colored lights so located as to be confused with traffic signals, and in addition thereto to enforce the provisions of chapter two hundred and eighty-one of the laws of one thousand nine hundred and twenty-eight, and the acts amendatory thereof and supplemental thereto: Provided, however, that nothing in this section shall be construed to in any way curtail the powers of actual enforcement now vested in the local authorities and the Motor Vehicle Department.

Section 11. All ordinances adopted by any municipality or any resolution adopted by any county pertaining to the erection of traffic signals and traffic regulation devices shall, before the same become effective, be submitted to the said traffic commission and shall not be in force or effect until the same shall have been approved by the Commission, which approval shall be in lieu of the approval by the Commissioner of Motor Vehicles, as required under the provisions of article sixteen, chapter two hundred and eighty-one, laws of one thousand nine hundred and twenty-eight, and the Commission shall not be obliged to approve any such ordinances or resolutions unless after investigation by the Commission, it shall appear to be in the interest of safety and the expedition of traffic on the public highways.

Chapter 281, Laws of 1928

ARTICLE IX

Section 6. Local authorities shall have no power or authority to alter any speed limitations declared in this article, or to enact or enforce any rule or regulation contrary to the provisions of this act, except that local authorities shall have power by ordinance for the regulation of traffic by means of traffic

officers, semaphores, or electric signaling devices on any highway where traffic is heavy or continuous, and may increase the speed which shall be prima facie lawful where said through highway is continuously controlled at each intersection by traffic signals operated on the synchronized, progressive or similar systems, where the timing of the lights and local conditions warrant such regulation; provided, that such increase in speed shall not exceed a maximum speed of thirty miles per hour; and provided, further, that local authorities shall first place and maintain upon all such highways upon which the permissible speed is increased, adequate signs giving notice of such special regulations.

Article XIII

Traffic Signals

1. Traffic signals or signal devices shall conform strictly with the following particulars:

2. A three-color system shall be used; red, amber, and green. *Green* shall mean permission for traffic to go, subject to the safety of others or the specific directions of an officer; *Red* shall mean traffic to stop before entering the intersection of crosswalk, and remain standing until Green is shown; *Amber* (or yellow) shall be for the exclusive use of pedestrians; Amber shall mean vehicles and street cars to stop before entering the intersection or crosswalk, unless when the Amber so appears the vehicle or street car is so close to the intersection that it cannot be stopped within fifty feet. If within fifty feet of an intersection the vehicle or street car may proceed across the intersection, or make right or left turns. No vehicles or street cars shall enter the intersection or crosswalk if not within this distance of fifty feet, while the Amber is displayed but must wait for the green to appear alone.

3. All other uses of Green, Red, Amber or Yellow lights, so located as to be confused with traffic signals, shall be discontinued.

4. The colors shall be shown in the following sequence: a *Green* light displayed for a predetermined number of seconds followed by an *Amber* light for a reasonable time for pedestrian traffic, followed by a *Red* light, followed by a *Green* light. The timing of all lights shall be determined by the volume of traffic.

5. Semaphores shall have four vanes or sides, the stop vanes having a red field with the word "Stop" plainly visible thereon, and the go vanes a green field with the word "Go" plainly visible thereon.

6. When used at night, semaphores shall be equipped with red and green lights, corresponding with the vanes, or sides, and the same meaning and visibility as electrically equipped signals.

7. *Lenses.* Where a vertical arrangement of lenses is used, red shall be placed at the top, amber in the middle, and green at the bottom.

8. When it is necessary to place the lights horizontally, the order of the lights shall be red at the left, amber in the middle, and green at the right.

9. The light shall be of such power, as to cause the signal to be visible for at least three hundred feet.

10. All traffic signals shall be so located as to be plainly visible to all traffic to be regulated. This shall be accomplished by:

(a) One-way or two-way lights on four corners, or

(b) Three-way or four-way signal on one corner, or

(c) Two-way or four-way signal on diagonal corners, or mast arm suspension.

11. Poles carrying signal supports shall be so placed as to be out of pedestrian crosswalk lanes.

12. Each intersection on a continuously controlled highway shall be controlled by signals or by suitable signs. Provided, however, that if traffic signals are not erected at every intersection it shall not be construed as a continuously controlled highway.

13. Hereafter no traffic signal shall be so located as to obstruct the paved width of the highway, but where such signal is now located, no change shall be mandatory until after three years from the date of the passage of this act, nor shall it be mandatory until after three years from the date of the passage of this act to change or remove any traffic signal, sign or device now in use to conform with the provisions of this act; Provided, nevertheless, that no new traffic signal or device not conforming with the provisions of this act shall be installed or put to use; Provided, however, that where there is, or may hereafter be erected a fixed raised safety zone, the highway area covered by said raised safety zone shall not be construed to mean the paved width of the highway.

14. All traffic signals shall be placed at such height as to be plainly visible to approaching traffic at a distance of at least fifty feet from the intersection.

15. Traffic signals, operated by electricity, if within the curb line, shall be placed at a height of from eight to ten feet above the pavement.

16. If on bracket or mast arm, a signal shall clear the pavement by fourteen feet.

17. The period or cycle shall be based on counts of turning and through traffic, study of turns, study of special intersections, distance between intersections and speeds permitted.

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