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STATE OF NEW JERSEY



MANUAL ON UNIFORM APPLICATION OF OPTICALLY PROGRAMMED TRAFFIC SIGNALS

1976

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**MANUAL ON UNIFORM APPLICATION
OF
OPTICALLY PROGRAMED SIGNALS**

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GENERAL

Wherever warranted, properly installed and operated traffic control signals have proven to be valuable devices for controlling vehicular and pedestrian traffic flow. Traffic control signals can provide for the orderly movement of traffic, increase intersection traffic handling capacity, reduce the frequency of certain types of accidents, and provide a system by which the nearly continuous flow of traffic at a definite speed along a given route may be managed.

Conversely, improperly installed or nonwarranted signal installations may result in excessive delay and signal disobedience. Additionally, accident frequency can be significantly increased in some circumstances. The problem may be compounded in certain geometric and phasing situations where motorists or pedestrians can readily view signal indications not designed to control their movement.

The importance of eliminating or minimizing conflicting signal indication is clearly referenced repeatedly in the Manual on Uniform Traffic Control Devices (1971).

Section 4B-2, Area of Control, states, "A traffic control signal shall control traffic only at the intersection or mid-block location where the installation is placed." Section 4B-6(5) states, "The following combinations of signal indications shall not be simultaneously displayed on any one signal face, and shall not be simultaneously displayed in different signal faces on any one approach to an intersection unless the signal faces are shielded, hooded, louvered, positioned or designed so that none of these prohibited combinations of signal indication is readily visible to drivers:

- a. CIRCULAR GREEN with CIRCULAR YELLOW.
- b. Straight-through GREEN ARROW with CIRCULAR RED.
- c. CIRCULAR RED with CIRCULAR YELLOW.
- d. CIRCULAR GREEN with CIRCULAR RED.
- e. CIRCULAR GREEN with RED ARROW."

Section 4B-11, Visibility and Shielding of Signal Faces, states "Each signal face shall be so adjusted that its indications will be of maximum effectiveness to the approaching traffic for which they are intended.

"Irregular street design frequently necessitates placing signals for different street approaches with a comparatively small angle between their indications. In these cases, each signal indication shall, to the extent practicable, be shielded or directed by visors, louvers, or other means so that an approaching driver can see only the indication controlling his movement. . . . The foregoing does not preclude the use of special signal faces such that the driver does not see their indications before seeing other indications further ahead, when simultaneous viewing of both signal indications could cause the driver to be misdirected."

That every effort should be made to provide uniformity of design is also well stated in Section 4B-1, General Aspects, "The features of traffic control signals in which vehicle operators and pedestrians are interested are the location, design, indications, and legal significance of the signals. These are identical for all types of traffic control signals. Uniformity in the design features that affect the traffic to be controlled (as set forth in this Manual) is especially important for safe and efficient traffic operations."

PURPOSE

It is the purpose of this manual to establish a definitive uniform practice as regards the use, design, and installation of Optically Programed Traffic Signals. It is not intended that this manual make mandatory the use of Optically Programed Signals in the described applications, it is rather intended to insure that they are installed properly when engineering judgement indicates they should be used.

It is also intended that this manual not waive or obviate other standard traffic signal practices in the State of New Jersey, but rather define the recognized conditions of use and design where the benefits of Optically Programed Signals utilization are most pronounced. In all instances, sound engineering judgement and study should confirm proposed use and design practice.

APPLICATION CRITERIA

GENERAL Optically Programed Signals can limit the visibility of an indication exclusively to the roadway area where it must be seen, thereby eliminating conflicting and potentially confusing traffic signal displays in certain geometric and phasing situations. These conditions can generally be divided into two categories:

1. Problems associated with parallel or tightly skewed intersection approaches where the angle of the approach is such that a driver on that approach can mistakenly respond to signals designed to control another movement in the intersection. Examples of this occur at skewed intersections, intersections with conflicting thru and turn movement signal displays, intersections with conflicting pedestrian and vehicular indications, parallel roadways, and at intersections designed to provide free-flow movement in some lane(s) and not be signal controlled.
2. Problems associated with two or more signal displays not displaying identical signal indications where the distance between the conflicting indications is such that drivers and pedestrians can mistakenly respond to signals designed to control another movement or intersection. Examples of this occur at closely spaced signalized intersections with non-simultaneous phasing, split phase pedestrian signalization where median pedestrian storage is provided, installations of mid-block signals, and signalized diamond interchanges.

Optically Programed Signals have been determined effective in minimizing undesirable driver and pedestrian behavior in these types of situations, and the following application criteria is established for use:

APPLICATION

1. Skewed Intersection Signals – Optically Programed Signals should be considered for use in controlling vehicular movement on any signalized intersection approach where the angle between that approach and any other intersection approach is 45° or less.
2. Closely Spaced Signals – Optically Programed Signals should be considered for use at signal locations 200 feet or less “downstream” from another signal location displaying conflicting indication during any portion of either signal cycle. Where two intersections are spaced between 200 feet and 350 feet apart and the downstream greens are “leading” or “clearing” greens, Optically Programed Signals should be considered.

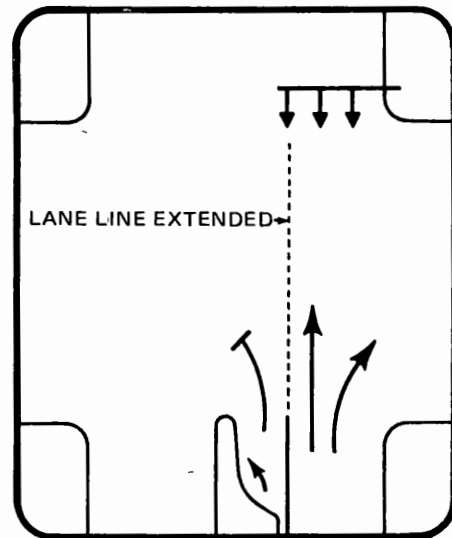
3. Exclusive Turning Movement Signals — Optically Programed Signals should be considered for use as turning movement signals used to control separate turning phases provided that the turning movement signals and adjacent parallel thru movement signals would create a prohibited combination of signal indications as defined in the Manual on Uniform Traffic Control Devices (1971) Sec. 4B-6(5)
4. Other — Optically Programed Signals should be considered for use in other locations where a history of undesirable pedestrian or motorist behavior can be reasonably attributed to conflicting signal indications and where engineering judgement indicates that controlling signal indication visibility will result in improved behavior.

DESIGN GUIDELINES

GENERAL The optimum location of a signal is such that it maximizes the motorist's view of the indication while limiting its visibility to drivers for opposing or conflicting movements. The benefits associated with the use of Optically Programed Signals to both maximize visibility in some areas while limiting its visibility in others, are dependent upon both roadway geometrics and signal design. The following design guidelines are provided to insure attaining maximum benefits

PLACEMENT OF OPTICALLY PROGRAMED SIGNALS: The signal face should be located both horizontally and vertically so that drivers who are not to see the signal do not travel along the same line of sight as those who are to see the signal. Lateral placement of the signal as well as mounting height are important considerations.

Lateral Placement — Laterally, an Optically Programed Signal should be located within a driver's normal view. Additionally, to minimize light "spillover" into an adjacent approach to that being controlled, the signal should be located as near as possible to the "lane line-extended" separating the controlled from the non-controlled approach (See Sketch #1)



SKETCH #1

Mounting Height — Mounting heights affect both lane control and distance limiting capacities of Optically Programed Signals. Spillovers into adjacent lanes or approaches can be minimized by installing signals at maximum practical height. Experience has indicated the following practical minimum

Application
Distance Limit to 350 ft.

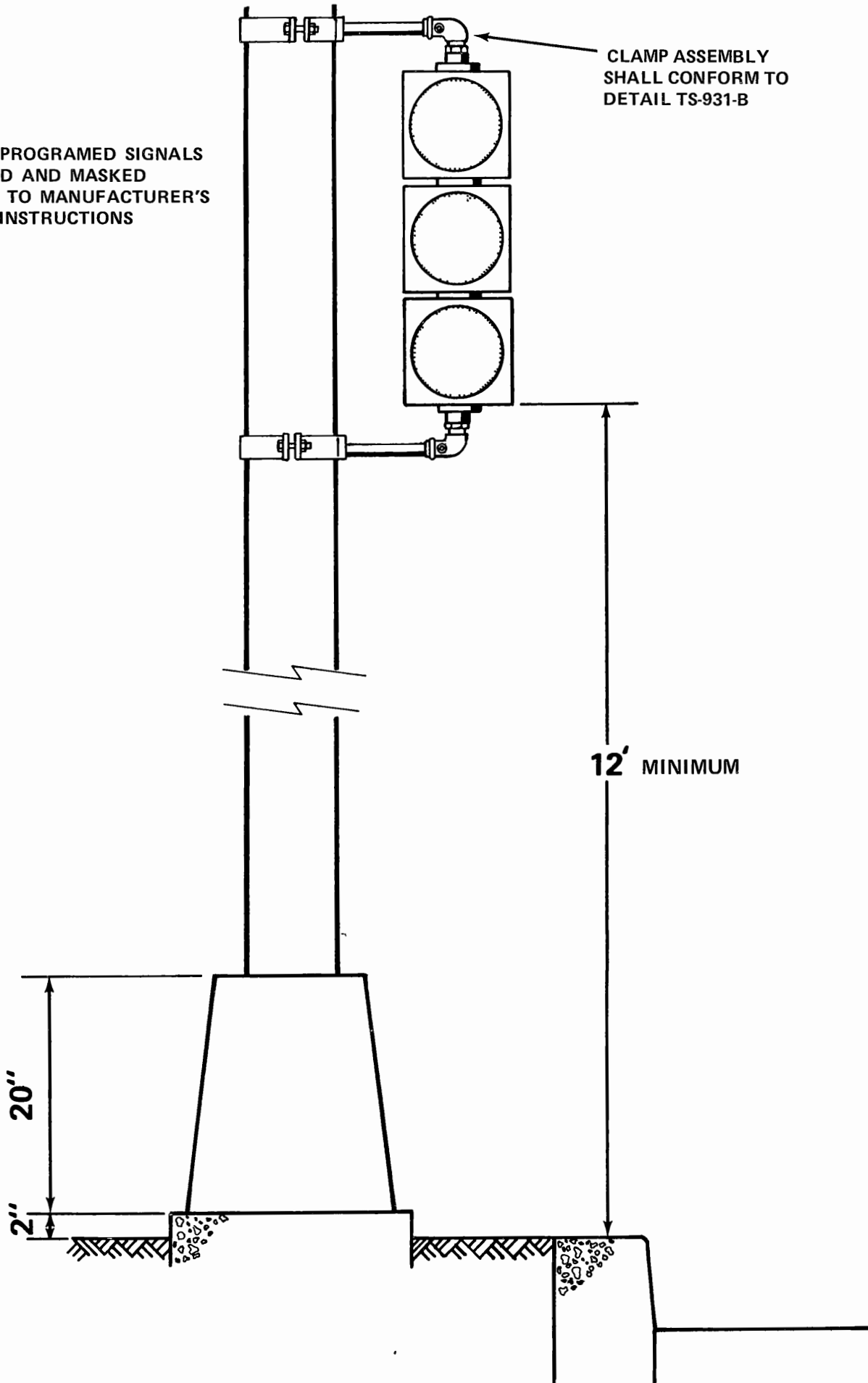
Min Mntg Height
17 ft

It is recommended that Optically Programed Signals, to be post top or bracket mounted, be installed at minimum height of 12 feet and that overhead mounted signals be installed at a minimum height (to bottom of face) of 17 feet. (See Sketches #2 and #3, Mounting Height).

NOTE

OPTICALLY PROGRAMED SIGNALS
TO BE AIMED AND MASKED
ACCORDING TO MANUFACTURER'S
PUBLISHED INSTRUCTIONS

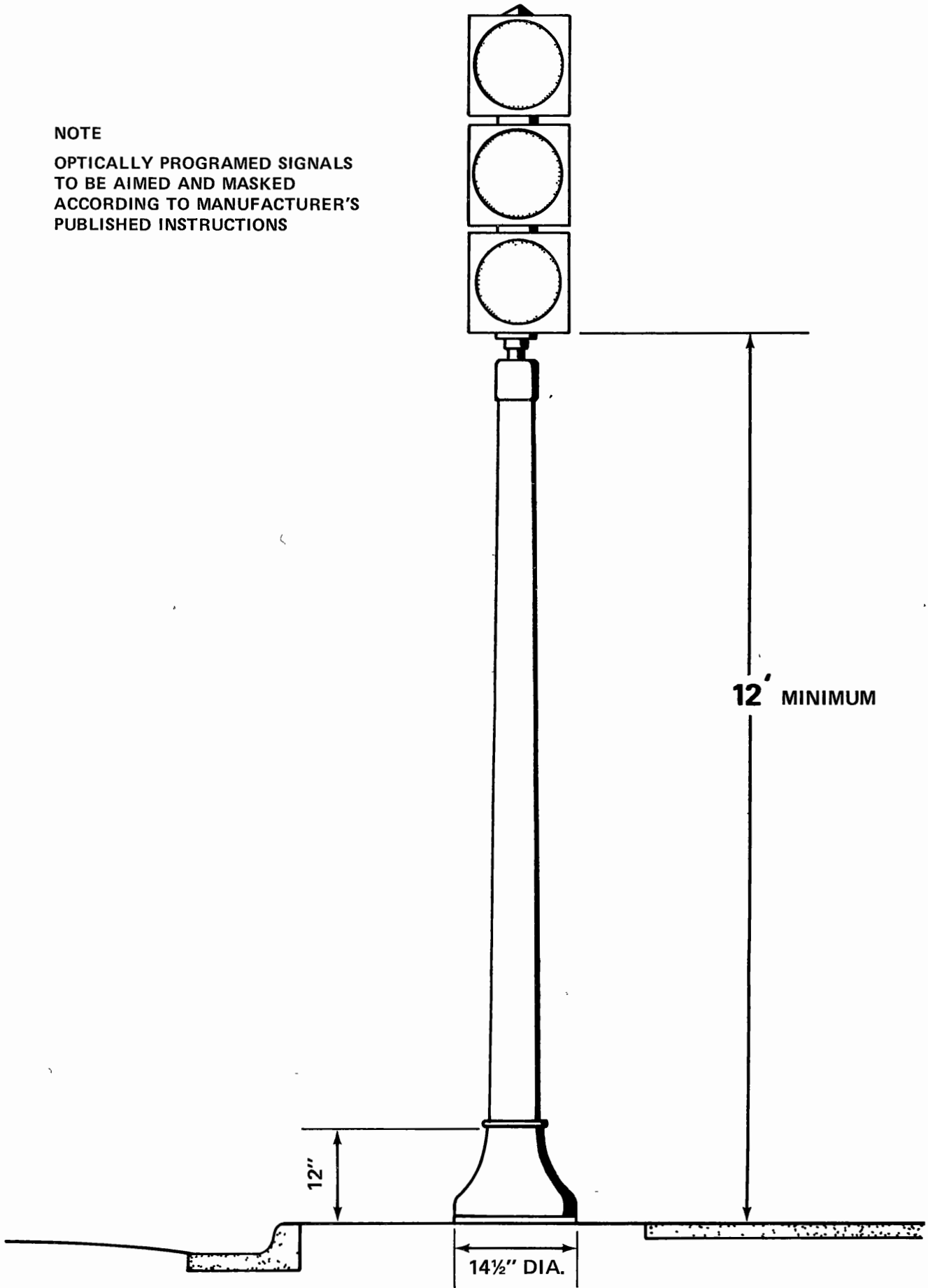
CLAMP ASSEMBLY
SHALL CONFORM TO
DETAIL TS-931-B



**SIDE-MOUNTED OPTICALLY PROGRAMED TRAFFIC SIGNALS
SKETCH #2**

NOTE

**OPTICALLY PROGRAMED SIGNALS
TO BE AIMED AND MASKED
ACCORDING TO MANUFACTURER'S
PUBLISHED INSTRUCTIONS**



**SKETCH #3
POST TOP MOUNTED OPTICALLY PROGRAMED TRAFFIC SIGNALS**

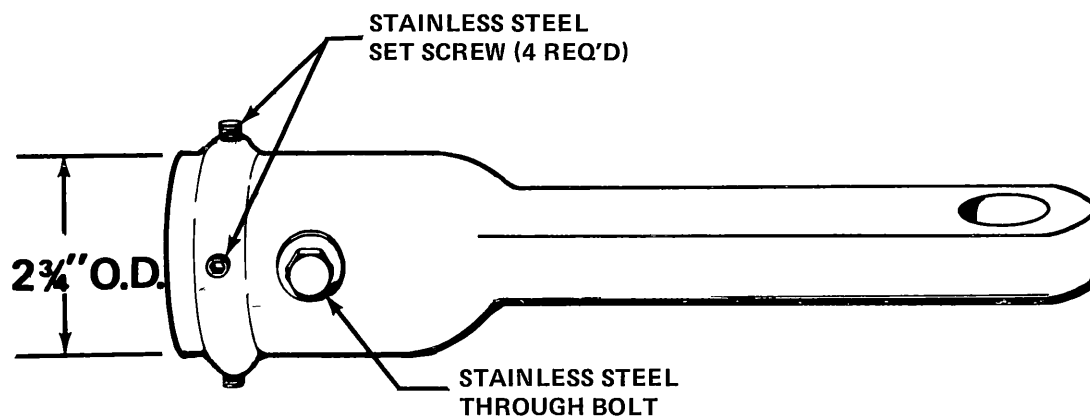
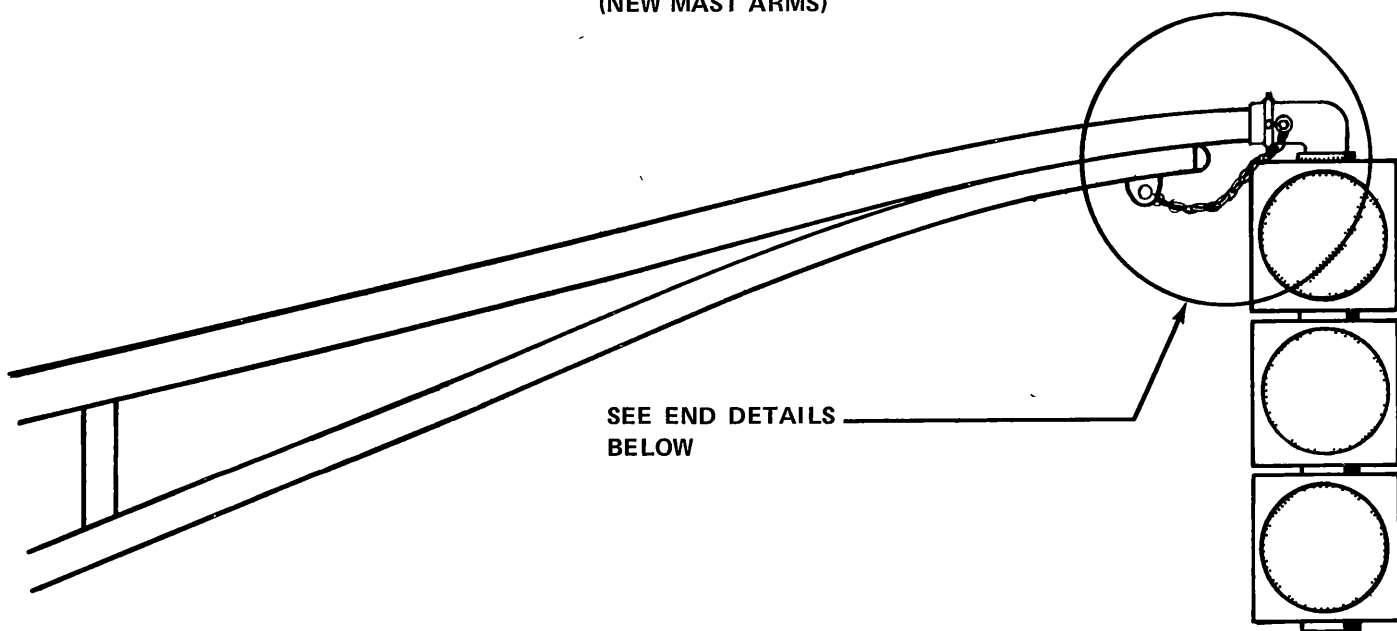
Signal Mounting — It is important to signal performance that Optically Programed Signals be mounted as rigidly as practical. It is recommended that overhead mounting be of the mast arm type. (See Sketches 4, 5, 6 & 7.)

Geometric Considerations — Severe roadway approach grades and horizontal curves should be considered in determining design of Optically Programed Signal installations. While "on-site" adjustments of signal tilt and face rotation can be accomplished, optimum signal placement and mounting heights design may be affected by unusual approach geometrics.

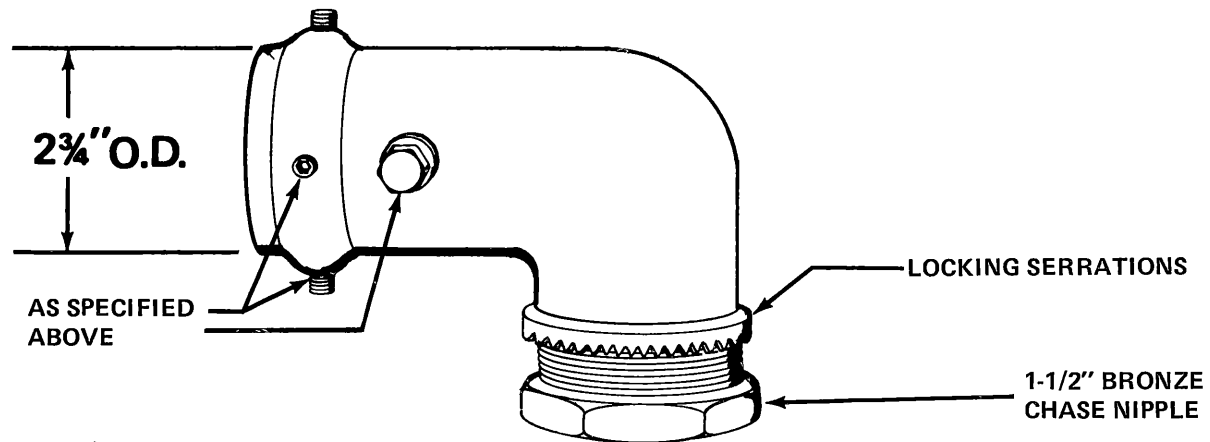
Maximum Area of Coverage — Care should be exercised in determining that the proposed signal location relative to stop bar location and street width is such that the entire required area of visibility is encompassed in the maximum signal visibility area. With Optically Programed Signals, this area is determined as a cone visible anywhere within 15° either side of the optical axis. The optical axis can be adjusted on site (face rotation or tilt). (See Sketch #8, Area of Coverage).

Other Design Considerations — Additional design information regarding use of Optically Programed Signals is available through this office upon request.

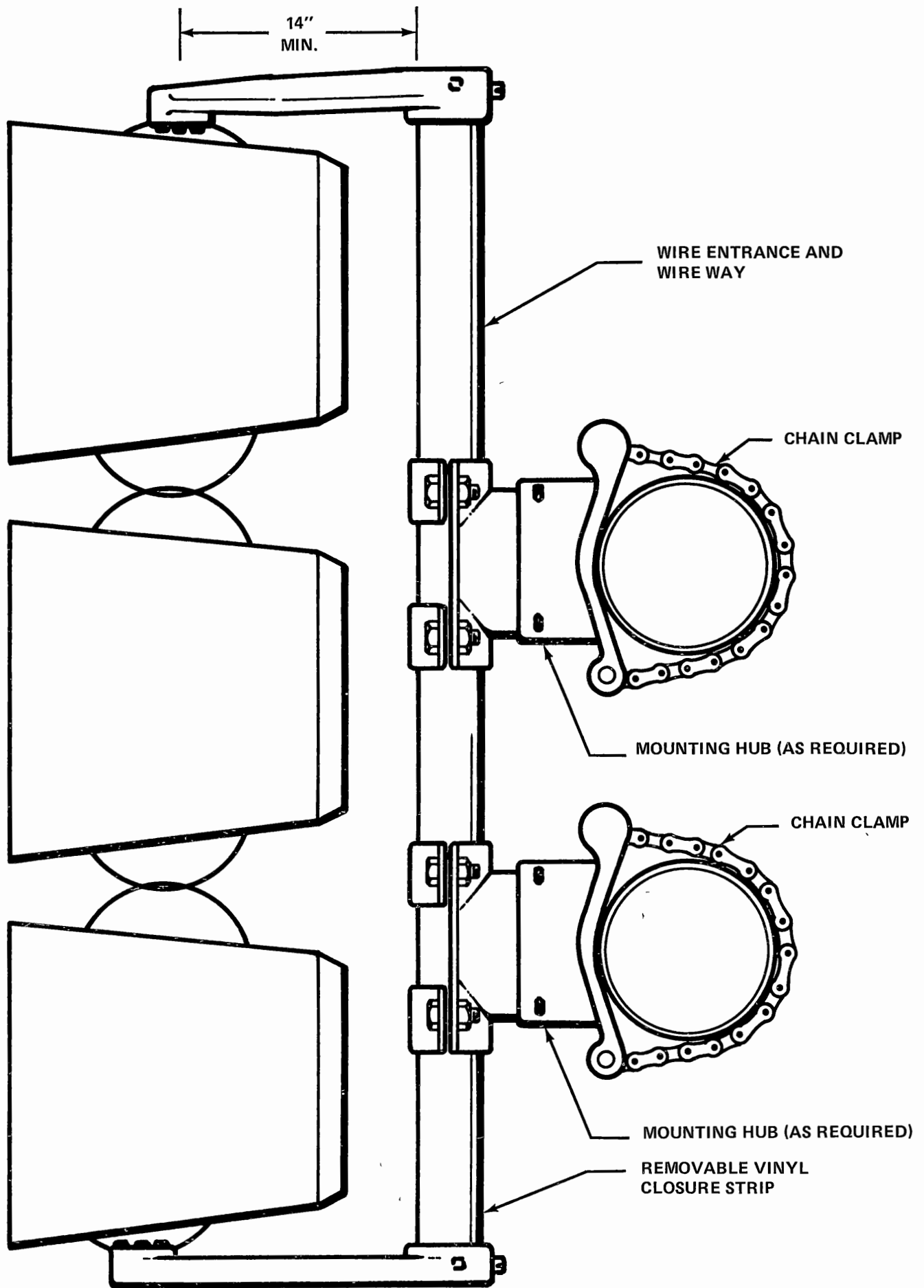
SKETCH #4
MAST ARM MOUNTED OPTICALLY
PROGRAMED TRAFFIC SIGNALS
(NEW MAST ARMS)



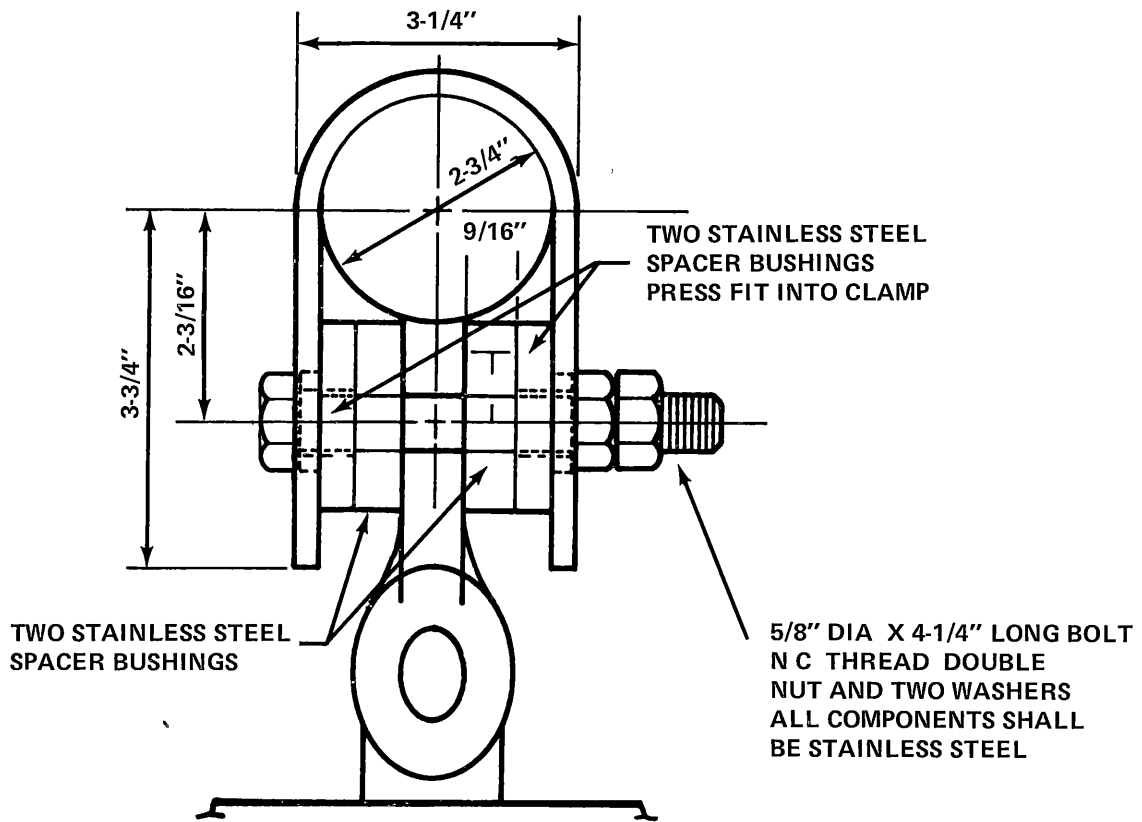
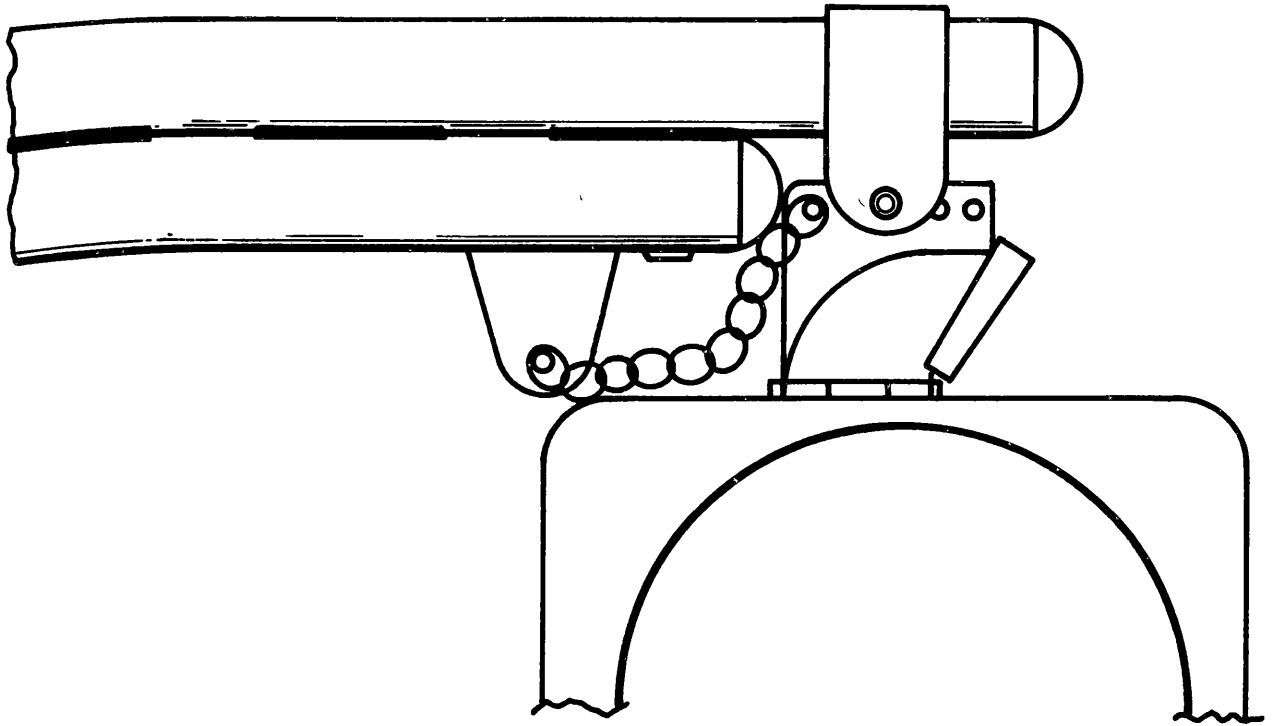
END DETAIL FOR MOUNTING
SIGNAL SECTIONS ABOVE MAST ARM



END DETAIL FOR MOUNTING
SIGNAL SECTIONS BELOW MAST ARM

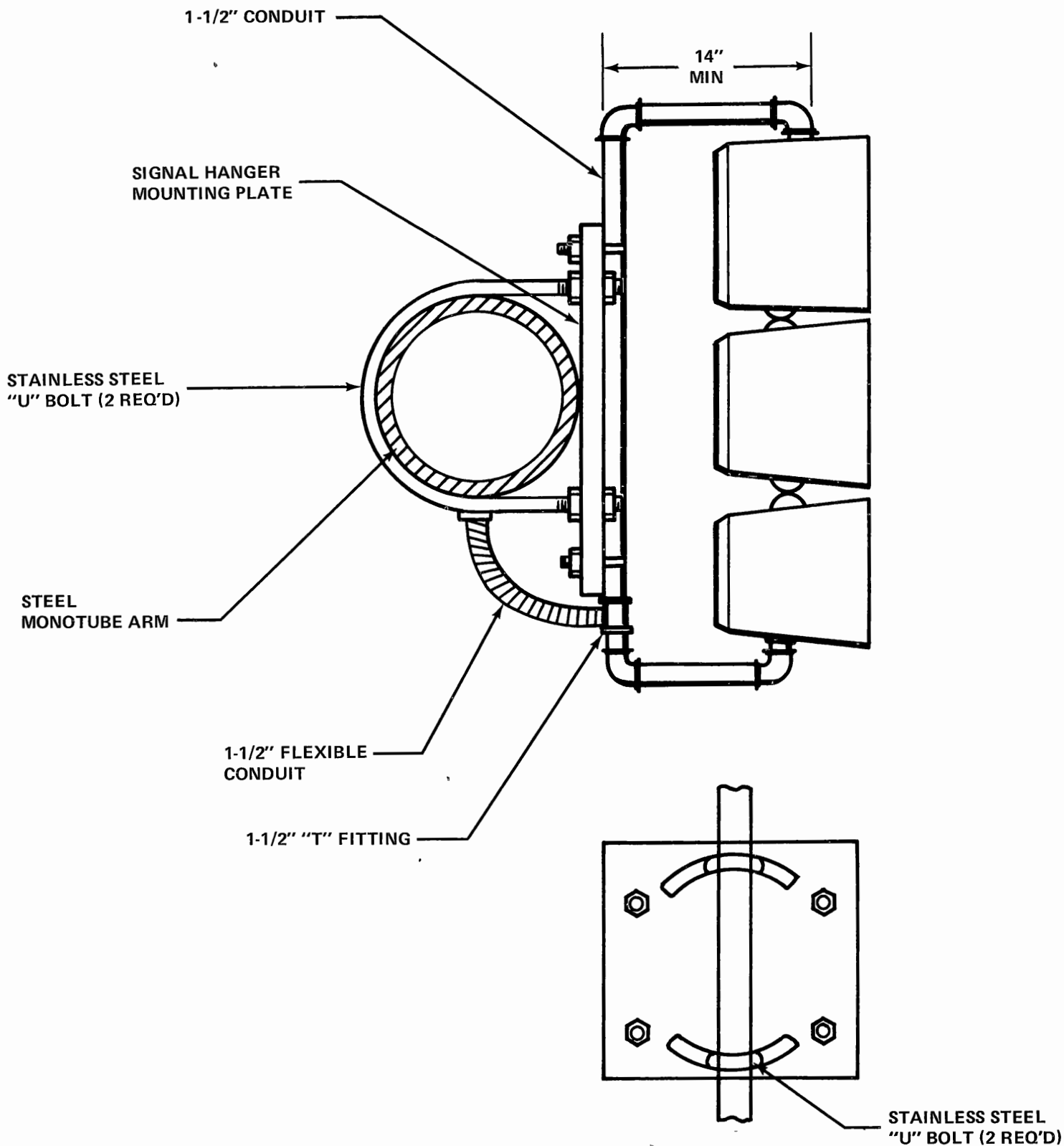


SKETCH #5
MID-ARM SIGNAL MOUNT BRACKET

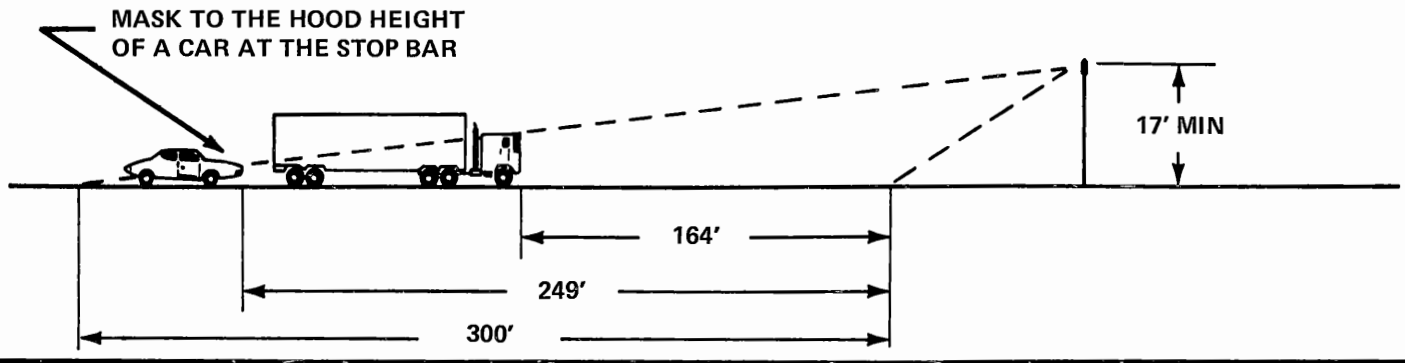
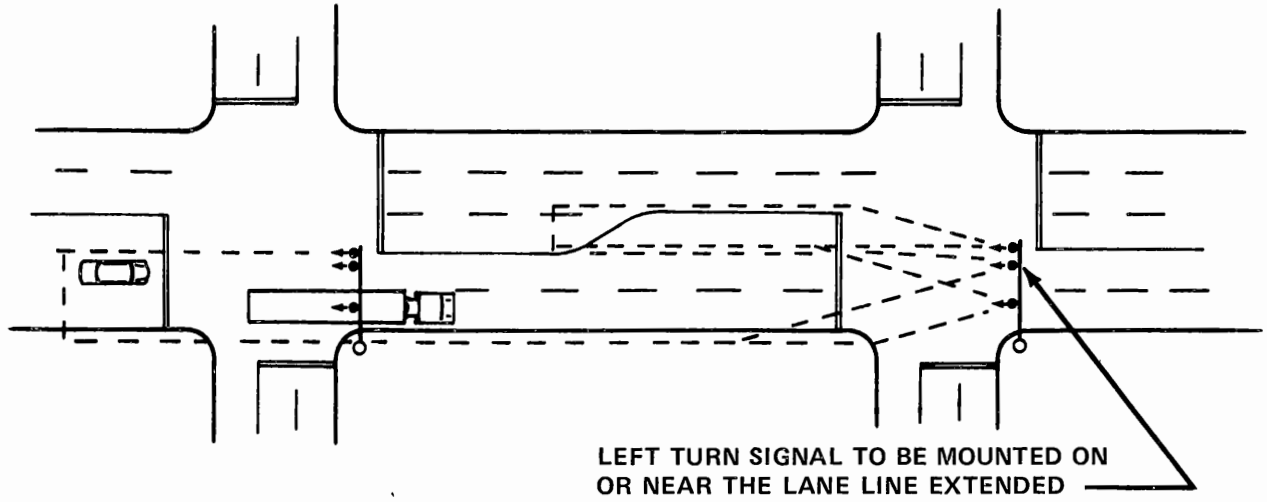


SKETCH #6
 MAST ARM MOUNTED OPTICALLY PROGRAMED TRAFFIC SIGNALS
 (EXISTING MAST ARMS)

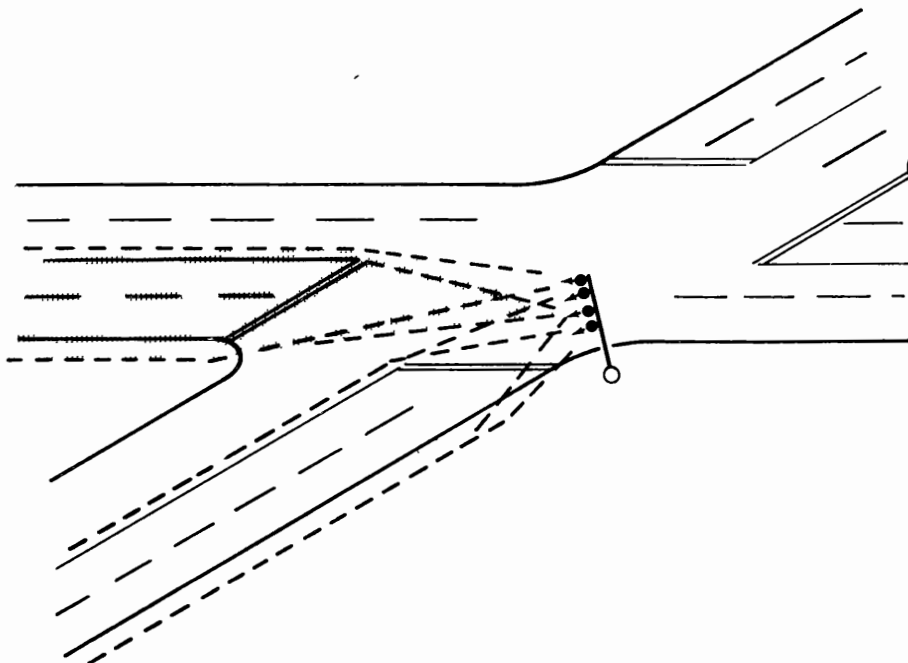
SKETCH #7
STEEL MAST ARM MOUNTED OPTICALLY PROGRAMED
TRAFFIC SIGNALS



SKETCH #8
AREA OF COVERAGE FOR DISTANCE LIMITING AND LEFT TURN LANES



AREA OF COVERAGE FOR SKEWED INTERSECTIONS



INSTALLATION/MAINTENANCE

GENERAL The effective utilization of Optically Programed Signals to accomplish the traffic engineering objectives is a function of both intersection signal design and the manner in which installed. The following guidelines outline significant installation procedures to maximize benefits.

SIGNAL ALIGNMENT The signal face should be so aligned, both horizontally and vertically, such that the area where the signal is meant to be seen appears on the center two-thirds of the optical masking surface as viewed from behind. This will insure maximum target value of indication as seen by approaching motorist. Signal "cut-off" should not be achieved by rotating signal face, but by masking out those parts of the intersection approach where the signal is not meant to be seen. Signal alignment can be accomplished by rotating around vertical axis and by adjustment of section tilt. The following are average tilt requirements.

GENERAL TILT REQUIREMENTS*		
MOUNTING	NEAR STOPLINE	FAR SIDE LOCATIONS
Mast Arm and Span Wire Bracket and Post Top	10 degrees 6 degrees	8 degrees 4 degrees

*Unusual approach grades may necessitate some adjustment of tilt to achieve desired area of coverage.

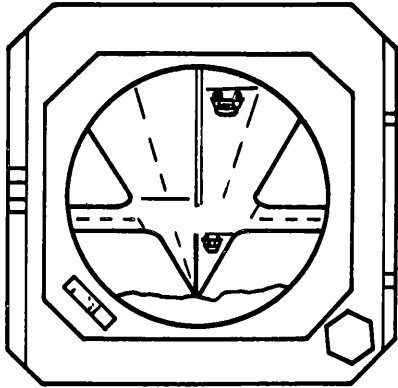
SIGNAL SUPPORT It is required that every effort be made to provide stable mounting of Optically Programed Signal faces to insure reliable control of visibility. Signal fittings should be tightened to insure against face rotation (and change in area of visibility) after masking is complete. In the case of span wire mounting, the signal face should be tethered to minimize face movement.

MASKING Exact control of the area of signal visibility of Optically Programed Signal is determined by selective placement of opaque "masking" material inside each signal section upon signal installation. Specific attention should be directed toward following the manufacturer's recommended procedure for masking to achieve optimum results. Of particular concern is that the masking process provides both an adequate area of signal visibility to the entire area where signal is designed to be seen and the light be "masked" from all other areas. (See Sketches #9 & #10, Masking.)

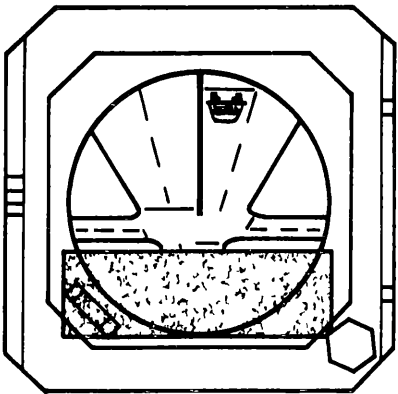
SEE SKETCH #9

NOTE:

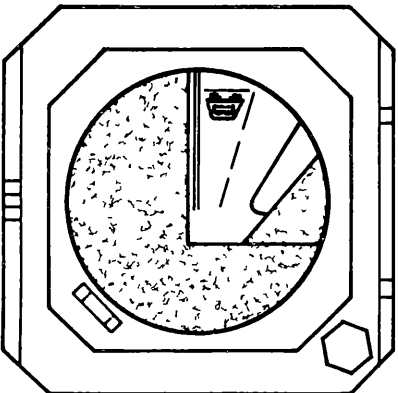
Masking tape to be applied according to manufacturer's published instructions



First, determine the point beyond which the driver of a small car should not see the signal. In this case, it would be the hood of the car at the second stop bar.



Next, apply a piece of optical masking tape across the optical limiter at this point and down to the bottom of the limiter. This will cover that driver and all the drivers behind him.



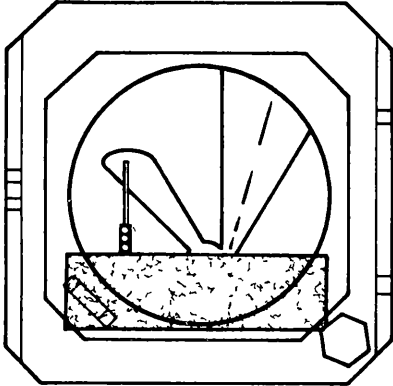
Complete masking by covering all areas where the signal does not have to be seen. Watch the car and truck drivers to determine where to place the masking tape. Trim off excess tape on the signal housing. Cut the tape in the groove on the housing, not at the edge of the glass. The entire optical limiter should be covered with optical masking except where the signal is to be seen.

MASKING OPTICALLY PROGRAMED TRAFFIC SIGNAL FOR DISTANCE LIMITING

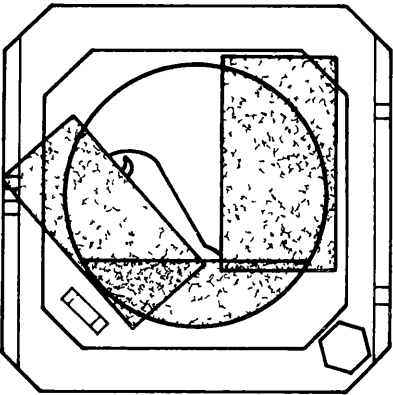
SEE SKETCH #10

NOTE

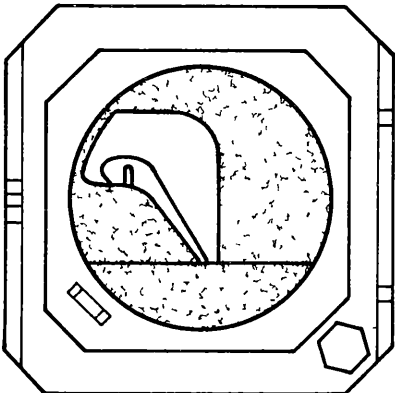
Masking tape to be applied according to manufacturer's published instructions



First, apply a piece of optical masking across the optical limiter to cover sky and distant roadway below the required cut-off



Next, mask the right and left sides using the eye heights of car and truck drivers as a guide to determine where the cut-off should be



Complete masking by covering all areas where the signal does not have to be seen. Open up any covered areas where the signal should be seen. Trim off excess tape on the signal housing. Cut the tape in the groove on the housing, not at the edge of the glass. The entire optical limiter should be covered with optical masking except where the signal is to be seen

NOTE A yellow lens may be substituted for an arrow and pedestrian lens while masking. Replace when masking is completed. Also replace lamp collar and diffuser

MASKING OPTICALLY PROGRAMED TRAFFIC SIGNAL FOR A LEFT TURN