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Abridgment

Standardization of Light Signals for Road Traffic Control

D. A. SCHREUDER

A recent technical report on road-traffic-control signals prepared by the International Commission on Illumination is briefly discussed. The report represents a first step toward international standardization of traffic signal lights in order to benefit trade and transportation. The principal subject areas of the technical report—color, luminous intensity, and luminous intensity distribution—are outlined. It is concluded that the report can be highly beneficial to road traffic and that official recommendations should be prepared.

Light signals for road traffic control are applied in an increasing number of cases to promote the flow of traffic at highly trafficked intersections. Although individual waiting times may increase, it is generally accepted that the capacity of intersections and road safety are increased.

International harmonization of industry and traffic requires standardization; lacking better grounds, these standards are usually based on the plausible assumption that road-traffic-control signals must be clearly visible for all road users. "Clearly visible" cannot be defined precisely, but it is usually understood as being well above the threshold of visibility found in a laboratory setup.

In recent years, a number of countries have set up national recommendations, regulations, or standards for traffic signals. Although they show a certain similarity, important discrepancies still exist that are unfavorable to trade and transportation. The International Commission on Illumination (CIE) took the initiative for further international harmonization. A technical report has been prepared and will be published in the near future (1). This paper briefly discusses that report.

The CIE report is restricted to those aspects of road-traffic-control signals that are directly seen by the users and are directly related to the signaling function. It does not cover other important matters concerning traffic signals, such as traffic engineering matters, the regulatory status, the legal obligations of local authorities and the road user, and electrical and mechanical engineering. The report deals with the color, the luminous intensity, and the luminous intensity distribution of signal lights. The "phantom effect" is also discussed. Since recognition of "cut-out" figures, or symbols, used with lights has become important, the report examines some details of their shape and size. Only lanterns of 20- and 30-cm diameter are considered.

COLORS

Road-traffic-control signal lights consist normally of three separate units that emit red, yellow (or amber), and green light. The colors given in the CIE technical report are in agreement with the 1975 CIE recommendation (2). In road traffic, people whose color perception is defective can take part as pedestrians and drivers. Therefore, even the "restricted" green was considered too wide, and further restrictions are given as follows (all boundary colors for the red signal and the yellow boundary for the green and white signals are restricted):

Color of Signal	Boundary	Equation
Red	Purple	$y = 0.990 - x$
	Yellow	$y = 0.320$
	Red	$y = 0.290$
Yellow	Red	$y = 0.382$
	White	$y = 0.790 - 0.667x$
	Green	$y = x - 0.120$
Green	Yellow	$y = 0.726 - 0.726x$
	White	$x = 0.650y$
	Blue	$y = 0.390 - 0.171x$
White	Yellow	$x = 0.440$
	Purple	$y = 0.047 + 0.762x$
	Blue	$x = 0.285$
	Green	$y = 0.150 + 0.640x$

The result is a rather bluish green, an amber yellow, and a light (nearly orange) red (3).

PEAK INTENSITY AND LIGHT DISTRIBUTION

For normal roads and for built-up areas, the rule-of-thumb value of 100 m has been adopted as the minimum distance from which signals must be (clearly) visible. When perceived from 100 m, lenses of 30- and 20-cm diameter have discernible dimensions. However, experiments did show that for viewing conditions that pertain to practical conditions of road traffic--notably taking into account the peripheral vision--the "power" of the beam can be described adequately in terms of the luminous intensity alone. Considerable research has indicated that under full daylight conditions a peak value (maintained value) of 200 cd ensures adequate visibility [see, for example, Adrian (4), Cole and Brown (5), Jainski and Schmidt-Clausen (6), and Fisher (7)]. It is desirable that at night the peak intensity should be between 50 and 100 cd; intensities of less than 25 cd or more than 200 cd should be avoided. At least 100 cd should be provided in directions making an angle of ±11° laterally or 8° down with the beam axis. Further research is required to find out whether a more detailed description of the beam and the light distribution is necessary.

SHAPE OF SYMBOLS

It is recommended that the signal be a light-emitting cut-out figure on a dark (black) background rather than a dark symbol on a bright background. Because the latter suffers from irradiation, the signal with a symbol can easily be confused with the

roundel signal without a symbol. It is important to ensure that the luminance of the symbol is reasonably uniform.

PHANTOM EFFECT

When light enters the signal lantern from the outside, it may, after reflection and refraction, be emitted in a way similar to the way in which light is emitted from a signal in operation. These are called phantom effects. Their adverse consequences can be reduced in a number of ways:

1. By reducing the light that falls into the lens (e.g., by means of hoods or louvers),
2. By reducing the light emitted after refraction (e.g., by special optical construction of the lens or the mirror, by special lamps, and by additional, internal shields),
3. By ensuring that signals in operation are always considerably "brighter" than the phantom (e.g., the minimum value of 200 cd), and
4. By limiting the confusion by means of redoubling the signals and locating them in a less "vulnerable" position in the intersection.

Further research on this matter is desirable, particularly since it is not completely clear at this time at what level the phantom effect begins to be really disturbing.

ADDITIONAL EQUIPMENT AND SIGNAL LOCATION

Background screens help to identify and localize the signal in the road and, by reducing the glare from the sky, may reduce the requirement for the peak intensity. Background screens are considered an essential part of all road-traffic-control signal installations.

The location of the signals at the intersection is also important. However, because intersections may vary considerably in size, shape, and layout, general rules can hardly be given. Furthermore, there are legal differences in traffic regulations from one country to the other.

CONCLUSION

The CIE technical report is the first attempt at international harmonization and standardization for road-traffic-control signal lights. The obvious next step is to prepare official CIE recommendations. As the results of the first tentative steps toward international cooperation already indicate, such recommendations can be of considerable benefit to road traffic.

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Abridgment

Construction-Zone Delineation

THOMAS D. DAVIS

A study conducted to find the need for improving delineation in construction zones with long-term lane closures or diversions is described. The need for improved delineation was established through two means: (a) a committee of traffic, construction, design, research, and specifications engineers and (b) positive guidance, a technique that develops improvements to the highway information system from the driver's viewpoint. Once the need was established, improved delineation concepts were developed and tested in actual construction zones and evaluated for effects on traffic performance and driver visibility. The experiments showed that (a) although 12.70 x 25.40-cm (5 x 10-in) yellow high-intensity reflectors were less expensive, more easily checked, and more reliable than steady-burn lights, reflectors did not change vehicle speed averages and variances or the proportions of vehicles using the lane adjacent to the reflectors; (b) although tall vertical panels used up less space and could be seen over the tops of lead vehicles when compared with type 3 barricades, panels decreased lane encroachments and did not change vehicle mean speeds or variances; (c) raised pavement markers as a paint supplement reduced undesirable lane weaves and encroachments, day and night; (d) removable traffic tape was easy to install and easy to remove and caused no problems while in use; and (e) raised pavement markers as a paint replacement were easy to install and easy to remove, and they reduced lane weaves day and night and reduced nighttime lane encroachments.

New Jersey's Construction-Zone Delineation Research Project is part of a national federal program to research many facets of construction-zone traffic and personal safety. The objective of this research is to improve delineation devices in safety zones where long-term diversions and lane closures are created by construction.

DETERMINATION OF DELINEATION NEEDS

Committee

Early in the project, a committee of traffic, construction, design, research, and specification engineers was formed. During the three meetings held, needed improvements in construction-zone delineation were presented and discussed, recommended experiments were reviewed and approved, and possible sites were discussed.