Candle Power of Rear Lights on Trucks

EDMUND R. RICKER, Traffic Engineer
New Jersey Turnpike Authority

● LATE in 1953, the Inter-Turnpike Safety Committee was formed with representatives from the Pennsylvania Turnpike Commission, the Ohio Turnpike Commission, the New York Thruway Authority and the New Jersey Turnpike Authority. This committee was organized for the purpose of comparing operating experience, preparation of uniform traffic regulations and study of additional safety measures. The first job assigned to this committee was the evaluation of the rear lighting of vehicles as it pertains to expressway operation, to determine the adequacy of existing lighting requirements and the preparation of recommendations for additional requirements if necessary. This committee has met on several occasions, studied the requirements of the various states and the Interstate Commerce Commission and collected certain data as to the candle power and condition of existing rear lighting on trucks. This paper is concerned with the latter phase of this study.

Present legal requirements for the intensity of rear lighting are stated either in terms of visibility distance (generally 500 ft.) during night operating conditions or by bench measurements of candle power measured at certain angles to the lamp axis. Neither of these methods appears satisfactory for field checks or for enforcement purposes. A visibility distance is subject to many variations, such as presence of other lights and dark adaptation of the observer, with the result that a glowing cigar butt can meet the minimum requirements under certain conditions. The bench measurements, while definitive, do not take into account the many variables encountered in practical truck operations, such as deterioration of equipment, loss of voltage, dirty lenses and reflectors, displacement from normal position, or connection to batteries and generator systems with low voltage or improper voltage. Police detachment representatives asked the committee to seek some means for direct measurement of the intensity of rear lamps with a corresponding regulation which would provide that a certain minimum output must be present regardless of design, maintenance, or condition of the lighting system.

The committee asked the Nela Park Laboratory of the General Electric Company to construct an experimental photometer to make direct measurements of the output of vehicle tail and stop lights. This device is shown in Figure 1. It consists of a baffled photometric tube, lens, barrier-layer cell, microammeter and appropriate switches and circuitry. It is balanced about a carrying handle and the total weight is less than three pounds. The major dimensions of the device are taken up by the hollow tube which is 8 inches in diameter and 4 feet long, for the purpose of providing a constant photometric distance of 4 feet as used in other tail light requirements. The end to be placed against the tail lamp is padded with 1½ inches of sponge rubber with a tapered hole which accepts the tail lamp and allows a 4-inch diameter or smaller source to be measured. At the opposite end of this tube is a plastic fresnel lens which focuses the light from a 10 degree cone onto the face of the barrier-layer cell. Two microammeters with scaled ranges of 0 to 0.8 and 0 to 20 candle power are used to measure the cell current. Two buttons positioned under the fingers of the operator's left hand select the appropriate scale range. A special calibration device was also provided consisting of a red sealed-beam type lamp having a suitable beam distribution and two filaments to simulate tail and stop lamp ranges and distribution. It is operated from a separate six volt DC source.

It must be understood that this device is experimental in nature and does not represent a direct measurement of any existing legal requirements for lamp output. The design is such that the candle power reading is obtained by the integration of light over a 10 degree cone, and all readings reported in later paragraphs are stated in these terms, rather than in light output at specific points. As a very rough relationship to the requirements of the Society of Automotive Engineers, the equivalent integrated candle power is approximately one-half the "on-axis" requirement, which, according to current standards, is 1.5 candle power for tail lamps, 15 candle power for stop lamps,

Figure 1.

and 100 candle power for turn signals.

The above described photometer was used over a period of several months to make measurements on vehicles traveling over the Pennsylvania and New Jersey Turnpikes. During the collection of this data, all trucks wishing to enter the turnpike at a given interchange were stopped on the shoulder and measurements made of the tail lamp and stop lamp intensity. Due to the fact that this operation was performed under the direction of state police personnel and was accompanied by a check of other safety equipment, it is probable that most of the truck drivers tried to present their lighting equipment in the best condition possible. This was indicated by the fact that some of them kept the motor turning at a faster-than-idling speed, that many of the lenses were freshly cleaned, that some trucks avoided the checking point by using other routes and that some had actually performed re-wiring operations as indicated by the fact that stop lamps were wired as tail lamps. The drivers were not requested to keep the motor turning at faster-than-idling speeds, but were permitted to do so. On several nights, the weather was rainy. Thus it is felt that the measurements taken are generally better than the average of existing conditions. The results of some 660 observations on the New Jersey Trunpike are shown in Table 1. The personnel making the tests attempted to make a rough comparison between the better lamps as measured, and their usefulness as observed while the truck was pulling away. It was the general concensus that the group having 1.5 or greater integrated candle power in tail lamps and 15 or greater integrated candle power in stop lamps was the minimum which could be considered adequate for safe operation on expressways. It may be noted from the table that 88.5 percent of the tail lamps and 97.4 percent of the stop lamps were thus adjudged inadequate. Some reference measurements were made of the tail lamps on the

current model passenger cars and these were found to give readings on the photometer in the range of 3 to 7 candle power for tail lights and the stop lights were generally off-scale on the meter.

Additional data were collected during the tail and stop lamp intensity survey. Concerning the height above ground and the distance from edge of body to the centers of

TABLE 1

SUMMARY OF TRUCK TAIL AND STOP LAMP SURVEYS CONDUCTED ON THE NEW JERSEY TURNPIKE BETWEEN JULY 27 AND SEPTEMBER 20, 1954

Integrated Candle Power	Tail Lights	Cumulative Percentage	Stop Lights	Cumulative Percentage
None	55	8.8	119	18.0
Less than 0.10	112	26.7	24	21.7
0.10 - 0.24	140	49.1	37	27.3
0.25 - 1.4	252 (6)[a]	88.5	191	56.2
1.5 - 4.9	84 (22)[a]	98.4	179	83.3
5	5 (1)[a]	Vehicles with stop lights wired as tail lights and no stop lights in operation were subtracted from the total for calculation of these percentages.	26	87.3
6	2		26	91.2
7	3 (2)[a]		10	92.7
8	1 (1)[a]		4	93.3
9	1		8	94.5
10	1		6	95.5
11	2 (1)[a]		7	96.5
12	1 (1)[a]			
13			3	97.0
14			3	97.4
15			1	97.6
17			2	
18	1 (1)[a]	100.0	3	
19			3	
20			3	
Greater than 20			5	100.0
	660		660	

[a] These vehicles had stop lights wired as tail lights and did not have stop lights in operation.

TABLE 2

MOUNTING HEIGHTS – TAIL LAMPS

	TRACTOR TRAILERS					STRAIGHT TRUCKS						
Mounting Height	Box	Flat Bed	Car Transport	Low Bed	Van	Tanker	Box	Rack	Panel	Open Body	Tractors	Total
Less than 18"					1							1
18 - 23 in.	6	1	3		15		1	3				29
24 - 29 in.	18	2	9		11		24	9	1	7	2	83
30 - 35 in.	77	29	7	2	5		27	16		10	2	175
36 - 48 in.	299	31	1			17	8	2	1	4	1	364
Greater than 48"	3					5						8
Total	403	63	20	2	32	22	60	30	2	21	5	660
MOUNTING HEIGHT – STOP LAMPS												
Less than 18"					2							2
18 - 23 in.	7	1	3		15		1	2				29
24 - 29 in.	26	4	4		10		24	10	1	10	2	91
30 - 35 in.	86	38	12	2	5		28	16		9	1	197
36 - 48 in.	281	20	1			17	7	2	1	2	2	333
Greater than 48"	3					5						8
Total	403	63	20	2	32	22	60	30	2	21	5	660

TABLE 3

DISTANCE FROM EDGE OF BODY —TAIL LAMPS

	TRACTOR TRAILERS				STRAIGHT TRUCKS							
Edge Distance	Box	Flat Bed	Car Transport	Low Bed	Van	Tanker	Box	Rack	Panel	Open Body	Tractors	Total
Less than 12"	3	1	4			1	1					10
12 - 18 in	8	1	3		3	5	4	2				26
19 - 24 in	22	3	1		4	1	7	5		1		44
25 - 36 in.	24	9	1		3	2	3	2				44
37 - 48 in	82	13			2	1					1	99
Total	139	27	9		12	10	15	9		1	1	223
DISTANCE FROM EDGE OF BODY — STOP LAMPS												
Less than 12"	4	1	3			3	1					12
12 - 18 in	10	1	4		5	4	3	2				29
19 - 24 in.	20	3	1		2	1	7	5		1		40
25 - 36 in.	21	8	1		4	2	3	2				41
37 - 48 in	84	14			1		1				1	101
Total	139	27	9		12	10	15	9		1	1	223

both tail and stop lights. These data are summarized in Tables 2 and 3. Examination of the mounting height summary indicates that 94 percent of the tail lights and stop lights lie within the 24 inch to 48 inch height range. This would probably be an acceptable placement range in the vertical plane. The location of lights with respect to the edges of the body is not standardized. It would appear most desirable to have these lights reasonably close to the edges of the body, as they would also serve the function of clearance lamps and provide better delineation of the extreme sides of the vehicle. However, present practice seems to be to place these lights close to the center of the body even when two lights are displayed.

SUMMARY

The Inter-Turnpike Safety Committee is continuing its study with a view to proposing to its parent bodies definite requirements as to the intensity placement and use of tail and stop lamps for vehicles traveling on the various turnpikes. It is recognized that the setting of these standards and the methods of measurement are matters of widened interest in the traffic field. Comments are earnestly solicited as to the significance of the reported measurements and suggestions for the proper standards to be used.