

	SURFACE VEHICLE INFORMATION REPORT	
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Recommendations of the SAE Task Force on Headlamp Mounting Height		

RATIONALE

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1. SCOPE

The SAE International task force on headlamp mounting height has considered the ramifications of reducing the maximum mounting height of headlamps on highway vehicles. The task force has concluded that it is in the best interest of the driving public to make a substantial reduction in the recommended maximum height at which headlamps, particularly low-beam headlamps, may be mounted. Heights as low as 36 to 40 in (90 to 100 cm) have been considered. New tractor vehicles are in fact being designed with headlamps mounted in this range. Further recommendations were withheld in anticipation of tests to demonstrate the effect of mounting height on the legibility of certain overhead signs.

1.1 Background

For the past several years there has been increasing concern on the part of automotive lighting committees within SAE and automotive lighting regulators at National Highway Traffic Safety Administration (NHTSA) over the glare from vehicle headlamps. Complaints to NHTSA from users indicate that both mirror glare and glare from opposing vehicles contribute to the problem.

Present mounting height standards allow headlamps to be mounted up to a height of 54 in (from the ground plane to the center of the headlamp). Generally, passenger vehicle occupants are seated such that their eye level ranges from about 40 in to 45 in. (100 to 114 cm). By comparing the range of vehicle driver's eyes and mirrors with the range of headlamp heights, it can be shown that passenger vehicle drivers' eyes and the vehicle's rearview mirrors can be located below the top cutoff of the projected beam of a following vehicle. In this high gradient zone, the light intensity from a lower beam headlamp beam, located 40 ft behind a driver's rearview mirror, will increase at least 20% (40% in some lamps) for every 1/10 degree (0.84 in) below the top cutoff of the beam pattern.

For a rearview mirror located 5 in below the top cutoff of a headlamp beam pattern, the beam gradients of 20 to 30% per 1/10 degree would cause an increase of 300% to 500% of the light that a driver would experience if the mirror were located exactly at the top cutoff. A 1000% increase in eye illumination could be experienced in comparison to that from a mirror located at an approximately equal distance above the top cutoff. These numbers give us a clue as to why passenger vehicle drivers are noticing the differences in glare from high-mounted headlamps.

1.2 History

The conflict between where passenger car drivers are located and where vehicle headlamps can be mounted can be traced by reviewing historical trends in vehicle lighting.

Passenger vehicle sizes and heights are decreasing as many vehicles are being downsized and as a result, the elevation of drivers' eyes and rearview mirrors has been reduced accordingly. Light trucks (pickups, vans, minivans and sport utility vehicles) on the other hand, are not decreasing in either size or market share. With headlamps routinely mounted well above those on passenger cars, light trucks are more popular than ever. The higher mounting heights on these vehicles most likely represent a substantial part of the increase in complaints about headlamp glare.

When headlamp mounting height standards were first written, headlamps on passenger vehicles were routinely mounted at 30 or even 32 in (approximately 79 cm) above the ground plane, 8 to 10 in above the 22 to 24 in (approximately 58 cm) mounting height we see today. It is probably safe to assume that the eyepoint of the driver was also higher by 8 to 10 in. If we use 44 in (112 cm) for today's passenger car driver, a rearview mirror mounted 2 or 3 in (6.4 cm) above the driver's eye in the old standard-setting vehicles would have an elevation of 54 to 57 in ($44 + 8 + 2$ to $44 + 10 + 3$ in), approximately 141 cm. This is essentially identical with the maximum mounting height of the headlamp that was prescribed at that time.

Another reason for the recent trend of dissatisfaction and irritation with vehicle lighting among passenger vehicle drivers may be found in the headlamp beam intensity distribution itself. In one of the first SAE photometric standards, J579a, the required light level was only about 75% of the present standard and only 60% of more advanced standards in Federal Code 49 CFR Part 571.108. In fact, contemporary halogen headlamps generally achieve 100% more light at the 1/2-degree-down seeing point than was available from the brightest of the SAE J579a design headlamps. At the time the mounting height standard was defined, a driver would have been exposed to roughly about 2800 cd viewing a following vehicle's 54 in mounting height headlamps (designed to SAE J579a) in his rearview mirror.

Today rearview mirrors (front surface, prism) in their "night" position may reflect as little as 4% of the incident light. In spite of their elevation in the headlamp beam, the glare concern for rearview mirrors is low compared to driver's side view mirrors. A side view mirror (no "night" adjustment; 50% reflectance), mounted at about 40 in or less, could theoretically be over 1.6 degrees below the horizontal of a headlamp mounted at 54 in / 137 cm. At a distance of 40 ft (12.2 m) on some halogen headlamps using axial-filament light sources, this is the approximate location of the maximum beam intensity (MBI). MBIs of over 30 000 cd are possible. This represents more than a tenfold increase of the exposure intensity over that which was typical when the standard was formulated.

It is apparent that mounting height or aiming guidelines must be revised to accommodate the changes in aerodynamic vehicle styling and headlighting technology. The most technically defensible solution is to lower the current maximum mounting height for headlamps in order to reduce the maximum exposure level to a reasonable value.

2. REFERENCES

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein.

- 2.1.1 Sivak, M., Flannagan, M., Gellatly, A.W., "Influence of Truck Driver Eye Position on Effectiveness of Retroreflective Traffic Signs," *Ltg. Res. Technology*, 25(1) 31-36, (1993)
- 2.1.2 Cobb, J., "Roadside Survey of Vehicle Lighting 1989," Transport and Road Research Laboratory, U.K., Research Report 290, (1989)
- 2.1.3 Kosmatka, W.J., "Obstacle Detection with Headlamps: Threshold Luminance or Contrast," *Proceedings of IES, IENSA Conference - 1995*, (1995)
- 2.1.4 Kosmatka, W.J., "Obstacle Detection Rationale for Vehicle Headlamps," *J of the IES*, Winter 1995, 36-40, (1994)