Photometric Specification of Automotive Headlamp

Introduction

Automotive front lighting solutions have been focusing on how to achieve optimal illumination of the road space in front of the driver. The objective is to illuminate the road and its surroundings as much as possible so that the driver is able to identify obstacles and pedestrians on the roadway. Conversely, they should protect preceding or oncoming drivers from excessive glare.

Advance forward lighting technology are being developed to provide drivers more illumination for maximum visibility. But having more illumination may result in greater glare to other drivers that can be incommodious and detrimental to visibility.

The typical solution involves switching between high and low beams. High beams are generally intended for distance illumination and for use when alone on the road. Low beams provide a light distribution that provides sufficient lateral and forward illumination without dazzling other road users with excessive glare.

Performance specification for headlamps indicating the maximum amount of light output and beam patterns (both intensity and distribution), have been established by regulatory bodies to balance the visibility benefits with the glare consequences.

ECE Versus FMVSS Regulations

The light distribution patterns of the Economic Commission for Europe (ECE) differ from those promulgated by Federal Motor Vehicle Safety Standard (FMVSS), which rely on standards established by Society of Automotive Engineers (SAE). In the past, vehicles in Europe uses illuminance (in lux) to characterize forward lighting systems. From 2015, new unit, luminous intensity (in Candela), was defined for headlight beams measurement as ECE looks to harmonize with the US standards.

In general. If the measurement distance is known and illuminance can still be used prior to the switch date, measurements in lux can be converted to candelas and vice versa.

Low Beam

Low beams, also known as dipped beam or passing beam, provide an asymmetrical illumination pattern that ensures sufficient lateral and forward illumination while minimizing glare towards oncoming cars and other road users.

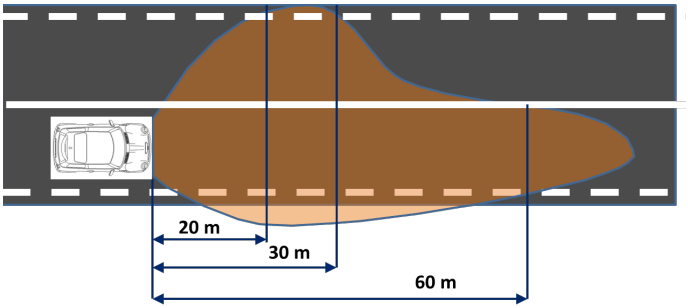

Figure 1 - The illustration shows the right-hand traffic, asymmetrical low beam pattern characterized by an extended visual range along the right side of the road aas required by both the ECE Regulations and North American FMVSS Regulations

Left-hand traffic countries have low-beam headlamps that dip to the left while right-hand traffic countries have low-beam headlamps that dip to the right.The ECE low beams are characterized by a distinct asymmetric cut-off line at the top of the beam creating a well-defined separation.

North American SAE low beam may or may not have a cutoff and permits much more glare as compared to ECE standards.

High Beam

High beams, also knowns as main beams or full beams, provide long range illumination to maximize the viewing distance of the driver and have a center-weighted light distribution beam pattern without any glare control.

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Hence, they are suitable for use only when there are no other oncoming or preceding vehicles.

The ECE regulations allow much higher-intensity high-beam headlamps than permitted under North American regulations.

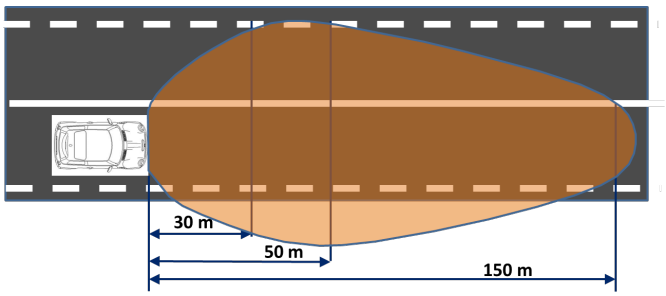

Figure 2 - The Illustration shows the unrestricted symmetrical high beam illumination pattern allowed by both the ECE and FMVSS/SAE standards

Photometric Performance of a Headlamp

Conventionally, the photometric performance of a headlamp are determined using a goniometer which utilizes motorized stage that rotates the test item around two axes at the right angles. Headlamps measurements are also tested at a number of points on a flat screen positioned at a distance of 25 meters in photometric tunnel or dark room. This method is generally very accurate and essential for national standards testing and type approval testing laboratories. Nevertheless, it does have certain limitations:

a) Point-by-point measurement may be time consuming
b) High capital investment

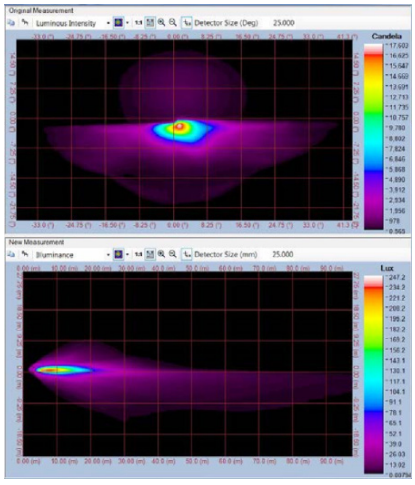

Figure 3 - Illumination distribution of headlamp

In new product development, a faster and more cost effective measurement technique is required. An alternative approach for photometric characterization of headlamps involves the usage of an imaging photometer.

Instead of a point to point measurement, such CCD based system can measure millions of angles or points simultaneously, thus enable rapid and accurate evaluation of headlamp beam patterns. It also permits conversion of headlamp beam patterns into roadway illumination distributions as shown in figure 3 and 4.

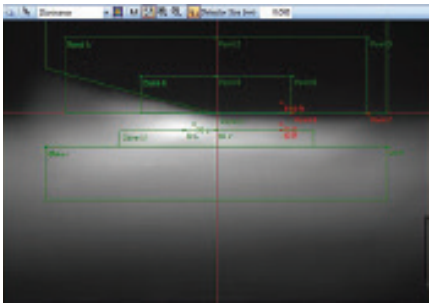

Figure 4 - Primary cut-off shape according UN ECE Regulation

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Learn more about the basic concepts of photometry and colorimetry with our free education booklet. Alternatively, you can call us a 6563 5533 or contact us through here for a free consultation.