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SURFACE VEHICLE RECOMMENDED PRACTICE

Submitted for recognition as an American National Standard

SAE J1735

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HARMONIZED VEHICLE HEADLAMP PERFORMANCE REQUIREMENTS

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Foreword—This Document has not changed other than to put it into the new SAE Technical Standards Board Format.

1. ***Scope***—This SAE Recommended Practice provides headlamp beam pattern test points which incorporate elements of European, Asian, and U.S. photometric tables. Alternative means of aiming headlamps are included which are consistent with methods presently used in the United States and in Europe.

2. ***References***

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the latest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J599—Lighting Inspection Code
SAE J1383—Performance Requirements for Motor Vehicle

2.2 Related Publications—The following publications are provided for information purposes only and are not a required part of this document.

2.2.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J575—Tests for Motor Vehicle Lighting Devices and Components
SAE J579 Cancelled—Sealed Beam Headlamp Units for Motor Vehicles
SAE J600—Headlamp Testing Machines
SAE J602—Headlamp Aiming Device for Mechanically Aimable Headlamp
SAE Paper 870238—The Potential Impact of Automotive Headlight Changes on the Visibility of Reflectorized Highway Signs, J. B. Arens, Office of Safety and Traffic Operations, Research and Development, Federal Highway Administration

2.2.2 ECE PUBLICATION—Available from Commission of the European Communities, 200, Rue de la Loi, B-1049 Brussels, Belgium.

ECE Regulation 20

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2.2.3 JIS PUBLICATION—Available from Japanese Standards Association, 1–24, Akasaka 4, Minato-ku, Tokyo 107 Japan.

JIS D 5500

2.3 Other Publications

"Headlamp Beam Pattern Philosophy," Lidstrom, O., Minutes of the SAE Headlamp Beam Task Force, April 4, 1990

"Obstacle Detection Rationale for Upper Beam Intensity," Kosmatka, W.J., Minutes of the SAE Headlamp Beam Task Force, February 26, 1992

"Headlamp Beam Gradient Aim Study," Kosmatka, W.J., Minutes of the SAE Headlamp Beam Task Force, October 4, 1993

"Partial Harmonization of International Standards for Low-Beam Headlighting Patterns," Sivak, M. and Flannagan, M., UMTRI-93-11, Univ. of Mich. Trans. Res. Institute, 1993

3. Definitions

3.1 H-V Axis—See SAE J1383.

3.2 Visual Aim—A method of aiming a headlamp by visual assessment of the location of certain beam pattern characteristics, such as visual edges/cutoffs or location of the High Intensity Zone, and positioning the beam pattern, projected on a surface, with respect to prescribed coordinates on that surface. (Also see 3.12 Cutoff.)

3.3 Low Beam Fractional Balance Aim—A method of aiming a headlamp where one or more points in the beam pattern, with specified percentage values of intensity relative to the Maximum Beam Intensity (MBI), are used to position the beam relative to the H-V axis. (Also see SAE J1383.)

3.4 High Beam Balance Aim—A method of aiming a headlamp via the upper beam such that the intensity of light at two points equidistant from a projection of the lamp's vertical plane are of equal magnitude at the same time that two points equidistant from a projection of the lamp's horizontal plane are of equal magnitude. (Also see SAE J1383.)

3.5 Mechanical Aim—A method of aiming a headlamp such that the lamp aiming plane is oriented to a predetermined mechanical feature of the lamp. "VHAD" and "REFERENCE PLANE" aim are both mechanical aiming methods.

3.6 Vehicle Headlamp Aiming Device (VHAD)—A device, permanently installed on a motor vehicle and/or headlamp by the manufacturer of the vehicle, which indicates the horizontal and vertical aim of the headlamps.

3.7 Photometric Aim—A method of aiming a headlamp using a device which measures luminous intensity at selected points of the beam pattern relative to the H-V axis.

3.8 Optical Aim—A method of aiming a headlamp based upon measurement of certain characteristics of the beam pattern. Optical aim methods include Photometric Aim, Fractional Balance Aim, and Image Processing Aim.

3.9 Aiming Reference Plane—A plane which is perpendicular to the longitudinal axis of the vehicle and tangent to the forward-most aiming pad on the headlamp.

3.10 Aiming Plane (Headlamp)—(See SAE J1383.)

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3.11 Image Processing Aim—Headlamp aiming method using an image sensor to measure the intensity pattern of the headlamp, a computer to determine the position of the pattern relative to the H-V axes, and a display device showing a proportional digitized representation of the headlamp beam pattern.

3.12 Cutoff—The visual cutoff is where, by visual impression, the best separation between the lighted area of the beam pattern and the dark area above it, is located. Objectively, this will be defined as: the location in the vertical direction where the maximum rate of change in the light intensity (the highest gradient) is found.

4. Headlamp Lens Aim Marking

4.1 Visual Aim—Headlamps designed to be visually aimed using an aiming screen shall be marked with a letter "V".

4.2 Fractional Balance Aim

4.2.1 Headlamps designed to be aimed by fractional balance means shall be marked with the letter "B".

4.2.2 Following the letter designation shall be two, two-digit numbers indicating first, the "2 degrees right" and second, the "1 degree down" fractional balance percentage values chosen to represent the design aim of the headlamp.

4.2.3 The two numbers may be separated by a space, dash (-), or slash mark (/) (e.g., B25/35 or B25-35), or presented as a series of four digits preceded by a "B".

4.2.4 Lens marking shall be no less than 3 mm in height and imprinted indelibly on the lens.

4.2.5 MARKING LOCATION—Same as "Replaceable Bulb Headlamps" (see SAE J1383).

4.3 Aiming Reference Plane Aim

4.3.1 REPLACEABLE BULB HEADLAMPS—(See SAE J1383.)

4.3.2 "Reference Plane" markings are not required for standardized sealed beam headlamps.

4.4 VHAD Aim—Markings are not required for headlamps with VHAD.

4.5 Image Processing Aim—No special marking required.

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5. Headlamp Aiming Procedures

5.1 Visual Aim

5.1.1 LOW BEAM

5.1.1.1 *Vertical Aim*—For a lamp aimed using the right cutoff, the low beam shall be adjusted such that the top cutoff is located at the horizontal line representing the projected horizontal axis of the headlamp.

For a lamp aimed using the left side cutoff, the low beam shall be aimed such that the cutoff is located approximately 0.6 degree below the horizontal line, 2 to 4 degrees left, representing the projected horizontal axis of the headlamp.

5.1.1.2 *Horizontal Aim*—The left edge of the HIZ shall be located at the line representing a projection of the headlamp's vertical axis V-V.

For headlamps with no prominent left edge to the HIZ (but having a straight top cutoff, which has on its left side a transition zone angling left and downward), the left/right aim of the lamp will be accomplished by orienting the left/right position of the beam so that the left end of the top cutoff is located 0.4 degree right of the vertical (V-V) as shown in Figure 1.

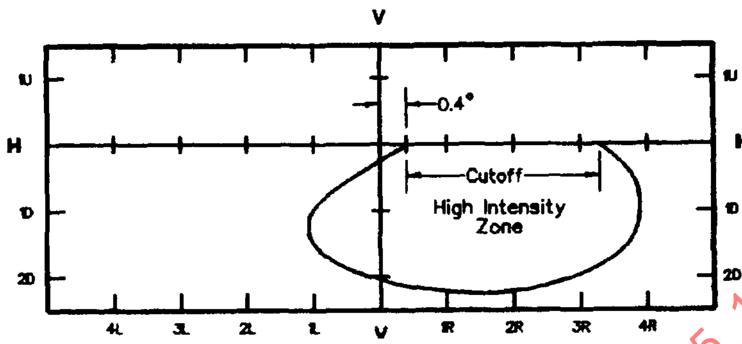

FIGURE 1—LOWER BEAM PATTERN

5.1.2 HIGH BEAM—The high beam shall be aimed so that the center of the high intensity zone is coincident with the horizontal and vertical lines on the aim screen.

5.1.3 VISUAL AIM SCREEN—Headlamp visual aiming will be conducted using a white screen with a matte surface, having a reflectance of 60% minimum. Lines indicating the horizontal and vertical coordinates should be no greater than 3 mm maximum in width. There should be no other visible marks, scuffs, or shaded areas which exceed 25 cm^2 in area.

5.1.4 SCREEN LOCATION—See SAE J599 for screen location and orientation.

Where the screen is to be used in conjunction with photometric testing, the H-V axes of the screen shall be positioned perpendicular to the goniometer axis.

5.1.5 SUITABILITY FOR VISUAL AIM—Refer to 6.3.

5.2 Balance Aim

5.2.1 LOW BEAM—With the headlamp mechanical axis coincident with the axis of the goniometer or the centerline of the aiming screen, the low beam shall be adjusted to satisfy the following criteria:

5.2.1.1 The measured value at the test point designated by the triangle in Figure 2 of SAE J1383 at H - 2 degrees right, shall be a percentage of the maximum beam intensity indicated by the first two-digit number following the "B" on the headlamp lens (as defined under "Headlamp Lens Aim Marking").

5.2.1.2 The measured value at the test point designated by the square, in Figure 2 of SAE J1383, at 1 degree down-vertical, shall be the percentage of the maximum intensity indicated by the second two-digit number following the "B" on the headlamp lens.

5.2.2 HIGH BEAM—(See SAE J1383.)

5.3 Aiming Reference Plane Aim—Adjust the position of the headlamp until the aiming plane of the lamp is normal to the axis of the vehicle or the H-V axis.

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5.4 VHAD Aim—Adjust the position of the headlamp until the device indicates the headlamp is properly aimed. Check manufacturer's instructions for horizontal positioning.

5.5 Image Processing—Aim the headlamp in accordance with the aimer manufacturer's instructions.

6. Photometric Tests

6.1 Low Beam Headlamps—A low beam headlamp, or the low beam of a dual beam headlamp, aimed in accordance with the appropriate procedure outlined in Section 5, shall be measured at the points and zones indicated in Figures 2 and 4.

6.2 High Beam Headlamp—A high beam headlamp, aimed in accordance with the appropriate procedure outlined in Section 5, shall be measured at the points indicated in Figures 3 and 5. (The high beam of a dual beam headlamp will retain the aim of the lower beam aimed in accordance with 6.1.)

6.3 Requirements for Lamps Marked With "V"—Adequacy of sharpness of cutoff.

6.3.1 Adjust beam location as it would be located for "visual aim."

6.3.2 Read photometric point values from 0.5 degree up to 0.5 degree down in 0.2 degree vertical increments along a line at 1 degree right. For lamps designed to be aimed using the left side of the beam, vertical 0.2 degree increments are read at 2 degrees left over the interval from 0.1 degree down to 1.1 degrees down.

6.3.3 Repeat 6.3.2 at 2 degrees right and 3 degrees right, or at 3 degrees left and 4 degrees left.

6.4 Photometric Test Voltage—(See SAE J1383.) For conversion of halogen light source photometric values to other than 12.8 V, the following factors are suggested:

a. For 12.0 V—0.81
b. For 12.8 V—1.0
c. For 13.2 V—1.11

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Test Point	Min (cd) (0.8 x Figure 4)	Max (cd) (1.2 x Figure 4)
0.5U, 1.5R	400	3 000
0.5U, 1.5L	100	850[1]
1.5U, 1.5R	150	1 300
2.0D, 15R, and 15L	700	—
0.86D, 3.5L	1440	14 400
4.0U, 8L	65	900
2.0U, 1.5R	65	900
10U, V	—	150
0.6D, 1.3R	8000	—
0.86D, V	3600	—

[1] Point value is 1.3 x Figure 4 value.

FIGURE 2—LOW BEAM PERFORMANCE REQUIREMENTS

Test Point	Min (cd) (0.8 x Figure 5)	Max (cd) (1.2 x Figure 5)
H-V	20 000	168 000
H-3R	12 000	168 000
H-3L	12 000	168 000

FIGURE 3—HIGH BEAM PERFORMANCE REQUIREMENTS

6.4.1 MEASUREMENT METHODS FOR ZONES IN FIGURE 4

Zone 1	Search for the highest intensity. The "MIN" value shall be met.
Zone II	Photometry values shall be met at all four corners of the zone.
Zone III	Photometry values shall be met at four extreme corners of the zone and at the lower boundary line from 5L to 5R.
Zone IV	Scan 4U line from 15L to 15R and along V line from 4U to 10U. "MAX" value shall not be exceeded.
Zone V	Scan 45U line from 45L to 45R and along V line form 10U to 90U. "MAX" values shall not be exceeded.

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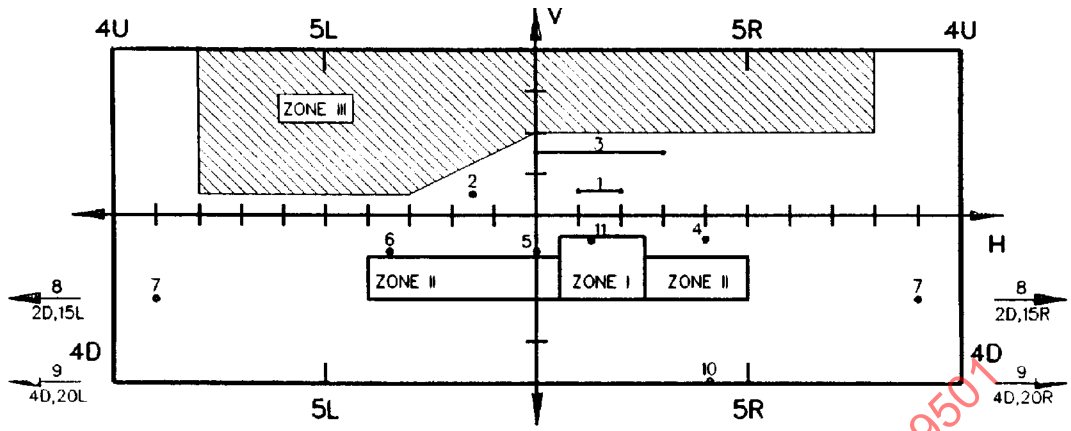

Test Points	Min (cd)	Max (cd)
1. 0.5U, 1R-2R	500	2 400
2. 0.5U, 1.5L	125	650
3. 1.5U, V-3R	200	1 000
4. 0.5D, 4R	5 000	—
5. 0.86D, V	4 500	—
6. 0.86D, 3.5L	1 800	12 000
7. 2.0D, 9R and 9L	1 250	—
8. 2.0D, 15L and 15R	1 000	—
9. 4.0D, 20L and 20R	300	—
10. 4.0D, 4R	—	50% of MAX in Zone I (but not to exceed 12 500 cd)
11. 0.6D, 1.3R	10 000	—

Zone	Description	Min (cd)	Max (cd)
Zone I	(See Above)	15000	—
Zone II	(See Above)	1875	—
Zone III	(See Above)	80	650
Zone IV	(4U-10U, 15L-15R)	—	525
Zone V	(10U-90U, 45L-45R)	—	125

NOTE—438 cd is permitted within a 2 degree conical angle.

FIGURE 4—LOW BEAM DESIGN GUIDELINES

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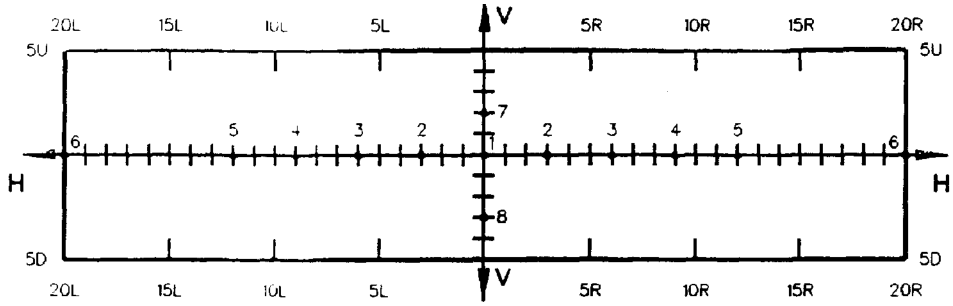

Test Points	Min (cd)	Max (cd)
1. H-V[1]	25 000	140 000
2. H-3R and 3L	1 500	—
3. H-6R and 6L	4 000	—
4. H-9R and 9L	2 500	—
5. H-12R and 12L	1 200	—
6. H-20R and 20L	250	—
7. 2U-V	1 200	—
8. 3D-V	2 500	—

[1] "H-V" includes a zone of H ± 0.5 degree, V ± 0.5 degree.

FIGURE 5—HIGH BEAM DESIGN GUIDELINES

6.5 Re-aim Allowance—In order to accommodate slight aim differences between photometers, 1/4 degree re-aim is allowed for point measurements in Figures 2 and 3.

7. Performance Requirements

7.1 Low Beam

7.1.1 The low beam shall meet the photometric values in Figure 2.

7.1.2 LOW BEAM HIGH INTENSITY ZONE—In the zone bounded by 0.5 degree down to 2.0 degrees down, and 0.5 degree right to 2.5 degrees right, at least one point shall measure 15 000 cd.

7.2 High Beam—The high beam shall meet the photometric values shown in Figure 3.

7.3 Low Beam Cutoff—In order for a low beam to be satisfactory for visual aiming, the cutoff shall meet the following criteria.

7.3.1 CUTOFF APPEARANCE

7.3.1.1 For Lamps Designed to be Aimed Using the Top Right Cutoff—The cutoff shall appear to be approximately straight and parallel to the horizontal from at least 1 degree to 3 degrees right.

7.3.1.2 For Lamps Designed to be Aimed Using the Top Left Cutoff—The cutoff shall appear to be approximately straight and parallel to the horizontal from at least 2 degrees left to 4 degrees left.

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7.3.2 A lamp aimed and measured as described in 5.3 shall meet the following:

7.3.2.1 The gradient in the vertical direction for each 0.2 degree interval shall be computed according to Equation 1:

$$\text{Gradient, } G_n = (\text{INTENSITY}_{n+1} - \text{INTENSITY}_n)/\text{INTENSITY}_n \quad \text{(Eq. 1)}$$

where:

INTENSITY_n = Photometric intensity at each 0.2 degree increment beginning with n = 1, at the topmost point

7.3.2.2 The maximum vertical gradient, G, is the largest value computed for the intervals along the vertical lines.

NOTE—If either the first or last interval gradient is the largest, the true maximum gradient may not have been found. The lamp may be misaimed and require re-aim or the beam may not meet the requirements in 7.3.1.

7.3.2.3 The maximum vertical gradients at 1, 2, and 3 degrees right or 2, 3, and 4 degrees left, shall be no less than 0.6 (60% change in 0.2 degree).

8. Guidelines

8.1 Photometric Design Guidelines

8.1.1 LOW BEAM PHOTOMETRIC GUIDELINES—For a low beam or dual beam headlamp aimed in accordance with the procedures outlined in Section 5, photometric guidelines are shown in Figure 4.

8.1.2 HIGH BEAM PHOTOMETRIC GUIDELINES—For a high beam headlamp aimed in accordance with the procedures outlined in Section 5, photometric guidelines are shown in Figure 5.

8.2 Low Beam Cutoff—In order for a low beam to be visually aimable, the cutoff shall meet the following criteria:

8.2.1 CUTOFF APPEARANCE

8.2.1.1 *For Lamps Designed to be Aimed Using the Top Right Cutoff*—The cutoff shall appear to be approximately straight and horizontal from at least 1 degree right to 3 degrees right.

8.2.1.2 *For Lamps Designed to be Aimed Using the Top Left Cutoff*—The cutoff shall appear to be approximately straight and horizontal from at least 2 degrees left to 4 degrees left.

8.2.2 A lamp aimed and measured as described in 6.3 shall meet the following:

8.2.2.1 The gradient in the vertical direction for each 0.2 degree interval shall be computed according to Equation 2:

$$\text{Gradient, } G_n = (\text{INTENSITY}_{n+1} - \text{INTENSITY}_n)/\text{INTENSITY}_n \quad \text{(Eq. 2)}$$

where:

INTENSITY_n = Photometric intensity at each 0.2 degree increment beginning with n = 1, at the topmost point

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8.2.2.2 The maximum vertical gradient, G, is the largest value computed for the intervals along the vertical lines.

NOTE—If either the first or last interval gradient is the largest, the true maximum gradient may not be found. The lamp may be misaimed and require re-aim or the beam may not meet the requirements in 8.2.1.

8.2.2.3 The maximum vertical gradients at 1, 2, and 3 degrees right or 2, 3, and 4 degrees left shall be no less than 0.8 (80% change in 0.2 degree).

PREPARED BY THE SAE ROAD ILLUMINATED DEVICES STANDARDS COMMITTEE
AND THE SAE LIGHTING COORDINATING COMMITTEE

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Rationale—SAE J1735 introduces harmonized vehicle headlamp performance requirements intended for European, Asian, and U.S. It is conducive to the consolidation of all headlighting standards and practices proposed by the Road Illumination Devices Committee to meet the global needs of lighting technology for the future.

Three primary areas addressed include visual aim, use of the left side of the beam for aiming, and glare light levels. Additional topics addressed include alternative aiming methods, fractional balance protocols, harmonized low beam test points, zonal photometric requirements, and the high beam H-V intensity limit.

The development of this proposal initially involved the formation of a philosophy task force to outline a strategy, and subsequently, layout a plan for successful harmonization of the low beam headlamp beam pattern.

HEADLAMP BEAM PATTERN TASK GROUP (HBPTG)

Objectives of the Task Group

The objectives of the HBPTG were to develop a harmonized low beam pattern that would be acceptable in all regions while reducing misaim sensitivity, and to determine the pertinent characteristics necessary to define the beam pattern. Additional aspects considered included perceived visibility, appearance on the roadway, relative insensitivity in perceiving misaim, visibility performance, and glare.

The approach taken entailed a bench marking study of beam patterns, drive evaluations, field studies to evaluate the effect of misaimed headlamps, and computer analyses using DETECT and CHESS models.

Headlamp Beam Pattern Philosophy

In February of 1990 the HBPTG completed a "Philosophy" plan for the low beam. Safety was a prime concern, but it was implied rather than isolated as a specific requirement, given the issue of safety was already embodied in the entire purpose for the development of headlamp beam patterns.

Worldwide (NHTSA/GRE/JAPAN) implementation and acceptance of a world harmonized beam pattern was key and it was felt that the work should be conducted as a cooperative effort and completed in a timely manner.

The features embodied in the philosophy considered: the world environment, design and testing requirements, signs, vehicle base standard (initial standard to be component based), and unrestricted methods for aiming. The beam pattern specified required flexibility such that higher output light sources could be accommodated. Compromises were incorporated to account for weather conditions and considerations made for providing photometric features to aid in aiming.

Also considered were the requirements for beam definition which detailed specified points and/or zones, a weighting system for test points, establishment of a photometry methodology for zonal areas, and when necessary, objective definition of gradients.

Headlamp Beam Pattern Philosophy Task Group Plan

The Task Group (HBPTG) presented the results of their work to the Lighting Committee on April 4, 1990. A consensus was reached to proceed with a plan for successful harmonization of the low beam headlamp beam pattern. This action was based on background information indicating a desire for harmonization on the part of U.S. lighting companies and vehicle OEMs. Reciprocity was a major importance, and written commitment mandatory to achieve worldwide compliance.

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Despite controversy surrounding the SAE/FMVSS108 beam pattern in European countries, it is still widely accepted in Europe. The exceptions are Germany and France which adhere to ECE requirements. However, flexible national statutes allow for these exclusions as a relatively small number of U.S. exports enter their borders. Also noteworthy are the number of U.S. military vehicles operating in Germany and other areas of Europe, which are equipped with SAE type headlamp systems.

The plan introduced at the April 4, 1990 meeting by the HBPTG was a two stage plan detailing only the specific accomplishments to be pursued. The first stage recommended the worldwide acceptance of existing U.S. and ECE beam patterns as the first step in harmonization.

It is widely believed that U.S. and ECE beam pattern variations are "practically" indistinguishable from the safety aspect. Though visual differences exist, the predominant needs for safe vehicle operation are equally well accomplished by both systems. Shortcomings and compromises to "optimal" performance are exhibited by both U.S. and ECE beam patterns. There are only three test points in the SAE/FMVSS test pattern which, in practice, prevent meeting the ECE beam pattern. They are the 0.5U-1.5L to L, the 0.5D-1.5L to L, and the 0.5U-1R to R test points.

The second stage consisted in the development of a consensus beam definition encompassing the favorable aspects of both the U.S. and ECE beam pattern philosophies. OEM vehicle manufacturers with expanding global interests have also recognized a need to minimize costs associated with design and tooling headlamp types to accommodate U.S./ECE/Japanese markets, and to improve the overall regulations.

Beam Pattern Criteria

- **The new pattern should consider the world driving environment.**
  (road surfaces, road delineation, traffic situations, combinations of lighted and unlighted roads, overhead and roadside signs, oncoming traffic, etc.)

- **Design and testing requirements must be considered.**
  Manufactured components vary slightly from the ideal design, and as a result, beam pattern variations occur. High quality standards reduce these variations but do not eliminate them. Development of a design standard and a manufacturing standard will insure safety and customer satisfaction are preserved.

- **The initial standard should be component based with consideration given for its applicability to vehicle based standard.**
  A component standard aids in the testing and compliance area. A vehicle based standard requires the designer to consider how a system of lamps perform on a vehicle. The concept of two headlamps on a vehicle, separated by 1200 mm, aimed in the same direction and producing the same beam pattern is not entirely efficient. It is obvious that the beam cut off on the right hand headlamp is not as critical for either the U.S. or ECE beam patterns. The standard should consider the next point.

- **The standard should allow for symmetrical beam patterns.**
  Even if the standard is vehicle based, it is certain that sealed beam headlamps will be in existence for many years to come and should not be prohibited.

- **All types of road signs must be considered.**
  The variety of signs and their locations must be considered. Also must consider sign types and reflectance characteristics.

- **The beam pattern specified should have the flexibility to accommodate higher output light sources.**
  This is primarily due to the introduction of HID light sources.

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- **Compromises may be incorporated to account for weather conditions.**
  Adverse weather conditions are a part of the vehicle experience and should be considered in the development of the standard.

- **The beam pattern must be aimable without restricting the method of aim.**
  Considerations should be made for photometric features to aid aiming.

PROPOSAL AND REVISIONS

The HBPTG generated a set of five alternative low beam proposals to consider at the first Headlamp Task Force meeting. These proposals underwent a number of iterations, culminating in a final set of requirements known as Proposal 6. These requirements were revised in subsequent task force meetings to Proposal 7, 7a, and finally in Proposal 8.

Proposal 6

One of the principle guidelines used in creating these requirements was to adopt the best features of the present ECE and U.S. versions of low beam patterns. The major differences identified between ECE and U.S. low beam patterns were as follows:

- **ECE Patterns**

  Very low intensities above H-H to the left and above an angled line to the right. Intensities are about 400 cd near H-H.

  A sharp cut-off of intensities along or just below H-H to the left and along the angled line to the right, permits visual aim and reduces glare. Generally, a mechanical device is used to accomplish this (e.g., a bulb shield).

  No requirement for a very high intensity spot. Highest minimum is 7500 cd at two points in the "roadway seeing distance" region.

  Foreground lighting is fairly uniform.

- **U.S. Patterns**

  1000 to 2000 cd found above H-H for U.S. low beams. (The 2 to 3 times higher values for the U.S. beams give much better overhead sign illumination.)

  U.S. beams do not utilize sharp cut-offs, therefore it is harder to control large intensity gradients between the roadway illuminating points (lower quadrants) and the oncoming driver glare points (upper quadrants).

  U.S. beams must meet a 15 000 cd minimum.

  U.S. low beams usually are less uniform, partly indicative of the two strong hot spots (one from each of the two lamps) projected about 60 to 70 ft down the road.

  A lighting demonstration held in Anderson, Indiana in the Fall of 1989, though not conclusive, indicated positive and negative features for both ECE and U.S. beam patterns. A combination of the best features from each was certain to produce a visual improvement.

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