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PROPOSAL FOR INCLUSION OF HIGH-INTENSITY DISCHARDE (HID) HEADLAMPS IN REGULATION No. 113

A. BACKGROUND

Uniform provisions for the ECE approval of asymmetrical gas-discharge headlamps are contained in Regulation No. 98, gas-discharge headlamps, and Regulation No. 99, gas-discharge light sources. Installation of headlamps with gas-discharge light sources on four-wheeled vehicles has been accepted by Regulation No. 48 since 1998, and their diffusion in the market has been accelerating.

In 1998 the cost of HID headlamps was prohibitive for motorcycles, but with the expansion of the technology on other vehicles, mass production has lowered the costs and made HID commercially feasible. Consequently, there are now models on the market equipped with this technology.

The use of HID headlamps on motorcycles increases effective night-time vision, for a constant generator output, or gives the same illumination for a smaller electrical supply. This provides a great potential for developing new lighting systems with greater and more reliable performance throughout the motorcycle range. IMMA members consider this to be an essential option for improving motorcycle safety in the future, particularly as more and more other types of vehicle are being equipped with HID lamps.

Within the ECE Regulations the fitting of such lamps is currently covered by paragraph 5.18. of Regulation No. 53, which states, "Lighting and light-signalling devices type-approved for four-wheeled vehicles of categories M_1 and N_1 and referred to in paragraphs 5.14. and 5.15. above may also be fitted to motorcycles." However, this only applies to asymmetrical headlamp beams.

IMMA therefore believes that Regulation No. 113 should be amended to include a specification for a symmetrical HID headlamp beam, so that the advantages of this kind of beam pattern can be pursued. Consequential amendments to Regulation No. 53 would also have to be introduced.

Ever since HID headlamps have been discussed, questions related to safety, glare and other issues have been raised. IMMA's view on these general questions is set out in Annex 1 to this proposal. The JARI report on glare form motorcycles is contained in Annex 2. The consequential amendment to Regulation No. 53 is contained in Annex 3.

B. PROPOSAL

The proposal outlined below covers the technical specification of the new beam pattern. It is based on Regulation No. 98 and the Regulation No. 113 beam pattern for symmetrical beams. The full amendment document will be developed once the technical specification has been approved.

IMMA proposal for adding a beam pattern for a high-intensity discharge lamp to Regulation No. 113

For Class E (Gas-discharge headlamp for motorcycles)

Test point/ line/ zone	Position in B-β Grid in angular degrees		Required illumination in Lux at 25 m	
	Vertical β **/	Horizontal β **/	Minimum	Maximum
1	0.86 D	3.5 R	4	20
2	0.86 D	0	8	-
3	0.86 D	3.5 L	4	20
4	0.50 U	1.50 L and 1.50 R	-	1.08
6	2.00 D	15 L and 15 R	2	-
7	4.00 D	20 L and 20 R	1	-
8	0	0	-	1.92
Line 11	2.00 D	9 L to 9 R	3	-
Line 12	7.00 U	10 L to 10 R	-	1.08
Line 13	10.00 U	10 L to 10 R	-	1.08
Line 14	10 U to 90 U	0	-	1.08
15 */	4.00 U	8.0 L	0.1 */	1.08
16 */	4.00 U	0	0.1 */	1.08
17 */	4.00 U	8.0 R	0.1 */	1.08
18 */	2.00 U	4.0 L	0.2 */	1.08
19 */	2.00 U	0	0.2 */	1.08
20 */	2.00 U	4.0 R	0.2 */	1.08
21 */	0	8.0 L and 8.0 R	0.1 */	-
22 */	0	4.0 L and 4.0 R	0.2 */	1.08
Zone 1	1U/8L-4U/8L-4U/8R-1U/8R-0/4R-0/1R-0.6U/0-0/1L-0/4L-1U/8L		-	1.08
Zone 2	>4U to <10 U	10 L to 10 R	-	1.08
Zone 3	10 U to 90 U	10 L to 10 R	-	1.08

Notes:

"D" means under the H-H line. "U" means above the H-H line.

"R" means right of the V-V line. "L" means left of the V-V line.

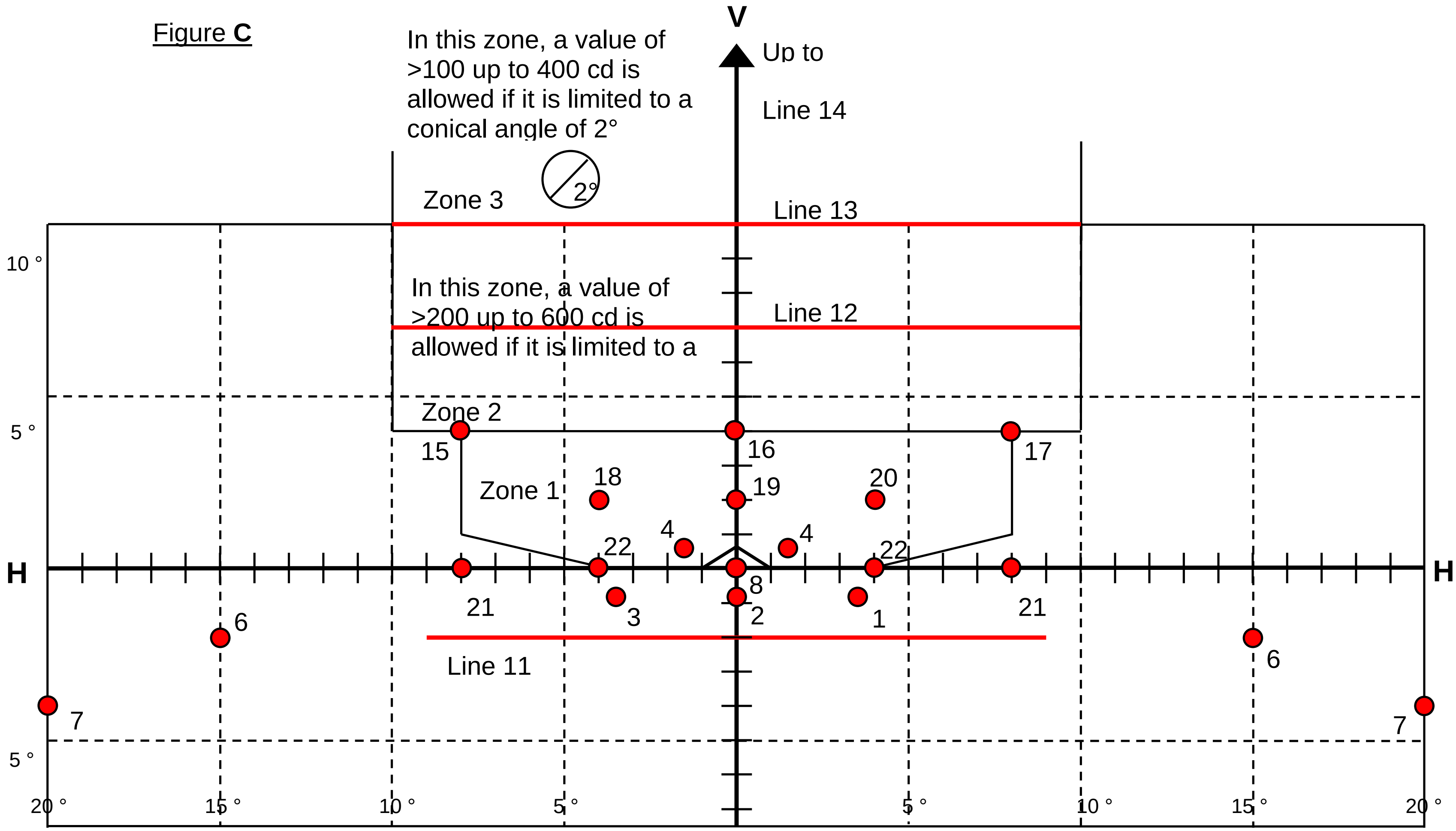
*/ During measurement of these points, the front position lamp approved to Regulation No. 50; if combined, grouped, or reciprocally incorporated-shall be switched on.

**/ a 0.25° photometry tolerance is allowed independently at each test point, unless indicated otherwise.

IMMA proposal for adding a beam pattern for a High-intensity discharge lamp to Regulation No. 113

Passing beam measuring screen for **Class E** headlamps (Dimensions in mm with the screen at 25 m distance)

Figure **C**



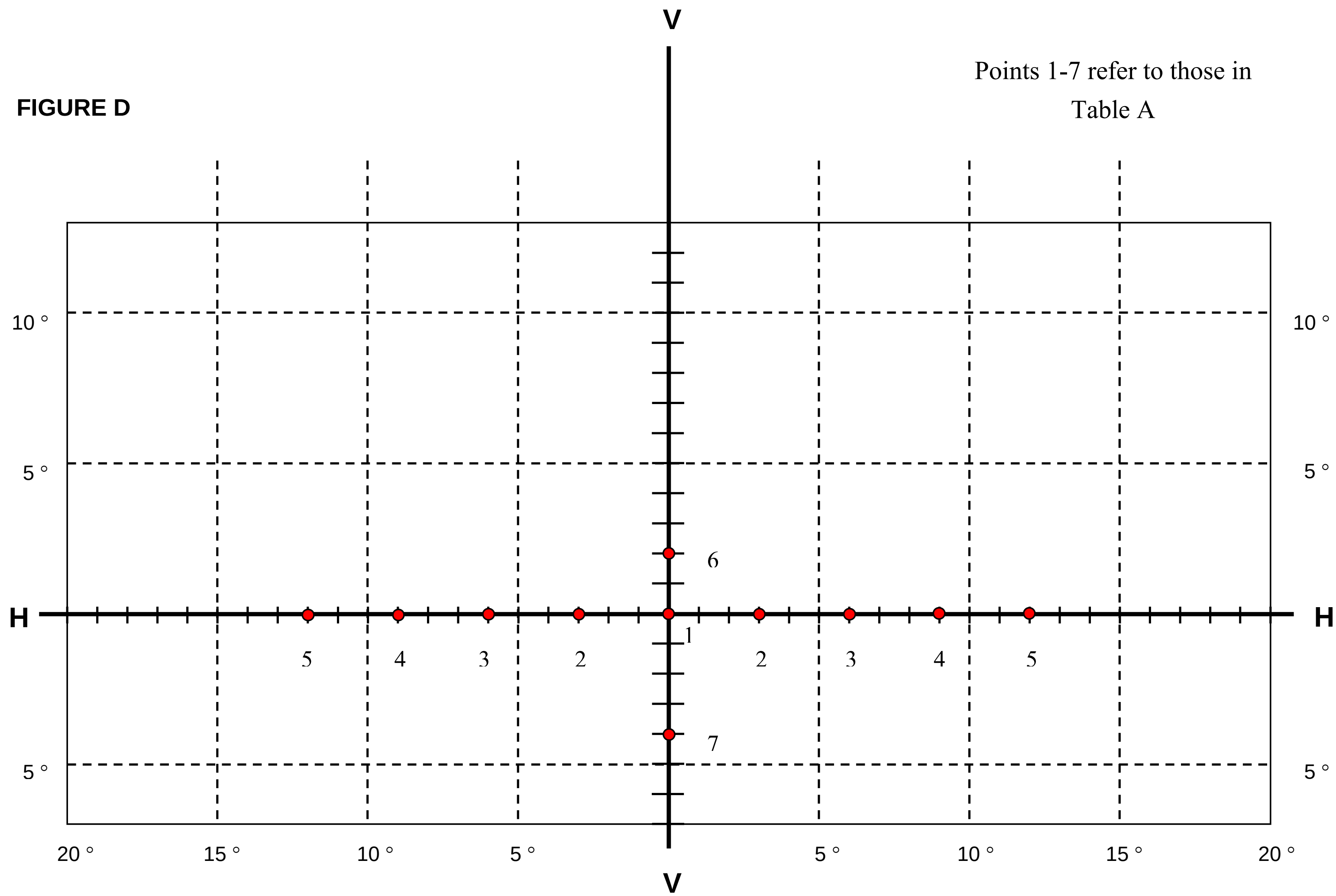
Note: The luminous intensity of zones 2 and 3 above are not applied to class E.

Regulation No. 113   Main beam

Primary main (high) beam proposal

FIGURE D

Points 1-7 refer to those in Table A



Secondary main (high) beam proposal

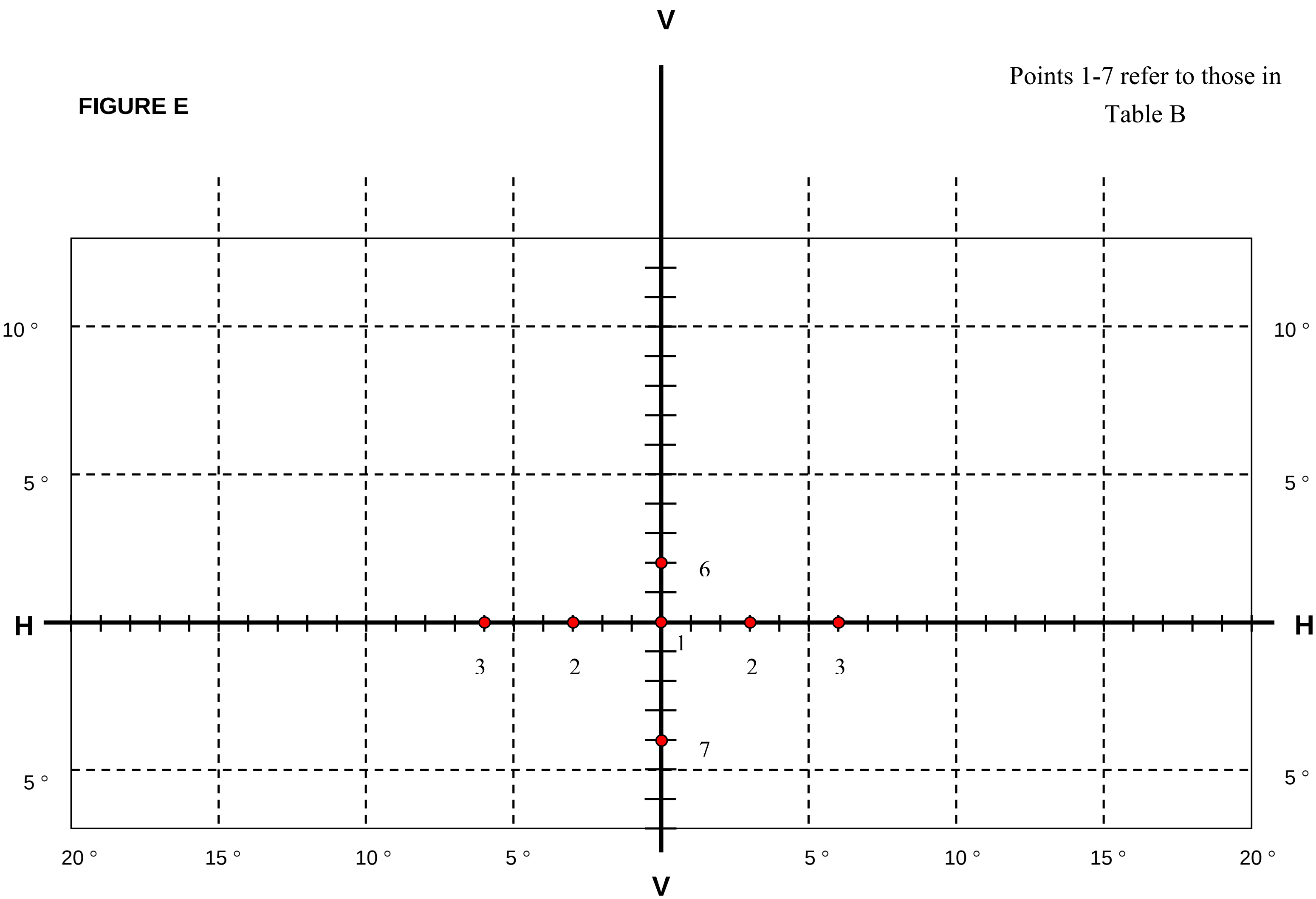


Table C - Primary high beam headlamp for Gas-discharge Headlamp

Refer to Figure D for details of test point positions

Test point number	Test point location	Required illumination in lux	
		MIN.	MAX.
1	H-V (1)	(1)	---
2	H-3R and 3L	30	---
3	H-6R and 6L	10	---
4	H-9R and 9L	6	---
5	H-12R and 12L	2	---
6	2U-V	3	---
7	4D-V	---	(2)
	MIN luminous intensity of the maximum	70	---
	MAX luminous intensity	---	180

(1) The intensity at H-V shall be equal to or greater than 80 per cent of the maximum intensity in the beam pattern.
(2) The intensity at 4D-V shall be equal to or less than 30 per cent of the maximum intensity in the beam pattern.

Table D - Secondary high beam headlamp operated with a harmonized passing beam headlamp or a primary driving beam headlamp or gas-discharge headlamp

Refer to Figure E for details of test point positions

Test point number	Test point location	Required illumination in lux	
		MIN.	MAX.
1	H-V (1)	(1)	---
2	H-3R and 3L	30	---
3	H-6R and 6L	10	---
6	2U-V	3	---
7	4D-V	---	(2)
	MIN luminous intensity of the maximum	70	---
	MAX luminous intensity	---	180

(1) The intensity at H-V shall be equal to or greater than 80 per cent of the maximum intensity in the beam pattern.
(2) The intensity at 4D-V shall be equal to or less than 30 per cent of the maximum intensity in the beam pattern.

Annex 1: Issues related to HID headlamps

1. General

Ever since HID has been a possibility, various issues related to glare have been discussed. Informal discussions with administration delegates created a list of ideas for how these problems might be solved in relation to HID on motorcycles. This Annex summarises IMMA's views on the issues raised.

2. Disability glare

Mr. Flannagan (April 2003) defines disability glare as "glare which diminishes a person's objective ability to see". For this reason it is a phenomenon which can cause dangers to drivers, as opposed to "discomfort glare" which is currently considered irritating but not dangerous.

On these two points, in the same paper, Mr. Flannagan concluded that "small, high intensity discharge lamps, do not seem to cause any problems with disability glare"; and that "there is no formal evidence linking discomfort glare to objective driving performance".

Nevertheless, IMMA's Member for Japan, JAMA, has carried out research with JARI into the specific situations in which motorcycles might produce glare. The full report is attached as Annex 2.

The situations included in the research were:

- Posture change due to changes in the number of occupants, amount of load
- Posture change during a turn and cornering
- Passing an oncoming vehicle
- Motorcycle posture change during straight acceleration
- Pitching on a road surface with irregularities
- Change in the direction of oncoming driver's gaze on an uphill slope
- When overtaking a vehicle
- When following a vehicle
- Stopping behind a vehicle (intersection, traffic signal, congestion, etc.)

The main conclusions were:

1. When a motorcycle carries a passenger or an equivalent load, the cut-off rises above the horizontal and creates glare potential. For this situation a headlamp levelling device is necessary.
2. The results indicated no need for evaluating glare ascribable to the unique posture characteristics of motorcycles. Accordingly, glare from motorcycle headlamps can be evaluated for the same traffic situations as for four-wheeled vehicles.
3. While banking is unique to motorcycles, the amount of light that reaches the oncoming driver's eyes during turning and cornering is extremely limited - incomparably less than the light during acceleration, pitching on a irregular road, and change in the oncoming driver's visual direction on a slope. Glare from a motorcycle in changing situations such as cornering in a curve and making a turn at an intersection was found to be insignificant.
4. The possible glare for a four-wheeled vehicle driver from the motorcycle headlamp was examined for the traffic situations where a motorcycle was passing an oncoming vehicle, a motorcycle was over-taking the preceding four-wheeled vehicle, where a motorcycle was following a four-wheeled vehicle, and where a motorcycle was stopping or slowly following at an intersection or in a congested traffic. In all these situations, all the test headlamps indicated that the glare was within a permissible range.

3. Is an Regulation No. 98 lamp too powerful for motorcycles or should a less powerful beam be used?

As motor vehicles and motorcycles both use the same roads, it is not necessary to make the lighting of motorcycles less or more powerful than those fitted to cars. As long as there is no glare problem, it is better to have a wider and brighter light distribution. It is not necessary to lessen the intensity of the motorcycle headlamp beam.

4. Is a specific headlamp aiming procedure necessary?

The JARI research shows that aiming is only a problem in laden conditions and that for these conditions, performance criteria for an allowable change in attitude should be defined along with the methodology to be used to measure the performance.

A manual adjustment, without special tools, which can be performed from the riding position should be an option, but other technologies must be allowed that would not require such a system (such as an automatic system instead of a manual system).

5. Is there a need for a lower aim or a softer cut-off to reduce on-road annoyance from small road irregularities?

As the JARI report shows, the effect of road irregularities is not a problem that is unique to motorcycles. A lower aim or a softer cut-off will lead to a deterioration in distance vision, a decrease in the effectiveness of headlamps and a reduction in safety.

6. HID compared to halogen lamps during cornering

The JARI experiments found that the oncoming driver's eye-point remained above the cut-off line throughout cornering, so that no glare problem is generated, whether the lamp is HID or halogen.

7. Dirt

A cleaning device is not necessary or practical for the following reasons:

1) Both halogen and HID are subject to the same amount of glare increase by dirt on the headlamp (see: Benno Spinger, "Aspects of HID headlamps for motorcycles", fiftth International. Motorradconferenz 2004, IfZ Essen; Germany)
2) There is a smaller probability of motorcycle operation in rainy or snowy weather, thus reducing the probability of smearing the motorcycle headlamps with dirt.
3) Unlike the motor vehicle driver, the rider is always exposed and outside the motorcycle. The use of a washer could seriously impair a rider's vision, if the solution reaches the helmet visor or motorcycle fairing. More importantly, if the washer solution gets in the rider's eyes, a serious accident may occur.

8. Number of HID lamps

As the glare from a pair of HID is equivalent, whether the are mounted on a motorcycle or a car, it is not necessary to limit the number of HID lamps to one. The same issue was dealt with when the latest beam patterns were added to Regulation No. 113.

9. Should there be a phased introduction of the "full strength" HID?

Since motor vehicles and motorcycles use the same road, it is not necessary to limit "the strength" of motorcycle headlamps. A phased introduction of HID on motorcycles would have little or no impact, given the rapid increase in HID on cars. Unlike motor vehicle HID, the number of motorcycle HID is likely to be much smaller in the market. Also, it is unlikely that HID will be fitted on many motorcycle models in a short time. It is therefore not necessary to introduce motorcycle HID in phases.

Annex 2: Study on the glare from motorcycle headlamps

(Carried out by JARI on behalf of IMMA's member JAMA)

1. Introduction

In the recent years, high intensity discharge headlamps (HID) have come into use on four-wheeled vehicles. HID headlamps are characterized by a more powerful beam- roughly two times more luminous flux- than the halogen headlamps. However, if introduced on motorcycles, HID headlamps may increase glare for oncoming drivers because of the uniqueness of a motorcycle's posture under various riding conditions.

The present study was designed to achieve three objectives:
1) Examine the influence of load on motorcycle posture change;
2) Examine methods for evaluating motorcycle headlamp glare in relation to unique motorcycle posture change;
3) Examine motorcycle glare in different traffic situations.

The present study was carried out against the background of the following research questions:

(1) Measurement of motorcycle posture change according to load
Motorcycle posture change under a load(s), such as when carrying a rider and a passenger, was measured for those categories of motorcycles considered likelier to adopt an HID headlamp.

(2) Examination of methods for evaluating motorcycle headlamp glare
As compared with the four-wheeled vehicle, the motorcycle is subject to a greater variation of headlamp aim due to body banking and handle operation. This makes it possible that the motorcycle may cause glare to the oncoming drivers in situations such as cornering in a curve and turning at an intersection.

Accordingly, to evaluate the glare relating to the characteristic posture variation of a motorcycle, the eye-point of the oncoming driver was measured in relation to the aim of the motorcycle headlamp. Based on the measured results, attempts were made to determine if a glare evaluation method special to motorcycles would be necessary.

(3) Evaluation of the glare of motorcycle headlamps
The possibility of the motorcycle headlamp giving discomfort glare to the oncoming drivers of motor vehicles was examined in different traffic situations- a motorcycle and an oncoming four-wheeled vehicle passing each other; a following motorcycle overtaking the preceding four-wheeled vehicle; a motorcycle running behind a four-wheeled vehicle; a motorcycle behind a four-wheeled vehicle at an intersection or in a congested traffic.

2. Measurement of motorcycle posture change according to load

2.1. Purpose

The purpose of this research item of the present study was to determine the change in motorcycle posture under different load conditions such as the carriage of a rider and a passenger.

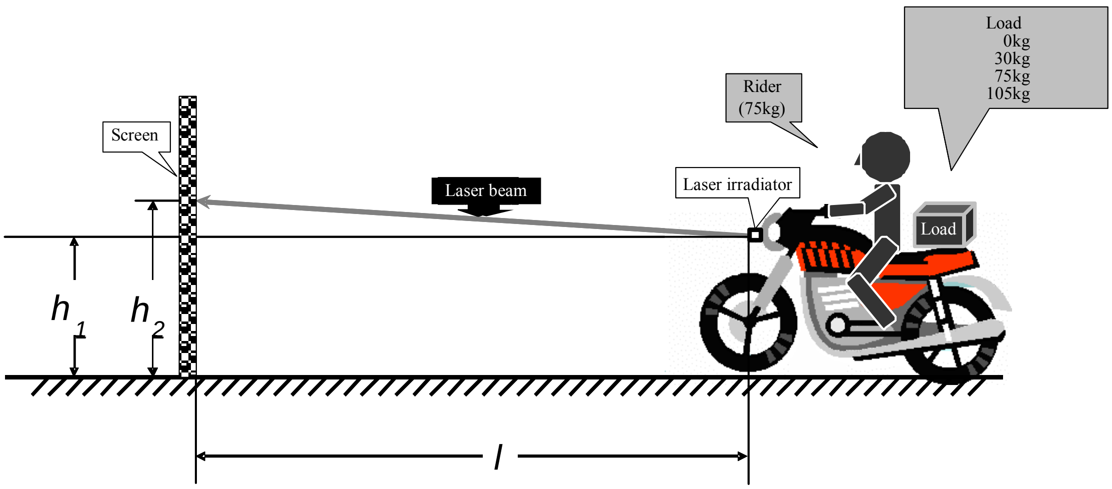
2.2. Method

Motorcycle posture change by a load was determined by measuring a change in the beam irradiation angle of a small laser installed on the test motorcycle (Fig. 2-1).

2.2.1. Test motorcycles

A total of four test motorcycles were selected from the four categories of motorcycles that were considered most likely to be equipped with an HID headlamp. The four categories were touring, sports, cruiser ("American"), and scooter. The major specifications of the test motorcycles were as follows:

(Category)	(Wheelbase)	(Displacement)	(Maintenance weight)
Touring	1,690 mm	1,832 cc	415 kg
Sports	1,505 mm	1,164 cc	271 kg
Cruiser	1,658 mm	399 cc	257 kg
Scooter	1,575 mm	499 cc	217 kg



$$\frac{h_1 - h_2}{l} \times 100 = \text{Irradiation angle (\%)}$$

Fig. 2-1: Method of measuring motorcycle posture change by loads

2.2.2. Loading Conditions

The following motorcycle loading conditions were tested with respect to the loads on the front and back seats:

	Front seat	Back seat
(1) 1 rider	Rider (75kg)	No load
(2) 1 rider + goods (30kg)	Rider (75kg)	Load (30kg)
(3) 1 rider +1 passenger	Rider (75kg)	Load (75kg)
(4) 1 rider +1 passenger + goods (30kg)	Rider (75kg)	Load (105kg)

2.2.3. Measurement Procedure

(1) Before measurement, the rider weighing 75 kg, including his riding gear, made a preliminary 5 km run.

(2) After the run, the test motorcycle was stopped and held vertical by a pair of vehicle holding jigs in a test room.

(3) With the rider on his seat, a load equivalent to a passenger or goods was placed on the centre of the back seat(Fig. 2-2).

(4) After stabilization of the motorcycle posture, the small laser installed near the headlamp was turned on, and the position of the laser and the coordinates of the laser beam projected on a screen were measured by a three-dimensional measurement instrument.
(5) In each loading condition, an inclination of motorcycle posture was calculated from the readings on the above coordinates, and the amount of posture variation was determined in comparison with the control posture of the motorcycle carrying a rider and no additional load.
(6) For each loading condition, the same procedure was used, i.e. a single preliminary run and posture measurement, and repeated twice more, giving a total of three measurements for each loading condition.

(Rider only) (Rider + Load equivalent to passenger)

Fig. 2-2: Loading conditions

2.3. Results

The average value of the three measurements in each loading condition was taken as the result. Figure 2-3 shows the variations of the headlamp cutoff line under the four loading conditions, where the headlamp was adjusted to the normal aiming (i.e. the cutoff line of the headlamp passing beam located 0.57 degree below the horizontal) when the test motorcycle was carrying one rider and no additional load.

The results indicate that each of the four motorcycle categories had its cutoff line 0.2-0.6 degree below the horizontal when the back seat load was 0 kg or 30 kg. However, when the back seat load was 75 kg or 105 kg (i.e. with a passenger or heavier), the cutoff line climbed above the horizontal. Accordingly, it is desirable to have a leveling system activated to adjust the headlamp's cutoff line position to below the horizontal, if the motorcycle is under a load equal to or more than a passenger (75 kg or more) on the back seat.

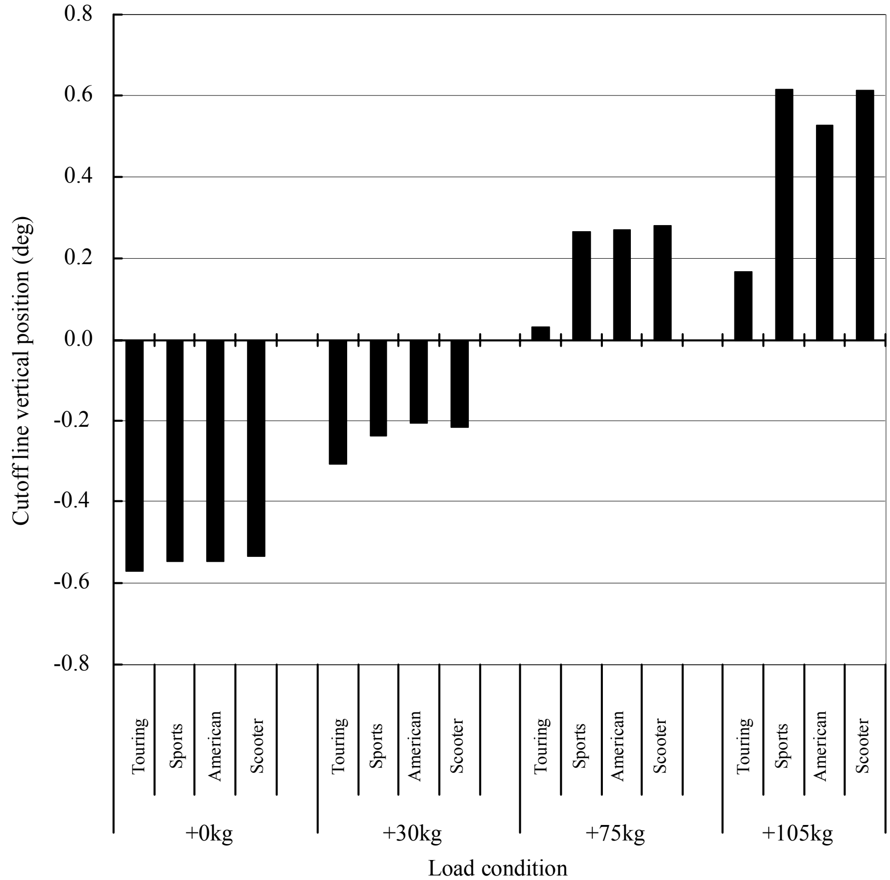


Fig. 2-3: Passing beam cutoff line vertical position vs. load condition

3. Examination of methods for evaluating motorcycle headlamp glare

3.1. Purpose

Compared to four-wheeled vehicles, motorcycles are subject to greater variations in the headlamp beam orientation due to chassis inclination and handling in operation. Consequently, motorcycles can cause discomfort glare for oncoming drivers, in situations such as cornering in a curve and making a turn at an intersection.

In the present study, attempts were made to investigate the direction of the oncoming driver's eye-point in relation to the aim of the motorcycle headlamp in order to examine the glare due to banking and other changes in motorcycle posture. Based on the investigation results, consideration was given to whether or not a glare evaluation method designed specifically for motorcycles was necessary, or whether standard methods of assessment would be adequate.

3.2. Investigation Method

3.2.1. Test Vehicle and CCD Camera

A medium-class motorcycle of 400 cc was employed as a test vehicle (Fig. 3-1). Two CCD cameras were attached to the headlamp of the motorcycle. The CCD cameras were both positioned 850 mm from the ground, i.e. at the height of the headlamp bulb.

The field angles of each CCD camera were 20 degrees horizontal and 15 degrees vertical. By arranging the two CCD cameras horizontally, their combined field angle stood at 40 degrees H and 15 degrees V. Consequently the picture taken by the CCD cameras extended from 7.5U to 7.5D vertically and from 20L to 20R horizontally in the headlamp's illumination range.

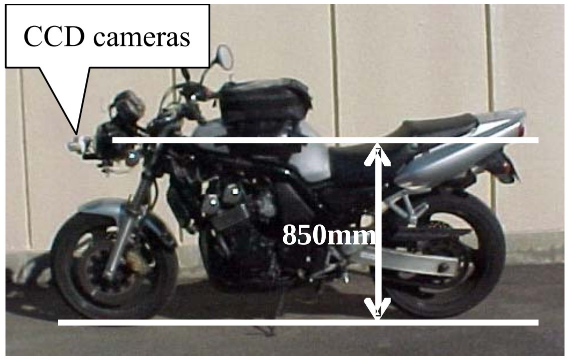


Fig. 3-1: Test motorcycle and CCD cameras

3.2.2. Running Distance and Course

The test motorcycle was run approximately 500 km on general surface roads. These roads were national roads (mainly National Road 1 in Kanagawa and Shizuoka prefectures), local roads (Prefecture roads around the City of Tsukuba), small roads (in mountainous areas around Hakone and Mt. Fuji), and urban streets (in and around the City of Tsukuba).

3.2.3. Method of Analysis

The images taken by the CCD camera during the 500 km trip were transferred into a personal computer, with which image analysis was performed to determine the direction of the oncoming driver's eye-point in relation to the headlamp beam distribution pattern.

For stretches of road not interrupted by an intersection, the position of the oncoming driver's eye-point was determined according to the head-to-head distance between the oncoming vehicle and the test motorcycle (i.e. 100 m, 50 m and 30 m). At intersections, where the test motorcycle made a left or right turn, the head-to-head distance was often shorter than 30 m. Therefore, the eye-point at intersections was measured at three points; immediately after the oncoming driver entered the CCD camera image, immediately before the oncoming driver exited from the image, and at roughly the midpoint between these two limits. Figure 3-2 shows an example of the CCD camera images taken for analysis for a cornering situation.

(Running straight) (Turning left) (Turning right)

Fig. 3-2: Examples of CCD camera images analyzed

3.3. Results

3.3.1. Glare-Causing Conditions

Conditions under which the headlamp of a motorcycle cause glare for the oncoming drivers were investigated. The passing beams of headlamps of motorcycles sold in Japan generally have a horizontal light distribution pattern with a straight cutoff line, and their aim is set usually 0.57 degree below the cutoff line (0.57 D) so as to prevent them from creating glare for the oncoming drivers. Accordingly, the present study adopted the assumption that the oncoming driver encounters glare when his eye-point comes below the 0.57 D cutoff line of the motorcycle headlamp.

There are two general groups of conditions which create glare for oncoming drivers:

1. motorcycle-related conditions such as cornering and handle operation
2. road-related conditions such as uphill inclination and bumpy surfaces

Attempts were made to distinguish motorcycle-related conditions from road-related conditions. Only the CCD camera images where the oncoming driver's eye-point was below 0.57 D were used for the measurement of the duration of exposure to glare.

3.3.2. Results

A total of 2,657 oncoming vehicles were recorded by the CCD cameras installed on the test motor vehicle. A situation in which the oncoming driver's eye-point was below 0.57 D was found in 194 cases or 7.3 % of the recorded total. Of these 194 cases, 166 cases (6.2 % of the total recorded cases) were analyzed as being due to road-related conditions while the remaining 28 cases (1.1 % of the total) were considered attributable to posture changes unique to motorcycle (Fig. 3-3).

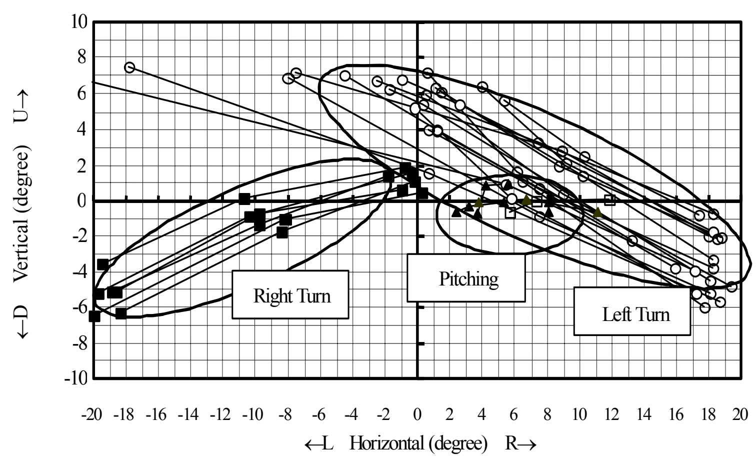


Fig. 3-3: Distribution of oncoming driver's eye-point below the motorcycle headlamp cutoff line according to motorcycle posture (28 cases)

Of the 28 cases, two indicated a horizontal position of the eye-point between 0.5 L to 0.5 R which was considered to create a situation of relatively intense glare. However, the duration for which the two cases recorded the eye-point as being between 0.5 L to 0.5 R horizontal and below 0.57 D vertical, was only 0.1 to 0.3 second. Both cases were found to have been caused by the motorcycle's pitching motions during acceleration (Fig. 3-4).

The remaining 26 of the 28 cases were associated with motorcycle posture changes during turning at an intersection. In these cases, when the eye-point dropped below 0.57 D, its horizontal position was measured as being between 20 L and 10 L or between 10 R and 20 R. Since this horizontal position was substantially away from the centre of the headlamp's light distribution, it was considered improbable that the oncoming driver experienced glare from the motorcycle turning at the intersection.

The glare duration was no more than 0.5 second in all 28 cases but one. The exceptional case, with a duration of 0.7-0.8 seconds, indicated that the glare had been caused by the combination of motorcycle pitching during acceleration and the uphill slope of the road.

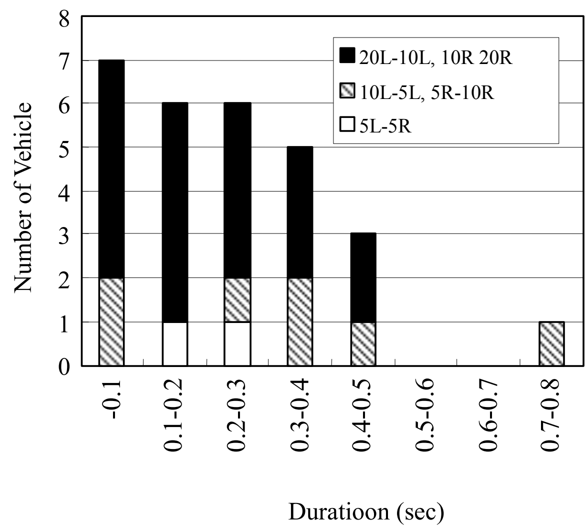


Fig. 3-4: Duration of oncoming driver's eye-point being below the motorcycle headlamp cutoff line according to motorcycle posture (28 cases)

3.3.3. Method for evaluating the glare of motorcycle headlamps

The results of the above investigation using CCD cameras indicated that there were two possible glare factors attributable to motorcycles:

1) chassis pitching during acceleration
2) banking during turning at an intersection.

However, only two cases recorded glare ascribable to pitching, which amounted to only 0.08 % of the total number of oncoming vehicles recorded by the CCD cameras. Moreover, the eye-point in the two cases came below the cutoff line for only 0.1 to 0.3 seconds. It is therefore reasonable to state that the two cases did not pose any serious glare problems.

In the cases where the motorcycle made a left turn at an intersection, the angle between the aim of the motorcycle headlamp and the direction of the oncoming driver's eye-point was large. This suggested relatively moderate nature of glare problems in the case of motorcycles making a left turn. (The larger the angle between the direction of gaze and the direction of the light source, the less intense the glare becomes even if the luminance at the eye-point remains constant.)

In the cases where the motorcycle made a right turn, the oncoming driver's eye-point might have come below the cutoff line vertically but was horizontally located far from the center of light distribution. Consequently, the glare was considered moderate when the motorcycle is making a right turn. The inclination of the motorcycle headlamp's cutoff line was below 15 degrees during a right turn, or roughly equal to or below the inclination or a four-wheeled vehicle's headlamp during

a right turn. Therefore, motorcycles created no more glare than four-wheeled vehicles when making a right turn.
For these reasons, it was apparent that the glare from motorcycle headlamps could be evaluated in the same way as glare from four-wheeled vehicle headlamps in different traffic situations.

4. Evaluation of glare in passing situations

4.1. Purpose

The results in paragraph 3. above indicated that there was no need to consider special glare evaluation methods for addressing the motorcycle's unique posture variation such as cornering in a curve and making a turn at an intersection. This paragraph, therefore, focuses on discomfort glare in the situations where a motorcycle is passing an oncoming vehicle, is overtaking a four-wheeled vehicle, is following a four-wheeled vehicle, or is stopping behind or slowly following a four-wheeled vehicle at an intersection or in a congested traffic.

4.2. Method

4.2.1. Types of motorcycle headlamps

The following four types of motorcycle headlamps were employed for glare evaluation:

(1) Symmetrical light distribution (horizontal pattern)

- Prototype HID: An HID motorcycle headlamp conforming to the light distribution requirements for motorcycle (125cc or more) halogen headlamps of Regulation No. 113 Class D.
- Prototype halogen: A halogen motorcycle headlamp conforming to the light distribution requirements prescribed in Regulation No. 113 Class D.
- SAE halogen: A halogen motorcycle headlamp currently in use in Japan and the U.S.

(2) Asymmetrical light distribution (Left rise pattern)

- Regulation No. 98 HID: A HID four-wheeled vehicle headlamp complying to Regulation No. 98 (for left-hand traffic use).

4.2.2. Headlamp height and separation

The headlamp (bulb) of the test motorcycle was installed 850 mm from the ground. The headlamps (bulbs) of the test car were 600 mm from the ground and 1,000 mm apart, bulb to bulb.

4.2.3. Headlamp aiming

The prototype HID and halogen headlamps were each aimed according to the designation of the lamp manufacturer who made them. The other two headlamps were aimed so that their horizontal cutoff line fell on 0.57 D by visual aiming. For the Regulation No. 98 HID and for four-wheeled vehicle headlamps that had a kink, horizontal aiming was done so that the kink moved to the front of the headlamp.

4.2.4. Headlamp test voltage

The halogen headlamps were supplied with a 12.8 V voltage, using a constant-voltage supply device. The HID headlamps were supplied with a constant voltage by their ballasts.

4.2.5. Observation car

An ordinary sedan car was employed as an observation vehicle, equipped with halogen headlamps. Its side mirrors had no anti-glare function, but its inside rear-view mirror had an anti-glare function (in this test the inside mirror was set to the anti-glare function).

4.2.6. Test course layout

The test road had a single lane 3.5 m wide on each side, and the test motorcycle and the observation car were positioned at the center of their respective lanes.

4.2.7. Glare evaluation scale

The widely used De Boer's 9-point scale was used for the discomfort glare evaluation (Fig. 4-1).

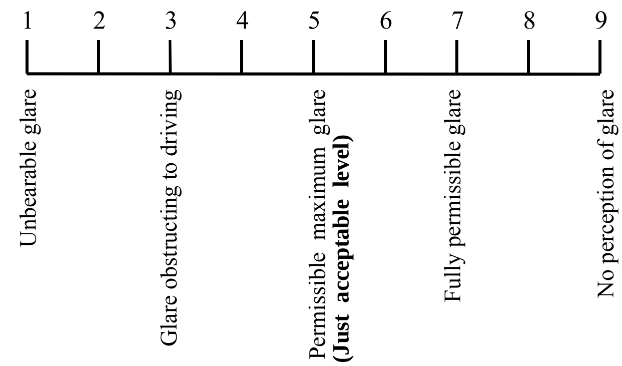


Fig. 4-1: Glare evaluation scale (De Boer's 9-point)

4.2.8. Method for evaluating glare

Glare from the headlamp may become a problem in the passing situation where headlamp light is received straight from the oncoming vehicle and also in the situation where headlamp light is received from the following vehicle via mirrors. Accordingly, the direct and indirect glare for a car driver from the headlamp of a motorcycle was examined in the following four types of traffic situations:

(1) A motorcycle and an oncoming car passing each other

The subject started the observation car from a point 200 m away from the stationary motorcycle, and evaluated the glare from the motorcycle while moving in the observation range demarcated between 100 m and 30 m from the motorcycle. The subject was instructed to evaluate the glare without gazing at the headlamp of the oncoming motorcycle as in real driving on a straight road.

(2) A motorcycle taking over a car in adjacent lane

The subject in the stationary observation car evaluated the glare from the following motorcycle from 100 m to 0 m, as it approached in the adjacent passing lane at an approach speed of 10 km/h. The subject was instructed to evaluate the glare while looking ahead without gazing at the rear-view mirrors.

(3) A motorcycle approaching the preceding car in the same lane

The subject in the stationary observation car evaluated the glare from the following motorcycle from 50 m to 5 m, as it approached at a speed of 5 km/h in the same lane. The subject was instructed to evaluate the glare while looking ahead without gazing at the rear-view mirrors.

(4) A motorcycle stopping behind a stationary car at intersection
The subject in the observation car evaluated the glare from the following motorcycle in a situation where a motorcycle stopped 3 m in behind the stationary car or followed slowly 3 m behind the car. The subject was instructed to evaluate the glare while looking ahead without gazing at the rear-view mirrors.

4.2.9. Subjects
A total of 12 male subjects who had an ordinary driving license were employed. They ranged from 26 to 50 in age and measured 0.7 or higher in corrected visual acuity.

4.3. Results
The median value of the 12 subjects' De Boer's 9-point glare evaluations was obtained for five types of headlamps (4 types of motorcycle headlamps and 1 four-wheeled vehicle headlamp), (see paragraph 4.2.7.).

4.3.1. Glare evaluation where a motorcycle is passing an oncoming four-wheeled vehicle
An evaluation value of 7 was obtained for the five types of headlamps, all implying a permissible glare level (Fig. 4-2). Consequently it is reasonable to consider that the use of HID headlamps in motorcycles will not bring any glare problems in situations where a motorcycle and four-wheeled vehicle pass each other in a straight road.

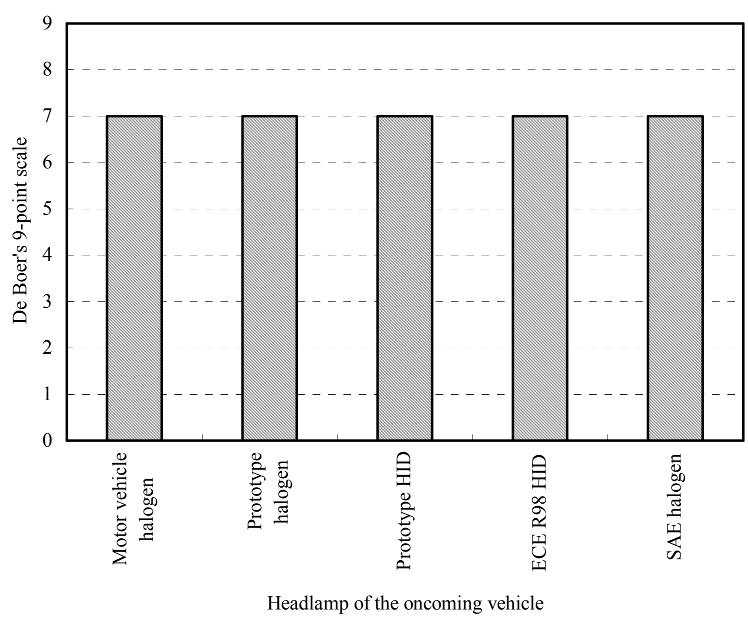


Fig. 4-2: Evaluation where a motorcycle is passing an oncoming four-wheeled vehicle

4.3.2. Glare evaluation where a motorcycle is overtaking a four-wheeled vehicle in the adjacent lane

The Regulation No. 98 HID motorcycle headlamp scored 6, and the remaining three motorcycle headlamps scored 8 (Fig. 4-3). Thus, all the headlamps came within the permissible glare range. It is reasonable to consider that motorcycle headlamps do not pose any glare problems in situations where a motorcycle is overtaking a four-wheeled vehicle in a straight road.

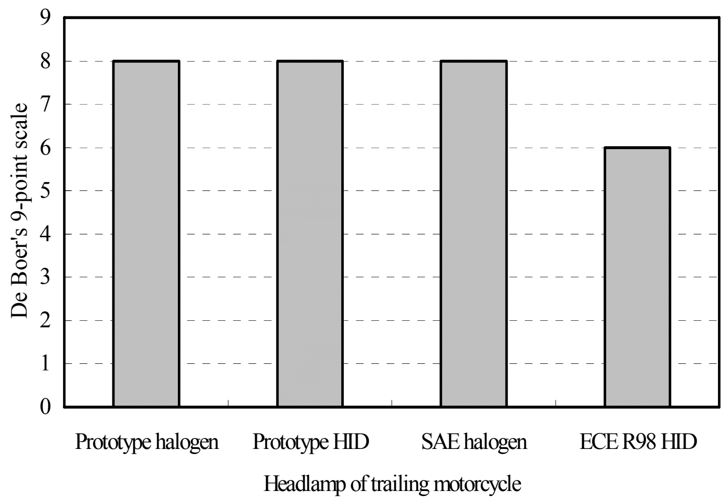


Fig. 4-3: Evaluation where a motorcycle is overtaking a four-wheeled vehicle

4.3.3. Glare evaluation where a following motorcycle is approaching a four-wheeled vehicle in the same lane

The Regulation No. 98 HID motorcycle headlamp scored 7, and the remaining three motorcycle headlamps scored 8 (Fig. 4-4). All the headlamps came within the permissible glare range. It is reasonable to consider that motorcycle headlamps do not pose any glare problems in situations where a following motorcycle is approaching a four-wheeled vehicle in the same lane.

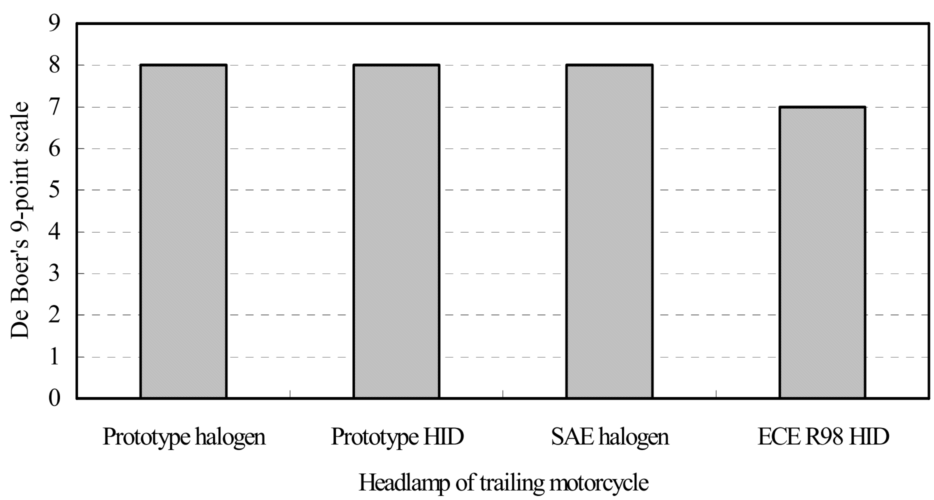


Fig. 4-4: Evaluation where a following motorcycle is approaching a four-wheeled vehicle in the same lane

4.3.4. Glare evaluation where a motorcycle is behind a four-wheeled vehicle at an intersection or in congested traffic

All the four types of motorcycle headlamps scored a permissible glare evaluation even though their headlamp height was raised from 800 mm to 1,000 mm above the ground (Fig. 4-5). Accordingly, it is reasonable to consider that motorcycle headlamps do not pose any glare problems in situations where a motorcycle stops behind a four-wheeled vehicle at an intersection or a motorcycle is slowly following a four-wheeled vehicle in a congested traffic.

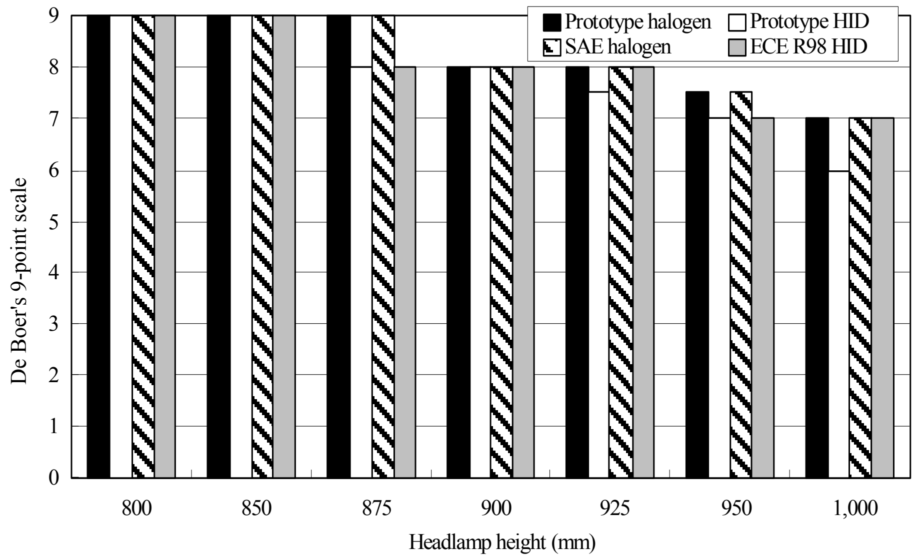


Fig. 4-5: Evaluation where a motorcycle is behind a four-wheeled vehicle at intersection or in congested traffic

5. Conclusions

5.1. Motorcycle posture change by loads

The cutoff line of the passing beam remained below the horizontal by 0.2 to 0.6 degrees when the load on the back seat was no more than 30 kg. But when the load on the back seat was 75 kg (equivalent to a passenger) or more, the cutoff climbed above the horizontal. This indicated that it was desirable to have a leveling system that keeps the cutoff line below the horizon.

5.2. Method of evaluating motorcycle headlamp glare

The results indicated no need for evaluating glare ascribable to the unique posture characteristics of motorcycles. Accordingly, glare from motorcycle headlamps can be evaluated for the same traffic situations as for four-wheeled vehicles- a motorcycle and an oncoming four-wheeled vehicle passing each other on a straight road; a motorcycle over-taking a four-wheeled vehicle; a motorcycle stopping or slowly following behind a four-wheeled vehicle at an intersection or in a congested traffic. Glare from a motorcycle in changing situations such as cornering in a curve and making a turn at an intersection was found to be insignificant.

5.3. Glare in passing situations

The possible glare for a four-wheeled vehicle driver from the motorcycle headlamp was examined for the traffic situations where a motorcycle was passing an oncoming vehicle, where a motorcycle was over-taking the preceding four-wheeled vehicle, where a motorcycle was following a four-wheeled vehicle, and where a motorcycle was stopping or slowly following at an intersection or in a congested traffic.

In all these situations, all the test headlamps indicated that the glare was within a permissible range.

<u>Annex 3</u>: Proposal of amendment to Regulation No. 53 for HID headlamp

Para.	Current Requirements	Proposal
6.1.	**DRIVING BEAM HEADLAMP**	
6.1.1.	Number:	
6.1.1.1.	For motorcycles having a cylinder capacity ≤ 125 cm^3 One or two of approved type according to: - Class B, C or D of Regulation No. 113; - Regulation No. 112; - Regulation No. 1; - Regulation No. 8; - Regulation No. 20; - Regulation No. 57; - Regulation No. 72.	For motorcycles having a cylinder capacity ≤ 125 cm^3 One or two of approved type according to: - Class B, C,D **<u>or E</u>** of Regulation No. 113; - Regulation No. 112; - Regulation No. 1; - Regulation No. 8; - Regulation No. 20; - Regulation No. 57; - Regulation No. 72**;** **<u>- Regulation No. 98.</u>**
6.1.1.2.	For motorcycles having a cylinder capacity > 125 cm^3 One or two of approved type according to: - Class B or D of Regulation No. 113; - Regulation No. 112; - Regulation No. 1; - Regulation No. 8; - Regulation No. 20; - Regulation No. 72. Two of approved type according to: - Class C of Regulation No. 113.	For motorcycles having a cylinder capacity > 125 cm^3 One or two of approved type according to: - Class B, D **<u>or E</u>** of Regulation No. 113; - Regulation No. 112; - Regulation No. 1; - Regulation No. 8; - Regulation No. 20; - Regulation No. 72**;** **<u>- Regulation No. 98.</u>** Two of approved type according to: - Class C of Regulation No. 113.
6.2.	**PASSING BEAM HEADLAMP**	←
6.2.1.	Number:	←
6.2.1.1.	For motorcycles having a cylinder capacity ≤ 125 cm^3 One or two of approved type according to: - Class B, C or D of Regulation No. 113; - Regulation No. 112; - Regulation No. 1; - Regulation No. 8; - Regulation No. 20; - Regulation No. 57; - Regulation No. 72.	For motorcycles having a cylinder capacity ≤ 125 cm^3 One or two of approved type according to: - Class B, C,D **<u>or E</u>** of Regulation No. 113; - Regulation No. 112; - Regulation No. 1; - Regulation No. 8; - Regulation No. 20; - Regulation No. 57; - Regulation No. 72**;** **<u>- Regulation No. 98.</u>**
6.2.1.2.	For motorcycles having a cylinder capacity > 125 cm^3 One or two of approved type according to: - Class B or D of Regulation No. 113;	For motorcycles having a cylinder capacity > 125 cm^3 One or two of approved type according to:

Para.	Current Requirements	Proposal
	- Regulation No. 112; - Regulation No. 1; - Regulation No. 8; - Regulation No. 20; - Regulation No. 72. Two of approved type according to: - Class C of draft Regulation No. 113.	- Class B, D **or E** of Regulation No. 113; - Regulation No. 112; - Regulation No. 1; - Regulation No. 8; - Regulation No. 20; - Regulation No. 72**;** **- Regulation No. 98.** Two of approved type according to: - Class C of draft Regulation No. 113.
6.2.5.	**Orientation**	←
6.2.5.3.		**Headlamp levelling device**
6.2.5.3.1.		**Dipped-beam headlamps with gas-discharge light sources shall be equipped with a device to adjust the vertical inclination defined in paragraph 6.2.5.2., that can be operated by the rider from his seated position.**

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