Analysis of Glare given to oncoming vehicles by Motorcycles DRLs at Night

- Based on Actual State of Motorcycles DRLs -

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National Traffic Safety and Environment Laboratory
* Japan proposed that headlamps of motorcycles equipped with optional daytime running lamps (DRLs) shall automatically be switched ON at night based on “Research on Daytime Running Lamps of Motorcycles (Informal Document No. GRE-75-09)” at the 75th session of GRE.

* The following comments were provided for our research by some experts in the last session.
  - Installation height of motorcycle DRL is high, compared to the actual state.
  - Luminous intensity of motorcycle DRL is high, compared to the actual state.

Reevaluate effects concerning the glare at night caused by Motorcycles DRLs suitable for the actual state by numerical analysis.
A numerical analysis was performed to evaluate effects of motorcycle DRL glare to oncoming vehicle driver, depending on its lighting condition at night. Model formula of Schmidt-Clausen and Bindels (1), which is often used to calculate De Boer rating scale was used for this analysis.

Glare evaluation rating \( W = 5.0 - 2\log\Sigma \left( \frac{E}{(1 + (L_h/C_{pl})^{0.5}) \theta^{0.46} C_{poo}} \right) \) \hspace{1cm} (1)

- \( E \): Illuminance at driver’s eyes (lx)
- \( L_h \): Driver’s adaptation luminance (cd/m\(^2\))
- \( \theta \): Angle between driver’s line of sight and direction of the lamp
- \( C_{pl} \): \( 4.0 \times 10^{-2} \) (cd/m\(^2\))
- \( C_{poo} \): \( 3.0 \times 10^{-3} \) (lx・min\(^{-0.46}\))

If the glare evaluation rating “W” is below 4, it follows that the glare exceeding allowable limit is caused.
* Sky illuminance: 0lx (Night)
* Road luminance: 0.1 cd/m² (equivalent to the road illumination of urban streets with a little traffic)
* Driver’s line of sight: Direction of traveling
* Vehicle positions: See the right figure.
  (assuming that vehicles pass each other on a two-way street)
* Eye-point height of vehicle driver: 1.2m
* Lamps specifications: as the following table

<table>
<thead>
<tr>
<th></th>
<th>DRL</th>
<th>Low Beam</th>
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</thead>
<tbody>
<tr>
<td>Number of lamps</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Interval of lamps</td>
<td>40cm</td>
<td></td>
</tr>
<tr>
<td>Installation height</td>
<td>0.6m to 1.2m</td>
<td>0.87m</td>
</tr>
<tr>
<td>Maximum luminous intensity</td>
<td>600cd or 1,200cd</td>
<td>9800cd</td>
</tr>
<tr>
<td>Light distribution patterns</td>
<td>Based on UN-R87</td>
<td>Based on UN-R113</td>
</tr>
</tbody>
</table>

In this analysis, “Maximum luminous intensity” and “Installation height” of the motorcycle DRL was varied.

The above condition for this numerical analysis was set based on “Research on Daytime Running Lamps of Motorcycles (Informal Document No. GRE-75-09)”. 
When DRLs are on at night, glare exceeding the allowable limit (glare evaluation rating < 4) occurs to the oncoming vehicle driver regardless of the DRL installation height.
Even when the DRL central luminous intensity is 600 cd, glare exceeding the allowable limit (glare evaluation rating < 4) occurs to the oncoming vehicle driver.
Glare exceeding the allowable limit (glare evaluation rating < 4) occurs to the oncoming vehicle driver, even when the motorcycles DRLs is suitable for the actual state.

Motorcycles DRLs need to be securely switched to Low Beam at night.