

STUDY ON EFFECTIVENESS OF AHO AND POSITION LAMPS ON TWO-WHEELED VEHICLE CONSPICUITY

Objective

The objective of this research item was to examine the effectiveness of AHO and the position lamps in improving the conspicuity of two-wheeled vehicles followed by a passenger car with its passing beams on, in the daytime and at dawn/dusk.

Method

Subjects observed the approach of an oncoming motorcycle followed by a passenger car with its passing beams on, and were instructed to indicate the motorcycle's conspicuity.

Test Vehicles - Three motorcycles and a passenger car were employed.

Lighting Conditions for Test Motorcycle - The following eight lighting conditions were adopted for test motorcycles, where candela values indicate the maximum luminous intensity of lamps and millimeter values indicate the distance between position lamp and headlamp as measured from the innermost point of the position lamp to the outermost point of the headlamp. Examples of lighting conditions are shown in Figure 7.

- (1) No lamps on
- (2) Headlamp passing beam on
- (3) White position lamps on (30 cd, 75 mm)
- (4) White position lamps on (30 cd, 150 mm)
- (5) Amber position lamps on (30 cd, 75 mm)
- (6) Amber position lamps on (30 cd, 150 mm)
- (7) Amber position lamps on (80 cd, 75 mm)
- (8) Amber position lamps on (80 cd, 150 mm)

Regarding the position lamps used in the test motorcycle, the light source, shape and area are as follows, where area refers to the area of the lens:

- (1) White position lamp 30 cd – incandescent, round (diameter: 60 mm), 28 cm²
- (2) Amber position lamp 30 cd – incandescent, round (diameter: 60 mm), 28 cm²
- (3) Amber position lamp 80 cd – LED, rectangular (45 mm H, 150 mm W), 68 cm²
- (4) Position lamp height from ground – 830 mm
- (5) Headlamp height from ground – 860 mm



(1) No lamps on



(2) Passing beam on (AHO)



(4) White position lamps (30cd, 150mm) on + AHO



(6) Amber position lamps (30cd, 150mm) on + AHO



(8) Amber position lamps (80cd, 150mm) on + AHO

Figure 7. Lighting conditions of test motorcycles

Lighting Conditions for Test Passenger Car -

In the case of the test passenger car, the corresponding height of the headlamp was 650 mm from the ground and the separation was 1,230 mm as measured between the centers of the two headlamps.

Test Course - A private road with a 3.5m-wide lane on each side was used as the test course.

Subject Location and Oncoming Vehicle

Operation - The location of the subjects and the operation setup for the test motorcycle are shown in Figure 8. The subjects were seated on three rows of benches with different seat heights. The eyepoints of the subjects were approximately 1.0 m high from the ground for the front row (nearest to the motorcycle), 1.2 m high for the center row, and 1.4 m high for the back row. The eyepoint location of the subject second from the innermost person in the second row was equivalent to the eyepoint location of the theoretical driver of a passenger car running along the center of the same lane (hereafter "eyepoint").

The test motorcycle was trailed by the test car at a distance of 30 m. Maintaining this condition, both vehicles cruised and passed the eyepoint at a constant speed of 60 km/h.

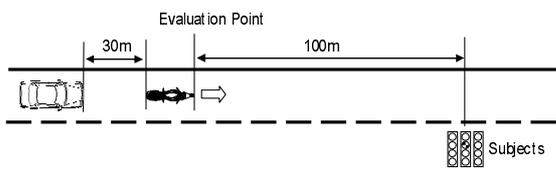


Figure 8. Subjects and oncoming motorcycle followed by car

Motorcycle Conspicuity Evaluation - To evaluate the conspicuity of motorcycles, the subjects were instructed to observe an oncoming motorcycle in the opposite lane trailed by a passenger car at a distance of about 30 m. (See Figure 9). The subjects were asked to imagine being a driver trying to make a right turn at an intersection. When the oncoming motorcycle reached the point 100 m ahead of the eyepoint, a signal sounded for 1 second whereupon the subjects recorded how the motorcycle appeared, using the conspicuity evaluation scale.



Figure 9. Experiment situation (Test motorcycle followed by car)

Conspicuity Evaluation Scale - Motorcycle conspicuity was evaluated on the following scale:

- 1 : Inadequate
- 2 : Somewhat inadequate
- 3 : Just acceptable
- 4 : Somewhat adequate
- 5 : Adequate

A value of 3.0 is the "just acceptable" level, so 3.0 or higher means an acceptable or adequate level of conspicuity.

Experimental Conditions - The conspicuity evaluation routine was repeated about 20 times for each of the 8 motorcycle lighting conditions under various levels of sky illuminance. Separate experiments were conducted during daytime, dusk and nighttime hours (sky illuminance level was under 20,000 lx).

Subjects - A total of 12 subjects ranging in age from 27 to 58 (average 43) participated in the experiment. All of them were lamp experts.

Results

The average conspicuity evaluation values rated by the 12 subjects are shown in Figure 10, in relation to sky illuminance. A value of 3.0 is the "just acceptable" level, so 3.0 or higher means an acceptable or adequate level of conspicuity.

The test results are summarized as follows:

- (1) The conspicuity evaluation value declined with a drop in sky illuminance.
 - (2) The conspicuity evaluation value proved to be the lowest when none of the motorcycle lamps were on. The value rose with the headlamp on and the position lamps on, in that order.
 - (3) In the case of position lamps + AHO, the conspicuity evaluation value was higher with amber position lamps compared to white lamps. (For example, when the luminous intensity was 30 cd and the separation was 150 mm, the difference in conspicuity evaluation value was around 0.4).
 - (4) Between position lamps of lower and higher luminous intensity, the more luminous ones gave a higher conspicuity evaluation value compared to the less luminous ones.
 - (5) The conspicuity evaluation value was higher when the position lamps were more widely separated from the headlamp.
 - (6) When the sky illuminance was between 10,000 and 20,000 lx, the headlamp on had a conspicuity improving effect (the difference in conspicuity evaluation value between headlamp on and off was around 0.7). Furthermore, the position lamps had a greater conspicuity improving effect (the difference in conspicuity evaluation value between position lamps + headlamp and no lamps was around 1.2).
 - (7) Under the no lamps condition, the conspicuity evaluation value declined below the acceptable borderline of 3.0 when sky illuminance was less than 5,000 lx. Accordingly, if sky illuminance is less than 5,000 lx (corresponding to 30 minutes before sunset on a clear day), it is preferable to turn on the headlamp in order to obtain adequate conspicuity.
- Under the headlamp condition, the conspicuity evaluation value dropped below 3.0 when sky illuminance was less than 1,000 lx. However, when the position lamps were turned on in addition to the headlamp, conspicuity was improved.
- Accordingly, if sky illuminance is less than 1,000 lx (corresponding to 5 minutes before sunset on a clear day), it is preferable to turn on both the headlamp and position lamps in order to obtain adequate conspicuity.

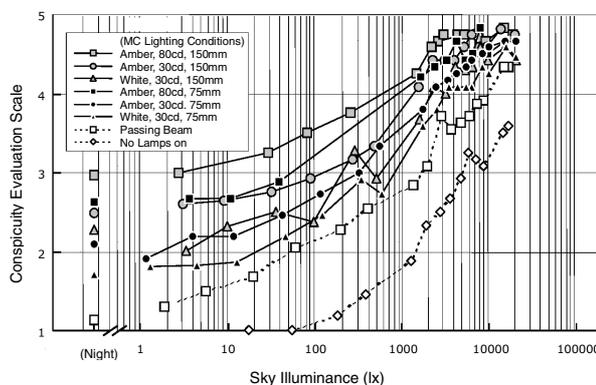


Figure 10. Conspicuity evaluation on motorcycle followed by car

CONCLUSION

- (1) As AHO was confirmed to be effective in improving the conspicuity of two-wheeled vehicles and reducing the number of accidents involving two-wheeled vehicles, the use of AHO should be introduced in more countries and regions.
- (2) To cope with the introduction of four-wheeled vehicles' DRL, amber position lamps should be combined with AHO for further improvement of two-wheeled vehicle conspicuity.
- (3) To further improve the conspicuity of two-wheeled vehicles, it would be advantageous to re-examine the color of position lamps (amber), their luminous intensity (higher intensity) and their separation distance from the headlamp (longer distance).

REFERENCES

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