Improvement of Daytime Conspicuity of Motorcycles

Dipl.-Phys. O. Bartels

Keywords: *Motorcycle, Conspicuity, DRL*

1 Introduction

Studies have shown that driving with light during daytime is expected to lead to a benefit in traffic safety. Therefore it is recommended in Germany since October 2005 that all multilane powered vehicles drive with activated passing beam or dedicated daytime running light (DRL, according ECE-R87) during daytime. DRL for multilane powered vehicles are specially designed for the conspicuity of the powered vehicle and have a different directional characteristic of the radiation than the passing beam. It is not excluded that with an increased share of DRLs on multilane powered vehicles motorcycles would be less conspicuous compared to the present situation because currently it is not allowed to install DRLs on motorcycles.

For this reason a study from the German Federal Highway Research Institute (BASt) investigated, to which extent the conspicuity of motorcycles increasable is compared to the current situation. It should be clarified at the same time, whether motorcycles with the current daytime signal pattern (passing beam) could possibly be worse conspicuous in the future because their special peculiarity impends to disappear in the 'sea of lights'.

This executive summary contains the essential results of the research projects ‚Signal Pattern of Powered Two Wheelers during Daytime at Introduction of a Mandatory Use of Daytime Running Light in Germany' and ‚Daytime Running Light on Powered Two Wheelers – Continuative Research' carried out by BASt.

2 Test design and realisation

In a research project BASt carried out two test series to assess the frontal signal pattern on a motorcycle. In a first test series five different frontal signal patterns were compared with each other and in a second test series seven frontal signal patterns which should make the motorcycle better visible and conspicuous by means of a special or adjusted signal pattern. Test persons assessed the conspicuity of the motorcycles on which the lamps were mounted, from a

distance of 50 m and 100 m for each signal pattern in a direct paired comparison. The motorcycles were placed in front or next to a car in a static traffic situation.

2.1 First test series

In a first test series the following five different configurations of lamps were mounted on a motorcycle:

- Signal pattern A: Passing Beam (white light, H4 filament lamp, round design)
- Signal pattern B: Passing Beam (white light, H4 filament lamp, round design) with permanently activated direction indicators (amber, P21W filament lamp)
- Signal pattern C: One DRL (white light, max. 500 cd in HV, filament lamp, oval design)
- Signal pattern D: One DRL (selective yellow light, max. 500 cd in HV, filament lamp, oval design)
- Signal pattern E: One DRL (amber light, max. 500 cd in HV, filament lamp, oval design)

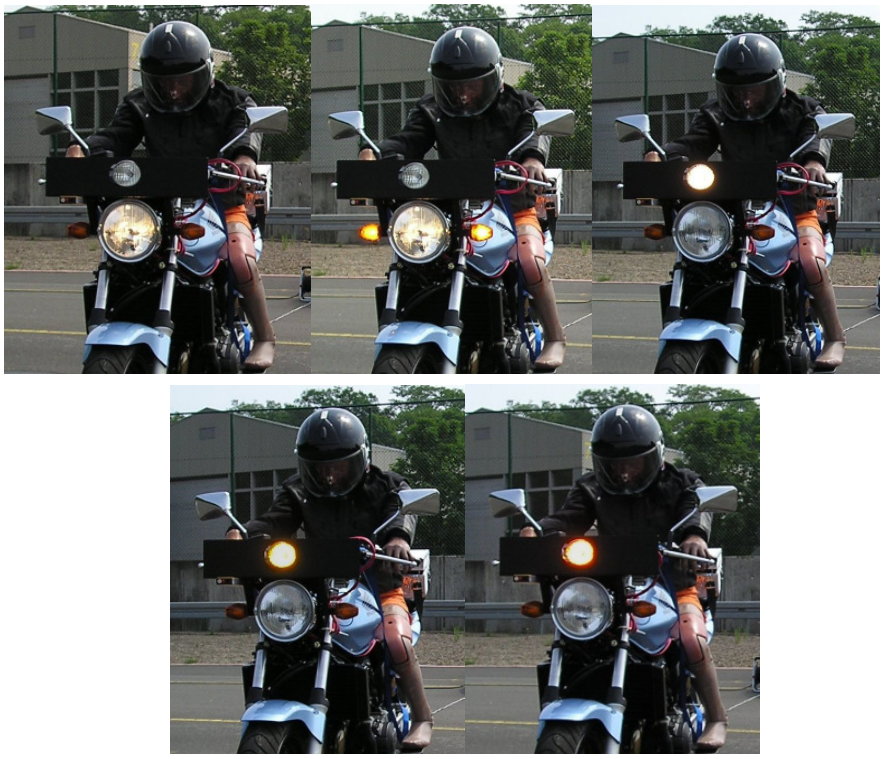

Figure 1: Experimental vehicle equipped with different signal patterns (signal pattern A-E of test series 1). From the upper left to the lower right: Passing beam, Passing beam with direction indicators, DRL 'white', DRL 'selective yellow', DRL 'amber'

2.2 Second test series

BASt performed a second test series with seven different signal patterns at the front of two different motorcycles. In this second test series six additional frontal signal patterns with different configurations of dedicated daytime running lights (single white DRLs as well as white DRLs in pairs respectively with higher luminous intensity) and one signal pattern from the first test series were tested. As in the first test series, test persons assessed the recognisability of the different signal patterns in an equivalent direct paired comparison. Following the seven assessed signal patterns are listed:

- Signal pattern A: One DRL (white light, max. 500 cd in HV, filament lamp, oval design)

- Signal pattern B: Two DRLs (white light, max. 500 cd/DRL in HV, filament lamp, oval design, distance of the DRLs 200 mm)
- Signal pattern C: Two DRLs (white light, max. 650 cd/DRL in HV, LED light source, round design, distance of the DRLs 200 mm)
- Signal pattern D: Two DRLs (white light, max. 1000 cd/DRL in HV, filament lamp, round design (small), distance of the DRLs 200 mm)
- Signal pattern E: One DRL (white light, max. 650 cd in HV, LED light source, round design)
- Signal pattern F: One DRL (white light, max. 1000 cd in HV, filament lamp, round design (small))
- Signal pattern G: One DRL (white light, max. 800 cd in HV, LED light source, elongate LED-string design)

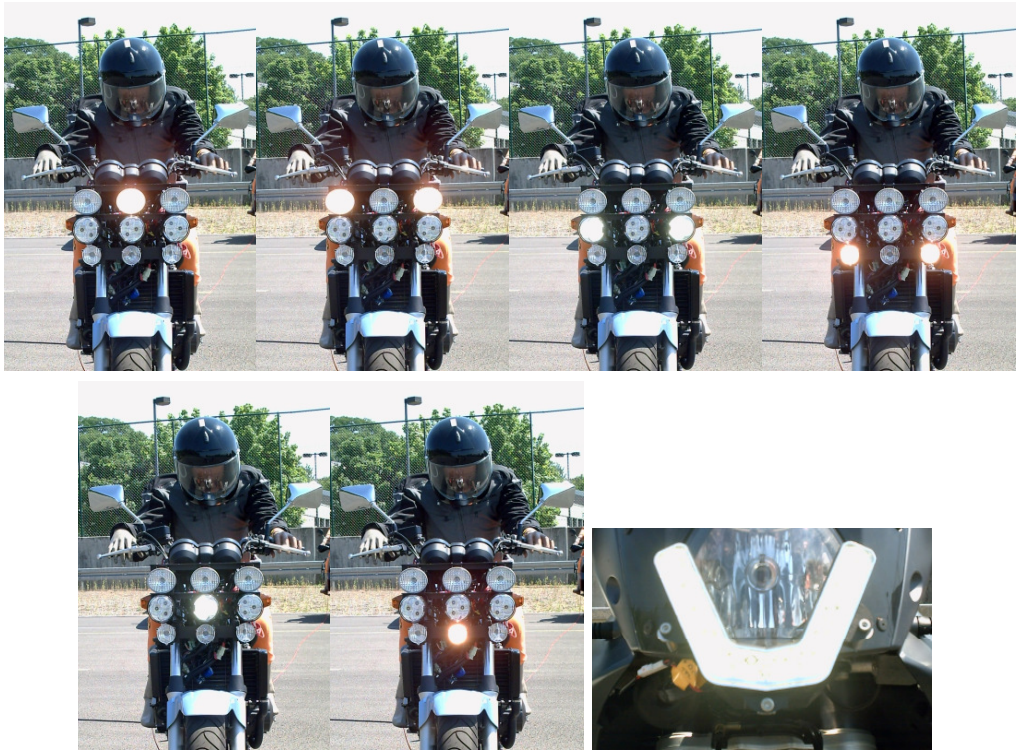

Figure 2: Experimental vehicle equipped with different dedicated daytime running lamps (signal pattern A-G of test series 2)

Figure 3: Traffic situations for the assessment of the conspicuity

3 Results

The major result of the first test series was:

- A signal pattern on the motorcycle consisting of one DRL (signal pattern C,D and E) was better recognisable for the test persons than the standard signal pattern of a motorcycle with activated passing beam (signal pattern A).
- The colour of the DRL had no statistically significantly influence on the recognisability of the signal pattern.
- Multilane vehicles and their lighting had no influence on the conspicuity of the motorcycles.

The analysis of the paired comparisons of the conspicuity of the motorcycle in the static experiment of the second test series resulted in the following conclusions:

- All signal patterns with two DRLs on the motorcycle (signal patterns B, C, and D) were statistically significantly better rated related to their recognisability than the signal patterns with only one DRL (signal patterns A, E, F and G).
- From a distance of 50 m the signal pattern C was rated as significantly better recognisable than the signal pattern B, even though the luminous intensity of the two signal patterns was almost equal (500 cd to 650 cd).

The light of the LED-DRL with its white colour is spectrally nearer to daylight and was therefore rated more brightly by the test persons. However, from a distance of 100 m this ‚colour effect' nearly disappeared and the signal patterns B und C were assessed to be equally recognisable.

- From a distance of 50 m the signal pattern C also was rated as significantly better recognisable than the signal pattern D, even though the luminous intensity of the signal pattern D was much bigger. Also in this comparison the light of the LED-DRL with its white, daylight-like colour was recognised and assessed brighter by the test persons than the signal pattern D with the much higher luminous intensity. However, from a distance of 100 m this ‚colour effect' also disappeared and the signal patterns C und D were assessed to be equally recognisable.

Additional to the pair comparison in both test series the conspicuity of the motorcycle with its different signal patterns was assessed by the test persons subjectively. The following additional conclusions can be drawn from this evaluation:

- The ‚colour effect' of signal pattern C was also observed at the signal pattern G. The elongate, string-shape LED-DRL appeared very bright, glaring and conspicuous from a short distance whereas signal pattern D did not look very conspicuous. But already from a distance of 50 m and clearly at a distance of 100 m the real luminous intensity of the DRL is crucial and the signal pattern D was much better recognisable.
- The distance of the test persons to the motorcycle for the assessment of the conspicuity had the largest effect on the conspicuity of signal pattern G. With the elongate, string-shape form of the DRL the luminous area became 'diffuse' with increasing distance and was nearly not recognisable in front of the background any more at large distances. This was not the case to the same degree with a more compact (e.g. round) luminous area of another DRL (e.g. signal pattern E).

4 Conclusions

Different configurations of lamps for the frontal signal pattern were mounted on a motorcycle for a comparative assessment. The investigated options of signal patterns contain alternative solutions to the passing beam which are intended to make motorcycles more conspicuous with a special or adjusted signal pattern.

The results of the research projects ‚Signal Pattern of Powered Two Wheelers during Daytime at Introduction of a Mandatory Use of Daytime Running Light in Germany' and ‚Daytime Running Light on Powered Two Wheelers – Continuative Research' can be summarised as follows:

- One DRL according to ECE-R87 is better recognisable than the normal passing beam.
- Two DRLs are better recognisable than a single DRL.
- DRLs with a luminous intensity at the upper limit of the range allowed in the ECE-R87 (400 cd - 1200 cd) are better recognisable at greater distances than DRLs with a low luminous intensity, whereas the differences in the conspicuity caused by different colours respectively colour regions fade with greater distances.
- On a greater distance (100 m) DRLs with a filament lamp as light source are equally recognisable to DRLs with LEDs as light source.

The results of the research projects did show that under daytime conditions an improved perception of motorcycles equipped with daytime running lamps can be observed so that there is an improvement for road safety if replacing the passing beam function by dedicated daytime running lamps.

As a consequence of the results of the research into conspicuity of motorcycles the mounting of one or two DRLs according to ECE-R87 on motorcycles should be permitted to have the possibility to drive with activated DRLs instead of passing beam during daytime. This leads to proposals for amendments to Regulation No. 53 and No. 87.

By that means an enhancement of daytime conspicuity of powered two wheelers is possible. In addition the energy consumption of the lighting can be reduced.