

Scientific expert opinion on the proposed changes to the Regulations No 149 (doc. GRE-84-16)

*Originally proposed by the GTB, prepared by IWG-SLR,
refers to photometric requirements of the motor vehicles' headlights.*

The proposal mentioned in the title (doc. GRE-84-16) contains proposals for changes to the requirements for headlights, including photometric requirements.

The type approval requirements for headlights should define the minimum (for road illumination) or maximum (for glare) photometric values, the fulfilment of which will guarantee road traffic safety. If the road in the night conditions is illuminated only with the vehicle's headlights - e.g. outside built-up areas – then the safety depends primarily on the early detection of an unexpected obstacle. Therefore, the minimum distance required of the illuminated road (range) in front of the vehicle should be greater than the vehicle stopping distance, which is directly related to the vehicle speed. In addition, adequate road width should be guaranteed to be illuminated.

The illuminance (its vertical value) is the photometric quantity used to evaluate the possibility of seeing an obstacle at night, at a certain distance from the vehicle on the surface of the obstacles above the road. The illuminance is used also to assess glare experienced by the eyes of oncoming drivers and in rear-view mirrors, although under certain circumstances luminance may also play a role in glare.

The current photometric requirements for headlamps, set out in the UN-ECE type approval Regulations, are based on numerous significant simplifications as well as technological and design limitations characteristic for the parabolic headlamp design and are not representative to any design. Especially contemporary – LED, projection, lens-only, matrix, light guide, etc. Modern headlamp designs are capable to provide much better illumination than the parabolic ones. Proposed (GRE-84-16) photometric requirements are continuation of existing system and are still **design based (oriented)**.

During the historical changes to the type approval requirements so far, essentially the photometric values have been adapted to the emerging new technologies (halogen, gas-discharge, LED) and were a continuation of previous ones. The fundamental structure of these requirements has not been changed and did not represent performance needs. This has now led to a situation that in the real road conditions, taking into account the methods and instruments used for headlamp aiming, the real range of the illuminated road may be even several times shorter (20 m) than the nominal (75 m) and different for particular type (class) of headlight. Actual maximum range can exceed 100 m.

It should be strongly emphasized that photometric requirements should not depend on the type of vehicle (passenger car, truck, two-wheeler, etc.) if the stopping distance (vehicle speed limit) is of the same value and many times greater than vehicle width.

At present the situation is such that for the same purposes, i.e. the illumination of the road in front of the vehicle at night with passing beam and without limiting the maximum speed it is possible to legally use devices with different minimum characteristics for identical driving conditions. Moreover – if they meet just minimum Regulation requirements - they usually are all insufficient. For example, motorcycle symmetrical passing beam headlights (class CS, DS) have a significantly shorter range and some times lower illuminance values than the basic asymmetric Class C single lamp. Additionally, motorcycle can use only single of these reduced values. This is because only one lamp (e.g. class CS, DS) can be installed on a motorcycle, unlike passenger cars and trucks, which are required to be equipped with two deadlamps of significantly higher required minimum values (class C) and greater range than single class CS or DS lamp. This is illogical as well as inconsistent and has no relation to

performance and safety. Especially in the situation when class C is proposed to be legally used on motorcycles. Meanwhile, two class C lamps, can be legal installed also on the motorcycle, and this is not a problem for motorcyclists.

Similarly illogical and inconsistent are several standardised but different photometric requirements for passing (and adaptive driving) beam headlamps which can be used equally on vehicle (car or truck) without any additional requirements - condition of safety use e.g. speed limit.

The provision allowing for different illuminance (intensity) at point B50L and glare zones (responsible for glare control) for headlights of different passing beam class, also seems to be logically doubtful and inexplicable. This state actually means a situation in which a headlamp (glare zone) approved for operation according to certain class requirements would not be approved according to other class. Nevertheless the driver observing the headlights on the vehicle coming from the opposite direction, does not perceive one class identically as another only because both are type approved. The feeling of glare does not depend on the type approval markings but on the real photometric parameters.

Another odd and illogical idea is to allow to replace the requirement(s) for the luminous flux of the light source with a luminous flux in wide rectangular zones (p. 4.5.3.2. b)). Such requirements do not guarantee proper illumination of the road. For example, most of flux can be directed 7-10 m in front of the vehicle or on the sides only. Therefore the formulation of such a requirement does not meet the criterion of minimum technical requirements for safety purposes and performance based ones. A proper alternative, which would make it possible to avoid specifying the luminous flux of the light source, would be to precisely define the minimum of illuminance distributed over the entire necessary area of the road.

There is no other justification than the design one for these above described different requirements. Thus, the principle of "technology neutral" requirements is violated. The system of requirements so constructed does not meet the basic requirement of consistency and logic with regard to the goal of illumination of the road at a safe and known distance, enabling effective detection of the obstacle and stopping the vehicle in front of it.

In addition proposing the "optional" requirements does not make sense when the devices need to meet mandatory (minimum for safety) requirements. If the minimum mandatory requirements are met, then any devices exceeding them in a safe direction should not be prohibited without any additional criteria. Therefore, as was shown above, it does not make sense to define separate requirements related solely to the design (vehicle/lamp) and / or historical events e.g. significantly weaker lights for motorcycles than for the car.

Well-known studies, including those presented at the GTB Glare and Visibility Forum, Geneva, 22 October 2018, confirm that none of the passing beam headlamps currently used provide sufficient road illumination. Moreover, the risk of a fatal accident with a pedestrian outside the built-up area, when the only lighting is the vehicle's headlights, is, according to various studies, from about 5 to 12 times higher! This is directly related to the philosophy and values of type-approval requirements and can no longer be tolerated. Therefore, when preparing the change of type-approval requirements for headlamps, one should take into account both the possibilities of modern technologies at an acceptable price level, as well as the minimum real safety needs, which should be identical for all vehicles that can legally drive with a certain, but the same maximum speed at night.

An unambiguous definition of what is meant by p. 4.2 "adequate" lighting with dipped beam and "good" with high beam, is also needed.

To prepare effective requirements serving road traffic safety, it is necessary to fundamentally establish:

1) Do the Contracting Parties agree that the headlamps (passing beam) - will not provide an effective and safe road illumination (range) as it is the case at present?

or

2) Will the meeting minimum type approval requirements guarantee the appropriate safe road illumination in the real world? And if, for any reason, it is not possible, the drivers should have clear information about the guaranteed safe lighting range and/or clearly specified safe speed of their vehicles.

As result the maximum safe speed value (stopping distance, visibility distance, etc.) information should be clearly described and hand-on to the vehicle user. It should be connected with meeting of minimum type approval requirements for headlights and their installation which should be the same for all vehicles with no design speed restrictions.

If more than one set of requirements for identical purpose will be legally possible to be met for each of such requirement (class), it should be followed by clearly described and given to vehicle user, maximum safe speed value (stopping distance, visibility distance, etc.) which should be different for each different class.

In both cases, all factors influencing the range of the illuminated road in real conditions should be taken into account, including installation parameters such as the height of the headlamp, the permissible inclination angles due to the vehicle load and the measurement uncertainty (precision) of the light aiming in the service conditions.

It also cannot be continued, as it is the case at present situation, where type-approval requirements are defined in separation from the subsequent operational aiming of lamps as part of the service and periodic technical inspection. The type-approval requirements should be supplemented by a description of the operational light setting / checking procedure, which together will guarantee of a minimum (clearly defined) illumination range / vehicle speed.

Otherwise the manufacturers and vehicle users will remain unaware of the dangers resulting directly from type-approval requirements. They will continue to feel relieved of responsibility if they deliver / use / put into service products that meet the formal requirements, but will not guarantee the minimum safety.

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