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Regulation No. 65 (Special warning lamps)

Proposal for amendments to Regulation No. 65

Submitted by the expert from the Society of Automotive Engineers*

The text reproduced below was prepared by the expert from the Society of Automotive Engineers (SAE) in order to clarify the execution of the design and test requirements for the special warning lamp while allowing for harmonization with the requirements for emergency warning lamps as prescribed by SAE. The modifications to the existing text of the Regulation are marked in bold for new or strikethrough for deleted characters.

* In accordance with the programme of work of the Inland Transport Committee for 2010–2014 (ECE/TRANS/208, para. 106, ECE/TRANS/2010/8, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

I. Proposal

Paragraph 1.6., amend to read:

"1.6. the "effective intensity" J_e in a fixed direction for both rotating and stationary flashing type is given by:

$$J_e = \frac{J_m}{1 + \frac{C}{FT}}$$

Where:

J_m : peak intensity (cd)

C: time constant, $C = 0.2$ sec

F: Form Factor $F = \frac{\int_0^T J dt}{J_m T}$

T: time of period

J: instantaneous intensity (cd)"

Paragraph 1.7., amend to read:

"1.7. "reference centre of the special warning lamp" means:

- (a) for a rotating or stationary flashing lamp (Category T), the optical centre of the light source, **which is not required to coincide with its geometric centre; the manufacturer of the special warning lamp of Category T may provide the location of the reference centre. In the absence of such specification of the reference centre by the manufacturer, the geometric centre of the external optical surface may be considered as the optical centre. In case of an array of light sources in the optical system, in the absence of the specification of the reference centre by the manufacturer, the geometric centre of the array shall be considered as the optical centre.**
- (b) for a directional flashing lamp (Category X), the intersection of the axis of reference with the exterior light-emitting surface; it is specified by the manufacturer of the special warning lamp. In the absence of such specification, it means the centre of the light source."

Paragraph 1.8., amend to read:

"1.8. "reference axis of the special warning lamp" means:

- (a) for a rotating or stationary flashing lamp (Category T), a vertical axis passing through the reference centre of the lamp, **which is not required to coincide with its geometric centre.**
- (b) for a directional flashing lamp (Category X), a horizontal axis parallel to the median longitudinal plane of the vehicle."

The manufacturer of the special warning lamp shall indicate the position of the special warning lamp in relation to the reference axis.

Insert a new paragraph 1.9.1.2, to read:

"1.9.1.2. starting at a point where the effective intensity is minimum, in steps no greater than 10°, around the reference axis, after reaching photometric stability as indicated in paragraph 2. of Annex 5 to this Regulation;"

Paragraph 1.9.1.2. (former), renumber as paragraph 1.9.1.3.

Paragraph 2.2.2., amend to read:

"2.2.2. a brief technical description stating in particular the light source provided by the manufacturer of the special warning lamp and including, where applicable, the electronic control unit(s), the ballast(s) or the light control gear(s) or the light source module and the light source module specific identification code. **In case the light source is a Light Emitting Diode (LED), the manufacturer's part number and the applicable binning code shall be documented.**"

Paragraph 2.2.5., amend to read:

"2.2.5. two ~~sample~~ **samples**, in principle below,"

Paragraph 2.2.6., amend to read:

"2.2.6. two samples of the ~~cover~~ **optical material**, provided that the construction of the special warning lamp with exception of the colour of the ~~cover~~ **optical material** remains unchanged and the approval may be extended simultaneously or subsequently for special warning lamps of another colour. In this case, it is sufficient to carry out the photometric and colorimetric tests. **The optical material for the warning lamp shall be pre-qualified for environmental endurance including absence of hazing caused by ultraviolet radiation, when exposed to direct sunlight for a period not less than 3 years. The method to be used for this test is per ISO 877-3:2009 .Plastics -- Methods of exposure to solar radiation -- Part 3: Intensified weathering using concentrated solar radiation.**"

Paragraph 5.1. amend to read:

"5.1. The special warning lamps must be so designed and constructed that in normal conditions of use, and notwithstanding the vibrations to which they may be subjected in such use, their satisfactory operation remains assured and they retain the characteristics prescribed by this Regulation. **The special warning lamp must be able to withstand, a wide-band random vibration for a duration of 6 hours starting at 10 Hz with a G-Load Power Spectrum Density of 0.1g²/Hz and ending at 250 Hz with a G-Load Power Spectrum Density of 0.00408g²/Hz with an RMS value of 1.81g and a tolerance of ±3 dB.**

The special warning lamps must be so designed and constructed that the relevant requirements with regard to **internal** voltage higher than 50 V are fulfilled."

Insert a new paragraph 5.1.1., to read:

"5.1.1. The special warning lamp must be able to withstand normal environmental corrosion. For this purpose, the product specimen shall be exposed for a period of 240 hours to a Salt/Fog environment per ASTM B 117 (with amendments) using ASTM D 1193 (with amendments), or ISO 9277 NSS (with amendments) using ISO 3696 (with amendments) Type IV Reagent Grade Water. After the exposure,

the specimen shall be gently dipped in clean running water, not warmer than 38°C, to remove salt deposits (without scrubbing) from its surface, and then air dried for a period of 1 hour. After drying, the specimen shall be examined for corrosion which would affect the results of other tests required in this Regulation."

Paragraph 5.4., amend to read:

"5.4. Field Replaceable Light source module"

Paragraph 5.4.1., amend to read:

"5.4.1. The design of the **field replaceable** light source module(s) shall be such that even in darkness the light source module(s) can be fitted in no other position, but the correct one."

Paragraph 5.4.2., amend to read:

5.4.2. The **field replaceable** light source module(s) shall be tamperproof.

Paragraph 5.6., amend to read:

"5.6. The frequency f , the "on" time t_H and the "off" time t_D shall correspond to the values indicated in the table in Annex 5 to this Regulation. They shall be measured at an ambient temperature of $+ 23^\circ \text{C} \pm 5^\circ \text{C}$ and with voltages at the terminals of the device which are between 90 per cent and 115 per cent of the rated voltage. Moreover, starting and correct functioning of the special warning lamp shall remain assured at temperatures between $- 20^\circ \text{C}$ and $+ 50^\circ \text{C}$ or if the special warning lamp is exposed to heavy rain, in accordance with the procedure described in Annex 4 to this Regulation. Under those conditions, one minute after a voltage equal to 90 per cent of the rated voltage has been applied, the frequency shall remain between **2.0** and **4.0** Hz."

Annex 3, amend to read (the title remains unchanged):

"Under the conditions of paragraph 7 of this Regulation, the trichromatic co-ordinates of light emitted through the ~~filters~~ **optical material** used for special warning lamps shall lie within the following boundaries:

1. Amber*
 - limit towards green : $y \leq x - 0.120$
 - limit towards red : $y \geq 0.390$
 - limit towards white : $y \geq 0.790 - 0.670 x$
2. Blue
 - limit towards green : $y = 0.065 + 0.805 x$
 - limit towards white : $y = 0.400 - x$
 - limit towards purple : $y = 1.667x - 0.222$
3. Red
 - limit towards purple : $y \geq 0.980 - x$
 - limit towards yellow : ~~$y \leq 0.335$~~ $y \leq 0.335$

Colorimetric data shall be measured twice; once at the beginning of the photometric evaluation as required in Annex 5, Section 7. of this Regulation, and next at the end of the same photometric evaluation.

For a special warning lamp whose colour coordinates are measured to be on the border of the colour boundaries to be considered for acceptability, evaluate the colorimetric data taken at the beginning and end of photometric evaluation. The special warning lamp shall be considered acceptable only if the data trend is to move towards the centre of the defined colour areas."

* Corresponds to a specific part of the "yellow" zone of the triangle of CIE colours."

Annex 4, amend to read (the title remains unchanged):

"A ~~simple~~ **sample** of the special warning lamp, fitted in its normal operating position, with all the drainage apertures open if they exist, shall be subjected to a precipitation of 2.5 mm of water per minute, **as measured using a standard rain gauge**, the water being directed at an angle of 45° and from a nozzle producing a full conical jet.

During the test, the device shall turn on its vertical axis at a rate of 4 turns per minute. **If the water is simultaneously directed to the specimen under test from all directions in the horizontal plane, there is no need to rotate the specimen during the test.**

The test shall last for 12 hours continuously after which the water jet shall be stopped.

One hour later, the sample shall be examined and shall be regarded as having passed the test if the accumulated volume of water does not exceed 2 cm³."

Annex 5, paragraphs 1. and 2., amend to read:

"1. Measurements of the photometric characteristics shall be taken at a distance of at least 25 m.

The angular diameter of the photoelectric receiver as seen from the special warning lamp shall be 10 minutes ~~of~~ of arc maximum. **The calibration of the photometric receiver shall be established using a traceable calibration standard with a correlated colour temperature of 2856 K.**

The response time of the photometric system shall be adequate to the rising time of the signal to be measured.

2. For special warning lamps having one level of intensity (class 1), the "by night" level shall apply.

For special warning lamps having two levels of intensity (class 2), measurements shall be carried out for each of the two levels.

The effective luminous intensities in various directions shall be as specified in the ~~table~~ **tables** below, **and shall be measured only after the light output from the special warning lamp has reached photometric stability (deviation of less than ±5 percent in the last 15 minutes of operation) at each level of intensity.**"

Annex 5, insert a new paragraph 6.1., to read:

"6.1. **The measurement of the flash timing characteristics of a special warning lamp where the light output rotationally changes along the surface of such lamp, shall be made with an adequate distance between the sensor and the lamp, such that the sensor is able to assimilate the light from the total surface of the lamp facing the sensor. The distance of the sensor from the special warning lamp should be adjusted such that the aperture**

through which the sensor is receiving the light, allows full view of the special warning lamp for the sensor."

Annex 5, paragraph 7.1. amend to read:

"7.1. The frequency, the "ON" time and the "OFF" time shall be as specified in the table below

		Colour blue or amber rotating system or flash light sources (category T and X)
Frequency f (Hz)	max.	4 4.0
	min.	≥ 2.0
"ON" time t_H (s)	max.	0.4/f
"OFF" time t_D (s)	min.	0.1

Documentation of data related to flash characteristic stability over a period of 200 hours of continuous operation shall be provided to show that the flash characteristics stay within the bounds specified within Annex 5 to this Regulation, and not vary by more than 20% of the initial flash rate."

Annex 5, paragraph 7.2., amend to read:

"7.2. The effective luminous intensities (J_e) within the relevant vertical angles for a special warning lamp (Category T) shall be as specified in the table below:

Category T			Colour		
			blue	amber	red
Minimum value of the effective luminous intensity J_e , within the specified vertical angles and a horizontal angle of 360° around the reference axis	0°	by day	120	230 240	120
		by night	50	100	50
	± 4°	by day	60	120	60
		by night	25	50	25
	± 8°	by day		170	
		by night		70	
Maximum value of the effective luminous intensity J_e	Inside ± 2°	by day	1 700		
		by night	700		
	Inside ± 8°	by day	1 500		
		by night	600		
	Outside the above areas	by day	1 000		
		by night	300		

Annex 5, paragraph 8.2., amend to read:

"8.2. If a special warning lamp contains two or more optical systems, all the optical systems shall work in phase **within** ~~This applies only to~~ each half of a complete "bar" which is designed to extend on the width of the vehicle. **In such a case, for the purpose of measurement of effective intensity, only one half of the "bar" shall be energized so that the light emission from the side not being measured is not added into the side being measured. The timing measurements as described in paragraph 6.1 of this Annex 5 apply to the operating half of the "bar".**"

Annex 6, amend the title to read:

"XENON RELATIVE ~~SPECIAL~~ SPECTRAL DISTRIBUTION"

Annex 7, Paragraph 2.5. amend to read:

"2.5. Criteria governing acceptability

The manufacturer is responsible for carrying out a statistical study of the test results and for defining, in agreement with the competent authority, criteria governing the acceptability of his product in ~~other~~ order to meet the specifications laid down for verification of conformity of products in paragraph 9.1. of this Regulation.

The criteria governing the acceptability shall be such that, with a confidence level of 95 per cent, the minimum probability of passing a spot check in accordance with Annex 8 (first sampling) would be 0.95."

Annex 8, Paragraph 2.3. amend to read:

"2.3. Approval withdrawn

Conformity shall be contested and paragraph 10 applied if, following the sampling procedure in Figure 1 of this Annex, the deviations of the measured values of the ~~headlamps~~ **special warning lamp** are:"

II. Justification

1. The intent of the justifications below is to bring significant clarity to the execution of the design and test requirements for the special warning lamp. While this ensures a significant level of harmonization with the requirements for emergency warning lamps as prescribed by SAE, it also provides that these requirements are based on real life applications, as well as scientific data. As a result, this is a major revision of the Regulation.

Paragraph 1.6.

2. The amendment in this paragraph pertains to the Form Factor Formula. The integration operator has been moved to the numerator to correctly represent the Schmidt-Clausen (1968) equation.

Paragraph 1.7.

3. This amendment pertains to the specification of the optical centre of an array that has non-uniform light distribution. By complying to this added requirement, the manufacturer is ensuring that it will still meet the photometric requirements for Category T.

Paragraph 1.8.

4. The amended text accomplishes clarity to the definition of the reference axis in the same manner as done above for the reference centre for Category T special warning lamps in amended paragraph 1.7. of this Regulation.

Paragraph 1.9.1.2.

5. This addition is to bring harmonization with SAE documents for special warning lamps for the process of photometric measurements after determination of the minima. The latter is going to be dependent on the type of equipment being used. We cannot dictate that. The SAE J 845, and SAE J 595 documents do not call out the discreteness of the steps for determining the minima. This implies that the motion is continuous rather than discrete. The higher the resolution in the motion capabilities for the measurement process, the more accurate it can be. This is where the automation of the equipment comes in. Once the minima has been determined, the measurements around the vertical axis are to be done in steps of 10° to be in harmonization with SAE J 845. Consequently, old paragraph 1.9.1.2 is renumbered as paragraph 1.9.1.3.

Paragraph 2.2.2.

6. Unlike part numbers for Incandescent, Halogen, or Gaseous Discharge Light sources, the part number of the device for an LED does not provide complete information regarding itself. The lamp manufacturer must document the LED part number including its binning information for the purpose of conformity of production. The added text is in line with the requirement of the "specific identification code" for the light source, mentioned in the previous sentence of paragraph 2.2.2.

Paragraph 2.2.5.

7. Editorial Change - Correction of Plurality in the sentence.

Paragraph 2.2.6.

8. This amendment pertains to the technological changes and new understanding gathered to-date on the optically transmissive material, previously referenced to a "cover" This word has now been replaced by the phrase "optical material". Thus, any transmissive or reflective material on the optical path of the light being emitted is subject to the requirement of environmental endurance. This can be the LED's own lens material around the semiconductor die, any intermediary optical medium, as well as the outer lens. It also involves reflective surfaces used for collecting and redirecting the light. In case of the LED itself, the manufacturer has to provide data proving that the LED lens material has been successfully tested for this purpose. Addition of weathering test for Optical materials is from that perspective. Hence the "ISO 877-3:2009 - Plastics -- Methods of exposure to solar radiation -- Part 3: Intensified weathering using concentrated solar radiation" is being referenced.

Paragraph 5.1.

9. The Regulation implicitly calls for a vibration test by saying "The special warning lamps must be so designed and constructed that in normal conditions of use, and notwithstanding the vibrations to which they may be subjected in such use, their satisfactory operation remains assured and they retain the characteristics prescribed by this Regulation."

10. The Technical Service Test Facilities have not been conducting necessary testing for vibration to determine eligibility of a special warning lamp for approval due to the absence

of clear specification for the test. Addition of specifics for vibration test is in harmonization with SAE requirements. Since Category T Special Warning Lamps are primarily mounted on the cab of a vehicle, it is unlikely that they will experience shock vibration. Hence the 6-axis resonant vibration as stipulated in SAE J 575 is being specified.

11. Clarity has been added to "requirements with regard to voltage higher than 50 V are fulfilled.", by preceding "voltage" with "internal". The inference is derived from the fact that supply voltages are limited to 28 V maximum (Annex 5, Paragraph 4.2. of this Regulation). Hence the only higher voltage must be internally generated.

Paragraph 5.1.1.

12. Addition of corrosion test requirements has been made with the goal of having the special warning lamp survive the corrosive effects of the environment including acid-rain as well as the spray from de-icing agents on the road. This is also in harmonization with SAE requirements for Special Warning Lamps.

Paragraphs 5.4., 5.4.1. and 5.4.2.

13. The words "Field Replaceable" have been added in front of the "light source module" to serve the purpose of clarity in the applicability of the requirement.

Paragraph 5.6.

14. To prevent rounding off Flash Rates less than 2 Hz and more than 4 Hz, the same have been changed to 2.0 Hz and 4.0 Hz.

Annex 3

15. Similar to paragraph 2.2.6 of this Regulation, the concept of "optical material" has been introduced here by replacing the word "filters".

16. Text has been added at the end of this Annex to bring clarity to the process of colorimetric evaluation.

17. An editorial change is made to paragraph 3. of this annex to remove the quotes at the end of the inequality.

Annex 4

18. Editorial Change – The word "simple" has been changed to "Sample" as commensurate with the subject.

19. Clarity has been added in the precipitation rate measurement by specifying the method of measurement so that a proper volumetric measurement can be made.

20. Newer rain test apparatus is capable of simultaneously directing water towards the specimen under test from all directions in the horizontal plane. Hence the use of such equipment exempts the requirement for rotating the specimen under test.

Annex 5, paragraph 1.

21. Editorial Change – Sub-Paragraph 2 edited to change "or" to "of" as commensurate with the subject.
22. In harmonization with SAE, the requirement for calibration at a correlated colour temperature of 2856 K for photometric measurement has been established.

Annex 5, paragraph 2.

23. Editorial Change – Sub-Paragraph 3 edited to correct plurality of the word "table" to "tables", as commensurate with the subject.
24. In harmonization with SAE, the requirement for Photometric Stability has been added in Sub-Paragraph 3.

Annex 5, paragraph 6.1.

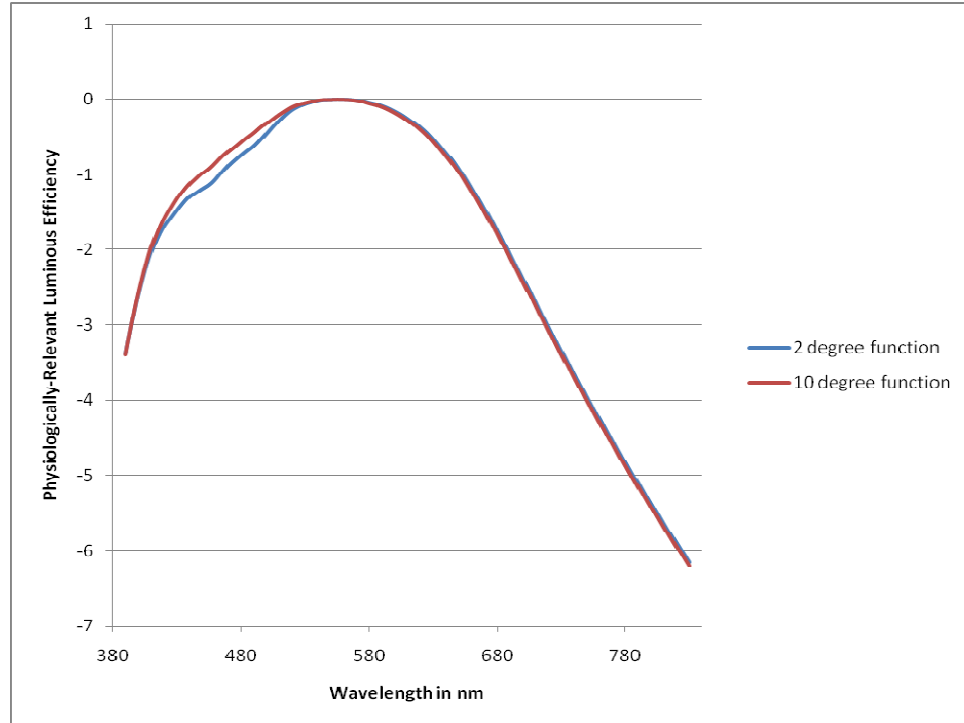
25. This paragraph has been added as a guideline to bring clarity for measurement of Flash timing characteristics, since there are no established rules in this regard.

Annex 5, paragraph 7.1.

26. Similar to amendment of paragraph 5.6. of this Regulation, to prevent the rounding off Flash Rates less than 2 Hz and more than 4 Hz, the same have been changed to 2.0 Hz and 4.0 Hz.
27. Addition of Flash Characteristic Stability requirement is towards harmonization with SAE, where a durability test for 200 Hours is specified. Effective Luminous Intensity is directly affected by the stability of the flash timing characteristics, and is therefore required to be measured after Photometric Stability per Annex 5, Section 2. of this Regulation.

Annex 5, paragraph 7.2.

28. The human eye is most sensitive to the amber colour in the macula. It is not as sensitive to the blue colour in any area. Data published by the CIE in 2008 - "physiologically-relevant" luminous efficiency functions consistent with Stockman & Sharpe cone fundamentals - is the basis for this conclusion. The same is presented in the chart below. The data is normalized to the efficiency at 556 nm. A higher negative number means lesser efficiency as compared to the one measured for 556 nm.



29. We specifically look at a group of Blue Wavelengths (~460 nm to 490 nm), and Amber wavelengths (~586 nm to 597 nm) that has been extracted out of this data set for the 2° and 10° vision. These wavelengths are for colours used on Special Warning Lamps.

<i>Field of Vision</i>	<i>Blue Wavelengths</i>		<i>Amber Wavelengths</i>	
	460 nm	490 nm	586 nm	597 nm
2°	-1.06982	-0.62358	-0.07036	-0.13678
10°	-0.84937	-0.44928	-0.08136	-0.15379

30. As one can see, the efficiency of the human eye for amber wavelengths is approximately 5 times better than that for the blue wavelengths.

31. Hence it can be implied that a higher intensity of amber in the peripheral angles is not necessary for visual acuity as compared to the blue colours. Balance in the design of optics can be achieved by having similar peripheral requirements across the spectrum.

32. In alignment with the above data, the requirement for higher intensity for amber at $\pm 8^\circ$ is eliminated. The Regulation has already been amended (Amendment 2 to Revision 1) to add the red colour with same requirements as blue, with no indication regarding usage of the same. It is therefore assumed that the height of the cab on which Category T special warning lamps are primarily fitted is not relevant.

33. In harmonization with SAE requirements, the ratio of photometric output is being kept the same between amber and blue/red (i.e. amber output is twice that of red/blue). Thus, 230 cd is being changed to 240 cd for amber by day at 0° , and 120 cd and 50 cd are added for day and night respectively at $\pm 4^\circ$.

Annex 5, paragraph 8.2.

34. Clarification is added regarding the operation of optical systems working in phase "within" each half of a complete "bar". Since the language of this section states "each half of a complete "bar" which is designed to extend on the width of the vehicle", the half must represent the left or right half.

35. In the additional requirement of de-energization of one half, it gives the option of unpowering that half, or masking that half, to prevent the light energy from that end affecting the measurements of the other half. If there are mirrors on the non-energized side throwing light towards the energized side, they have to be dealt with accordingly.

Annex 6

36. Editorial Change – "SPECIAL" in title of Annex changed to "SPECTRAL", as commensurate with the context.

Annex 7, paragraph 2.5.

37. Editorial Change – Sub-Paragraph 1 – "other" changed to "order" as commensurate with the subject.

Annex 8, paragraph 2.3.

38. Editorial Change – Sub-Paragraph 1 – "headlamps" changed to "special warning lamp" as commensurate with the subject.
