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Regulation No 128 of the Economic Commission for Europe of the United Nations (UN/ECE) — Uniform provisions concerning the approval of light emitting diode (LED) light sources for use in approved lamp units on power-driven vehicles and their trailers [2018/1998]

Incorporating all valid text up to:

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1. SCOPE

This Regulation applies to LED light sources shown in Annex 1 and intended for use in approved lamps of power-driven vehicles and of their trailers.

2. ADMINISTRATIVE PROVISIONS

2.1. Definitions

2.1.1. Definition of ‘category’

The term ‘category’ is used in this Regulation to describe different basic design of standardised LED light sources. Each category has a specific designation as for example: ‘LW1’, ‘LY2’, ‘LR2’.

2.1.2. Definition of 'type'

LED light sources of different 'types' are LED light sources within the same category which differ in such essential respects as:

2.1.2.1. Trade name or mark;

LED light sources bearing the same trade name or mark but produced by different manufacturers are considered as being of different types. LED light sources produced by the same manufacturer differing only by the trade name or mark may be considered to be of the same type.

2.1.2.2. Light source design, in so far as these differences affect the optical results;

2.1.2.3. Rated voltage.

2.2. Application for approval

2.2.1. Application for approval shall be submitted by the owner of the trade name or mark, or by his duly accredited representative.

2.2.2. Every application for approval shall be accompanied (see also paragraph 2.4.2) by:

2.2.2.1. Drawings in triplicate, sufficiently detailed to permit identification of the type;

2.2.2.2. A brief technical description;

2.2.2.3. Five samples;

2.2.3. In the case of a type of LED light sources differing only by the trade name or mark from a type that has already been approved it shall be sufficient to submit:

2.2.3.1. A declaration by the manufacturer that the type submitted

(a) is identical with (except in the trade name or mark); and

(b) has been produced by the same manufacturer as the type already approved, the latter being identified by its approval code.

2.2.3.2. Two samples bearing the new trade name or mark.

2.2.4. The competent authority shall verify the existence of satisfactory arrangements for ensuring effective control of the conformity of production before type approval is granted.

2.3. Inscriptions

2.3.1. LED light sources submitted for approval shall bear on the cap:

2.3.1.1. The trade name or mark of the applicant;

2.3.1.2. The rated voltage;

2.3.1.3. The designation of the relevant category;

2.3.1.4. A space of sufficient size to accommodate the approval mark.

2.3.2. The space mentioned in paragraph 2.3.1.4 above shall be indicated in the drawings accompanying the application for approval.

2.3.3. Inscriptions other than those covered by paragraphs 2.3.1 and 2.4.4 may be affixed, on the condition that they do not adversely affect the luminous characteristics.

2.4. Approval

2.4.1. If all samples of a type of LED light source which are submitted in pursuance of paragraphs 2.2.2.3 or 2.2.3.2 above meet the requirements of this Regulation, approval shall be granted.

2.4.2. An approval code shall be assigned to each type approved. Its first character shall indicate the series of amendments at the time of issue of the approval.

This will be followed by an identification code comprising not more than three characters. Only the following Arabic numerals and capital letters shall be used:

'0 1 2 3 4 5 6 7 8 9 A B C D E F G H J K L M N P R S T U V W X Y Z'.

The same Contracting Party may not assign the same code to another type of LED light sources.

2.4.3. Notice of approval or of extension or refusal or withdrawal of approval or production definitely discontinued of a type of LED light sources pursuant to this Regulation shall be communicated to the Parties of the Agreement which apply this Regulation by means of a form conforming to the model in Annex 2 to this Regulation and of a drawing, supplied by the applicant for approval in a format not exceeding A4 (210 × 297 mm) and on a scale of at least 2:1.

2.4.4. To every LED light source conforming to a type approved under this Regulation there shall be affixed in the space referred to in paragraph 2.3.1.4, in addition to the inscriptions required under paragraph 2.3.1, an international approval mark consisting of:

2.4.4.1. A truncated circle surrounding the letter 'E' followed by the distinguishing number of the country which has granted approval ⁽¹⁾;

2.4.4.2. The approval code, placed close to the truncated circle.

2.4.5. If the applicant has obtained the same approval code for several trade names or marks, one or more of them will suffice to meet the requirements of paragraph 2.3.1.1.

2.4.6. The marks and inscriptions specified in paragraphs 2.3.1 and 2.4.4 shall be clearly legible and be indelible.

2.4.7. Annex 3 to this Regulation gives an example of arrangement of the approval mark.

3. TECHNICAL REQUIREMENTS

3.1. Definitions

The definitions given in Resolution R.E.5 or its subsequent revisions, applicable at the time of application for type-approval, shall apply.

3.2. General specifications

3.2.1. Each sample submitted shall conform to the relevant specifications of this Regulation.

3.2.2. LED light sources shall be so designed as to be and to remain in good working order when in normal use. They shall moreover exhibit no fault in design or manufacture.

3.2.3. LED light sources shall exhibit no scores or spots on their optical surfaces which might impair their efficiency and their optical performance. This shall be verified when commencing approval testing and when required in the respective paragraphs in this Regulation.

3.2.4. LED light sources shall be equipped with standard caps complying with the cap data sheets of IEC Publication 60061 as specified on the individual data sheets of Annex 1.

⁽¹⁾ As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3.), document ECE/TRANS/WP.29/78/Rev.2, para. 2

- 3.2.5. The cap shall be strong and firmly secured to the rest of the LED light source.
- 3.2.6. To ascertain whether LED light sources conform to the requirements of paragraphs 3.2.3 to 3.2.5 above, a visual inspection, a dimension check and, where necessary, a trial fitting into the holder as specified in IEC publication 60061 shall be carried out.
- 3.2.7. The solid state junction(s) and possibly one or more elements for fluorescence-based conversion shall be the only element(s) of the LED light source that generate(s) and emit(s) light when energized.
- 3.3. Tests
 - 3.3.1. LED light sources shall first be aged at their test voltage for at least forty-eight hours. For multi-function LED light sources, each function shall be aged separately.
 - 3.3.2. Unless otherwise specified, electrical and photometric measurements shall be carried out at the relevant test voltage(s).
 - 3.3.3. Electrical measurements as specified in Annex 4 shall be carried out with instruments of at least class 0,2 (0,2 per cent full scale accuracy).
- 3.4. Position and dimensions of light emitting area
 - 3.4.1. The position and dimensions of the light emitting area shall conform to the requirements as given on the relevant data sheet of Annex 1.
 - 3.4.2. The measurement shall be made after ageing the LED light source according to paragraph 3.3.1.
- 3.5. Luminous flux
 - 3.5.1. When measured according to the conditions specified in Annex 4, the luminous flux shall be within the limits given on the relevant data sheet of Annex 1.
 - 3.5.2. The measurement shall be made after ageing the LED light source according to 3.3.1.
- 3.6. Normalized luminous intensity distribution/cumulative luminous flux distribution
 - 3.6.1. When measured according to the test conditions specified in Annex 4 to this Regulation, the normalized luminous intensity distribution and/or cumulative luminous flux distribution shall be within the limits given on the relevant data sheet of Annex 1.
 - 3.6.2. The measurement shall be made after ageing the LED light source according to paragraph 3.3.1.
- 3.7. Colour
 - 3.7.1. The colour of the light emitted by the LED light sources shall be specified on the relevant data sheet. The definitions of the colour of the light emitted given in Regulation No 48 and its series of amendments in force at the time of application for type approval shall apply to this regulation.
 - 3.7.2. The colour of the light emitted shall be measured by the method specified in Annex 4. The measured integral value of the chromaticity coordinates shall lie within the required chromaticity area.
 - 3.7.2.1. Moreover, in the case of LED light sources emitting white light and for use in forward lighting devices, the colour shall be measured in the same directions as where the luminous intensity distribution is specified in the relevant data sheet, but only where the specified minimum luminous intensity is exceeding 50 cd/klm. Each measured value of the chromaticity coordinates shall lie within a tolerance area of 0,025 units in the x direction and 0,050 units in the y direction, containing the measured integral value. The measured value in the direction of maximum luminous intensity and all measured values for a standard (étalon) LED light source shall also lie within the required chromaticity area for white light.

- 3.7.3. Moreover, in the case of LED light sources emitting white light, the minimum red content of the light shall be such that:

$$k_{\text{red}} = \frac{\int_{\lambda=610 \text{ nm}}^{780 \text{ nm}} E_e(\lambda) V(\lambda) d\lambda}{\int_{\lambda=380 \text{ nm}}^{780 \text{ nm}} E_e(\lambda) V(\lambda) d\lambda} \geq 0,05$$

where:

$E_e(\lambda)$ (unit: W) is the spectral distribution of the irradiance;

$V(\lambda)$ (unit: 1) is the spectral luminous efficiency;

λ (unit: nm) is the wavelength.

This value shall be calculated using intervals of one nanometre.

3.8. UV-radiation

The UV-radiation of the LED light source shall be such that the LED light source is of the low UV type complying with:

$$k_{\text{UV}} = \frac{\int_{\lambda=250 \text{ nm}}^{400 \text{ nm}} E_e(\lambda) S(\lambda) d\lambda}{k_m \int_{\lambda=380 \text{ nm}}^{780 \text{ nm}} E_e(\lambda) V(\lambda) d\lambda} \leq 10^{-5} \text{ W/lm}$$

where:

$S(\lambda)$ (unit: 1) is the spectral weighting function;

$k_m = 683 \text{ lm/W}$ is the maximum value of the luminous efficacy of radiation.

(For definitions of the other symbols see paragraph 3.7.3 above).

This value shall be calculated using intervals of one nanometre. The UV-radiation shall be weighted according to the values as indicated in the table below:

λ	$S(\lambda)$	λ	$S(\lambda)$	λ	$S(\lambda)$
250	0,430	305	0,060	355	0,00016
255	0,520	310	0,015	360	0,00013
260	0,650	315	0,003	365	0,00011
265	0,810	320	0,001	370	0,00009
270	1,000	325	0,00050	375	0,000077
275	0,960	330	0,00041	380	0,000064
280	0,880	335	0,00034	385	0,000053
285	0,770	340	0,00028	390	0,000044
290	0,640	345	0,00024	395	0,000036
295	0,540	350	0,00020	400	0,000030
300	0,300				

Note: Values according to 'IRPA/INIRC Guidelines on limits of exposure to ultraviolet radiation'. Wavelengths (in nanometres) chosen are representative; other values should be interpolated.

3.9. Standard LED light sources

Additional requirements for standard (étalon) LED light sources are given on the relevant data sheets of Annex 1.

3.10. Maximum test temperature

In case a maximum test temperature is specified in the relevant data sheet of Annex 1, the following requirements shall apply:

3.10.1. When measured according to the conditions specified in Annex 4, paragraph 5:

- (a) the luminous flux values at elevated temperatures shall be within the limits given in the relevant data sheet of Annex 1; and
- (b) the colour variation shall not exceed 0,010.

3.10.2. After completion of the measurement procedure as prescribed in paragraph 3.10.1, the LED light source shall be continuously operated during 1 000 h at the relevant test voltage(s); and

- (a) in case of an integrated heatsink at an ambient temperature corresponding to the maximum test temperature as specified in the relevant data sheet of Annex 1;
- (b) in case of a specified T_b -point at a T_b -value corresponding to the maximum test temperature as specified in the relevant data sheet of Annex 1.

3.10.3. After completion of the procedure as prescribed in paragraph 3.10.2, when measured according to the conditions specified in Annex 4, paragraph 5:

- (a) the luminous flux values at elevated temperatures shall not deviate by more than ± 10 per cent from the corresponding values of the individual sample measured according to paragraph 3.10.1; and
- (b) the colour variation shall not deviate from the corresponding values of the individual sample measured according to paragraph 3.10.1 by more than $\pm 0,010$.

3.10.4. After completion of the measurement procedure as prescribed by paragraph 3.10.3, the requirements in 3.2.3 shall be verified again.

3.11. LED light sources without general restrictions

3.11.1. Light emitting area characteristics

The size and position of the nominal emitter box as well as the side(s) of the light emitting area capable to generate the cut-off are specified in the relevant data sheet of Annex 1.

The values of the following characteristics shall be determined by using the method described in Annex 9:

- (a) luminance contrast;
- (b) size and position of zone 1a and zone 1b;
- (c) surface ratio $R_{0,1}$ and $R_{0,7}$
- (d) value of maximum deviation ΔL .

3.11.2. Luminance contrast of the light emitting area

3.11.2.1. The value(s) of luminance contrast of the light emitting area shall be within the limits given on the relevant data sheet of Annex 1.

3.11.2.2. In case in the relevant data sheet only one side of the light emitting area is specified as to generate the cut-off, zone 1b shall have a position closer to the corresponding side of zone 1a than to the opposite side.

3.11.3. Luminance uniformity of the light emitting area

3.11.3.1. The area of zone 1a (light emitting area) shall be within the nominal emitter box as specified in the relevant data sheet of Annex 1, and the size of the light emitting area shall be within the limits given on the relevant data sheet of Annex 1.

3.11.3.2. The value of $R_{0,1}$ shall be within the limits given on the relevant data sheet of Annex 1.

3.11.3.3. The value of $R_{0,7}$ shall be within the limits given on the relevant data sheet of Annex 1.

3.11.3.4. The deviation of the luminance ΔL shall not exceed ± 20 per cent.

4. CONFORMITY OF PRODUCTION

4.1. LED light sources approved to this Regulation shall be so manufactured as to conform to the type approved by meeting the inscriptions and technical requirements set forth in paragraph 3 above and Annexes 1, 4 and 5 to this Regulation.

4.2. In order to verify that the requirements of paragraph 4.1 are met, suitable controls of the production shall be carried out.

4.3. The holder of the approval shall in particular:

4.3.1. Ensure existence of procedures for the effective control of the quality of products,

4.3.2. Have access to the control equipment necessary for checking the conformity to each approved type,

4.3.3. Ensure that data of test results are recorded and that related documents shall remain available for a period to be determined in accordance with the Type Approval Authority,

4.3.4. Analyse the results of each type of test, applying criteria of Annex 6, in order to verify and ensure the stability of the product characteristics making allowance for variation of an industrial production,

4.3.5. Ensure that for each type of LED light source, at least the tests prescribed in Annex 5 to this Regulation are carried out,

4.3.6. Ensure that any collecting of samples giving evidence of non-conformity with the type of test considered shall give rise to another sampling and another test. All the necessary steps shall be taken to re-establish the conformity of the corresponding production.

4.4. The competent authority which has granted type-approval may at any time verify the conformity control methods applicable to each production unit.

4.4.1. In every inspection, the test books and production survey records shall be presented to the visiting inspector.

4.4.2. The inspector may take samples at random which will be tested in the manufacturer's laboratory. The minimum number of samples may be determined according to the results of the manufacturer's own verification.

4.4.3. When the quality level appears unsatisfactory or when it seems necessary to verify the validity of the tests carried out in application of paragraph 4.4.2. above, the inspector shall select samples, to be sent to the technical service which has conducted the type approval tests.

4.4.4. The competent authority may carry out any tests prescribed in this Regulation. Where the competent authority decides to carry out spot checks, criteria of Annexes 7 and 8 to this Regulation shall be applied.

4.4.5. The normal frequency of inspection authorised by the competent authority shall be one every two years. In the case where negative results are recorded during one of these visits, the competent authority shall ensure that all necessary steps are taken to re-establish the conformity of production as rapidly as possible.

5. PENALTIES FOR NON-CONFORMITY OF PRODUCTION

5.1. The approval granted in respect of a LED light source pursuant to this Regulation may be withdrawn if the requirements are not met or if a LED light source bearing the approval mark does not conform to the type approved.

5.2. If a Contracting Party to the Agreement applying this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation, by means of a communication form conforming to the model in Annex 2 to this Regulation.

6. PRODUCTION DEFINITELY DISCONTINUED

If the holder of the approval completely ceases to manufacture a type of LED light source approved in accordance with this Regulation, he shall so inform the Type Approval Authority which has granted the approval. Upon receiving the relevant communication, that Authority shall inform thereof the other Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in Annex 2 to this Regulation.

7. NAMES AND ADDRESSES OF THE TECHNICAL SERVICES RESPONSIBLE FOR CONDUCTING APPROVAL TESTS, AND OF TYPE APPROVAL AUTHORITIES

The Parties to the 1958 Agreement which apply this Regulation shall communicate to the United Nations secretariat the names and addresses of the Technical Services responsible for conducting approval tests and of the Type Approval Authorities which grant approval and to which forms certifying approval or extension or refusal or withdrawal of approval, or production definitively discontinued issued in other countries, are to be sent.

ANNEX 1

SHEETS ⁽¹⁾ FOR LED LIGHT SOURCES

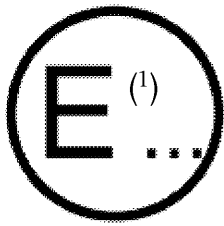
The sheets of the relevant LED light source category and the group in which this category is listed with restrictions on the use of this category shall apply as incorporated in Resolution R.E.5 or its subsequent revisions, applicable at the time of application for type approval of the LED light source.

⁽¹⁾ From 22 June 2017 onwards, the sheets for LED light sources, the list and group of light source categories with restrictions on the use of this category and their sheet numbers are incorporated in Resolution R.E.5 with symbol ECE/TRANS/WP.29/2016/111.

ANNEX 2

COMMUNICATION

(maximum format: A4 (210 × 297 mm))



issued by: Name of administration

.....

.....

.....

concerning ⁽²⁾: Approval granted

Approval extended

Approval refused

Approval withdrawn

Production definitively discontinued

of a type of LED light source pursuant to Regulation No 128

Approval No Extension No

1. Trade name or mark of the device:
2. Manufacturer's name for the type of device:
3. Manufacturer's name and address:
4. If applicable, name and address of manufacturer's representative:
5. Submitted for approval on:
6. Technical Service responsible for conducting approval tests:
7. Date of report issued by that Service:
8. Number of report issued by that Service:
9. Concise description:
- Category of LED light source:
- Rated voltage:
- Colour(s) of the light emitted: White/amber/red ⁽²⁾
10. Position of the approval mark:
11. Reason(s) for extension (if applicable):
12. Approval granted/refused/extended/withdrawn ⁽²⁾:
13. Place:
14. Date:
15. Signature:
16. The following documents, bearing the approval mark shown above, are available on request:

⁽¹⁾ Distinguishing number of the country which has granted/refused/withdrawn approval (see approval provisions in the Regulation).

⁽²⁾ Strike out what does not apply.

ANNEX 3

EXAMPLE OF THE ARRANGEMENT OF THE APPROVAL MARK

(see paragraph 2.4.4)

 $a = 2,5 \text{ mm min.}$

The above approval mark affixed to a LED light source indicates that the light source has been approved in the United Kingdom (E11) under the approval code 0A01. The first character of the approval code indicates that the approval was granted in accordance with the requirements of Regulation No 128 (*) in its original form.

(*) Not requiring changes in the approval number.

ANNEX 4

METHOD OF MEASUREMENT OF ELECTRICAL AND PHOTOMETRICAL CHARACTERISTICS

LED light sources of all categories with integrated heatsink shall be measured at ambient temperature of $(23 \pm 2) ^\circ\text{C}$ in still air. For these measurements, the minimum free air space as defined in the data sheets shall be maintained.

LED light sources of all categories with definition of a temperature T_b shall be measured by stabilising the T_b -point at the specific temperature defined on the category data sheet.

In case a maximum test temperature is specified in the relevant data sheet of Annex 1 additional measurements shall be carried out at elevated temperatures according to the method described in paragraph 5 of this annex.

1. LUMINOUS FLUX

1.1. A luminous flux measurement using an integrating method shall be made

- (a) in case of an integrated heatsink after 1 minute and after 30 minutes of operation; or
- (b) after stabilisation of the temperature at the T_b point.

1.2. The luminous flux values, as measured after

- (a) 30 minutes; or
- (b) stabilisation of temperature T_b ,

shall comply with the minimum and maximum requirements.

In case of (a), unless otherwise specified on the data sheet, this value shall be in between 100 per cent and 80 per cent of the value measured after 1 minute.

1.3. Measurements have to be carried out at relevant test voltage and at the minimum and maximum values of the relevant voltage range. Unless specified more tightly on the data sheet the following deviation of the luminous flux at the tolerance interval limits shall not be exceeded.

Rated voltage	Min. voltage	Max. voltage
6	6,0	7,0
12	12,0	14,0
24	24,0	28,0
Corresponding luminous flux tolerance (*)	$\pm 30 \%$	$\pm 15 \%$

(*) The maximum luminous flux deviation at the tolerance limits is calculated by using the measured flux at test voltage as reference. In between test voltage and voltage range limits the luminous flux behaviour shall be substantially uniform.

2. NORMALIZED LUMINOUS INTENSITY/CUMULATIVE LUMINOUS FLUX

2.1. The luminous intensity measurements shall be started

- (a) in case of an integrated heatsink after 30 minutes of operation; or
- (b) in case of a T_b point, specified in the relevant data sheet, after stabilisation of the temperature at this T_b point.

2.2. Measurements have to be carried out at relevant test voltage.

2.3. Normalized luminous intensity of a test sample is calculated by dividing the luminous intensity distribution as measured under paragraph 2.1 and 2.2 of this annex by the luminous flux as determined under paragraph 1.2 of this annex.

2.4. Cumulative luminous flux of a test sample is calculated according to CIE publication 84-1989, Section 4.3 by integrating the luminous intensity values as measured under 2.1 and 2.2 within a cone enclosing a solid angle.

3. COLOUR

The colour of the light emitted as measured under the same conditions as described paragraph in 1.1 of this annex shall both be within the required colour boundaries.

4. POWER CONSUMPTION

4.1. A power consumption measurement shall be made under the same conditions as described in paragraph 1.1 of this annex using the requirements of paragraph 3.3.3 of this Regulation.

4.2. Power consumption measurements shall be carried out at relevant test voltage.

4.3. Values obtained shall comply with the minimum and maximum requirements of the relevant data sheet.

5. PHOTOMETRIC MEASUREMENTS IN CASE A MAXIMUM TEST TEMPERATURE IS SPECIFIED

5.1. Temperature and temperature range

5.1.1. Photometric measurements as specified in paragraphs 5.3, 5.4 and 5.5 shall be carried out at elevated temperatures T in steps not larger than $25\text{ }^{\circ}\text{C}$, while the LED light source is continuously operated.

5.1.1.1. In case of LED light sources of a category with integrated heatsink the temperature range is defined by the ambient temperature of $(23 \pm 2)\text{ }^{\circ}\text{C}$ elevated up to and including the maximum test temperature as specified in the relevant data sheet of Annex 1, whereas the minimum free air space as defined in the relevant data sheet shall be maintained and a period of 30 minutes of operation shall be awaited after each increase of the ambient temperature.

5.1.1.2. In case of LED light sources of a category, for which a temperature T_b is specified, the temperature range is defined by the temperature T_b specified in the relevant data sheet elevated up to and including the maximum test temperature as specified in the relevant data sheet of Annex 1, whereas the temperature at the T_b -point is stabilised before each measurement.

5.2. Voltage

Measurements shall be carried out at relevant test voltage.

5.3. Measurement direction of luminous intensity and colour coordinates

All the values of luminous intensity and the colour coordinates in the temperature range as specified by paragraph 5.1 may be measured in one and the same direction. This direction shall be such that the luminous intensity is exceeding 20 cd for all measurements.

5.4. Luminous flux values at elevated temperatures

The values of the luminous flux at elevated temperatures T in the range as specified by paragraph 5.1 may be calculated by correcting the value of the luminous flux as measured according to paragraph 1.2 of this annex, by the ratio of the luminous intensity values as described in paragraph 5.3 and the luminous intensity value measured at:

(a) $23\text{ }^{\circ}\text{C}$, in case of an integrated heatsink;

(b) T_b , in case a temperature T_b is defined.

5.5. Colour variation

The colour variation is the maximum deviation of all colour points (given by the chromaticity coordinates x , y) at elevated temperatures T in the range as specified by paragraph 5.1, from the colour point (x_0, y_0) at:

- (a) 23 °C, in case of an integrated heatsink:

$$\max\{\sqrt{[(x(T) - x_0(23\text{ °C}))^2 + (y(T) - y_0(23\text{ °C}))^2]}\};$$

- (b) T_b , in case a temperature value T_b is defined:

$$\max\{\sqrt{[(x(T) - x_0(T_b))^2 + (y(T) - y_0(T_b))^2]}\}.$$

ANNEX 5

MINIMUM REQUIREMENTS FOR QUALITY CONTROL PROCEDURES BY THE MANUFACTURER

1. GENERAL

The conformity requirements shall be considered satisfied from a photometric, geometrical, visual and electrical standpoint if the specified tolerances for production LED light sources in the relevant data sheet of Annex 1 and the relevant data sheet for the caps are met.

2. MINIMUM REQUIREMENTS FOR VERIFICATION OF CONFORMITY BY THE MANUFACTURER

For each type of LED light source the manufacturer or the holder of the approval mark shall carry out tests, in accordance with the provisions of this Regulation, at appropriate intervals.

2.1. Nature of tests

Tests of conformity of these specifications shall cover their photometric, geometrical and optical characteristics.

2.2. Methods used in tests

2.2.1. Tests shall generally be carried out in accordance with the methods set out in this Regulation.

2.2.2. The application of paragraph 2.2.1 of this annex requires regular calibration of test apparatus and its correlation with measurements made by a competent authority.

2.3. Nature of sampling

Samples of LED light sources shall be selected at random from the production of a uniform batch. A uniform batch means a set of LED light sources of the same type, defined according to the production methods of the manufacturer.

2.4. Inspected and recorded characteristics

The LED light sources shall be inspected and test results recorded following the grouping of characteristics as listed in Annex 6, Table 1.

2.5. Criteria governing acceptability

The manufacturer or the holder of approval is responsible for carrying out a statistical study of the test results in order to meet the specifications laid down for verification of conformity of production in paragraph 4.1 of this Regulation.

Compliance shall be assured if the level of acceptable non-compliance per grouping of characteristics given in Table 1 of Annex 6 is not exceeded. This means that the number of LED light sources not complying with the requirement for any grouping of characteristics of any LED light sources type does not exceed the qualifying limits in the relevant Tables 2, 3 or 4 of Annex 6.

Note: Each individual LED light source requirement shall be considered as a characteristic.

ANNEX 6

SAMPLING AND COMPLIANCE LEVELS FOR MANUFACTURER TEST RECORDS

Table 1

Characteristics

Grouping of characteristics	Grouping (*) of test records between LED light source types	Minimum 12 monthly sample per grouping (*)	Acceptable level of non-compliance per grouping of characteristics (percentage)
Marking, legibility and durability	All types with the same external dimensions	315	1
External LED light source dimensions (excluding cap/base)	All types of the same category	200	1
Dimensions of caps and bases	All types of the same category	200	6,5
Dimensions related to light emitting surface and internal elements (**)	All LED light sources of one type	200	6,5
Initial readings, power, colour and luminous flux (**)	All LED light sources of one type	200	1
Normalised luminous intensity or cumulative luminous flux distribution	All LED light sources of one type	20	6,5

(*) The assessment shall in general cover series production LED light sources from individual factories. A manufacturer may group together records concerning the same type from several factories, provided these operate under the same quality system and quality management.

(**) In case a LED light source has more than one light output function the grouping of characteristics (dimensions, power, colour and luminous flux) applies to each element separately.

Qualifying limits for acceptance based on different numbers of test results for each grouping of characteristics are listed in Table 2 as maximum number of non-compliance. The limits are based on an acceptable level of 1 per cent of non-compliance, assuming an acceptance probability of at least 0,95.

Table 2

Number of test results of each characteristics	Qualifying limits for acceptance
20	0
21-50	1
51-80	2
81-125	3
126-200	5
201-260	6
261-315	7
316-370	8
371-435	9
436-500	10
501-570	11
571-645	12
646-720	13
721-800	14

Number of test results of each characteristics	Qualifying limits for acceptance
801-860	15
861-920	16
921-990	17
991-1 060	18
1 061-1 125	19
1 126-1 190	20
1 191-1 249	21

Qualifying limits for acceptance based on different numbers of test results for each grouping of characteristics are listed in Table 3 given as maximum number of non-compliance. The limits are based on an acceptable level of 6,5 per cent of non-compliance, assuming an acceptance probability of at least 0,95.

Table 3

Number of LED light sources in records	Qualifying limit	Number of LED light sources in records	Qualifying limit	Number of LED light sources in records	Qualifying limit
20	3	500-512	44	881-893	72
21-32	5	513-526	45	894-907	73
33-50	7	527-540	46	908-920	74
51-80	10	541-553	47	921-934	75
81-125	14	554-567	48	935-948	76
126-200	21	568-580	49	949-961	77
201-213	22	581-594	50	962-975	78
214-227	23	595-608	51	976-988	79
228-240	24	609-621	52	989-1 002	80
241-254	25	622-635	53	1 003-1 016	81
255-268	26	636-648	54	1 017-1 029	82
269-281	27	649-662	55	1 030-1 043	83
282-295	28	663-676	56	1 044-1 056	84
296-308	29	677-689	57	1 057-1 070	85
309-322	30	690-703	58	1 071-1 084	86
323-336	31	704-716	59	1 085-1 097	87
337-349	32	717-730	60	1 098-1 111	88
350-363	33	731-744	61	1 112-1 124	89
364-376	34	745-757	62	1 125-1 138	90
377-390	35	758-771	63	1 139-1 152	91
391-404	36	772-784	64	1 153-1 165	92
405-417	37	785-798	65	1 166-1 179	93
418-431	38	799-812	66	1 180-1 192	94
432-444	39	813-825	67	1 193-1 206	95

Number of LED light sources in records	Qualifying limit	Number of LED light sources in records	Qualifying limit	Number of LED light sources in records	Qualifying limit
445-458	40	826-839	68	1 207-1 220	96
459-472	41	840-852	69	1 221-1 233	97
473-485	42	853-866	70	1 234-1 249	98
486-499	43	867-880	71		

Qualifying limits for acceptance based on different numbers of test results for each grouping of characteristics are listed in Table 4 given as a percentage of the results, assuming an acceptance probability of at least 0,95.

Table 4

Number of test results of each characteristic	Qualifying limits shown as a percentage of results. Acceptable level of 1 % of non-compliance	Qualifying limits shown as a percentage of results. Acceptable level of 6,5 % of non-compliance
1 250	1,68	7,91
2 000	1,52	7,61
4 000	1,37	7,29
6 000	1,30	7,15
8 000	1,26	7,06
10 000	1,23	7,00
20 000	1,16	6,85
40 000	1,12	6,75
80 000	1,09	6,68
100 000	1,08	6,65
1 000 000	1,02	6,55

ANNEX 7

MINIMUM REQUIREMENTS FOR SPOT CHECKS BY THE TYPE APPROVAL AUTHORITY

1. General

The conformity requirements shall be considered satisfied from a photometric, geometrical, visual and electrical standpoint if the specified tolerances for production LED light sources in the relevant data sheet of Annex 1 and the relevant data sheet for the caps are met.

2. The conformity of mass-produced LED light sources shall not be contested if the results are in agreement with Annex 8 to this Regulation.
 3. Conformity shall be contested and the manufacturer requested to make the production meet the requirements if the results are not in agreement with Annex 8 to this Regulation.
 4. If paragraph 3 of this annex is applied, a further sample of 250 LED light sources, selected at random from a recent production run, shall be taken within two months.
-

ANNEX 8

COMPLIANCE APPROVED BY SPOT CHECK

Compliance approved or disapproved shall be decided according to the values in Table. For each grouping of characteristics LED light sources shall be either accepted or rejected according to the values in the table ⁽¹⁾.

	1 % (*)		6,5 % (*)	
	Accept	Reject	Accept	Reject
First sample size: 125 units	2	5	11	16
If the number of non-conforming units is greater than 2 (11) and less than 5 (16) take a second sample size of 125 units and assess the 250 units	6	7	26	27

(*) The LED light sources shall be inspected and test results recorded following the grouping of characteristics as listed in Annex 6, Table 1.

⁽¹⁾ The proposed scheme is designed to assess the compliance of LED light sources to an acceptance level of non-compliance of 1 per cent and 6,5 per cent respectively and is based on the Double Sampling Plan for Normal Inspection in IEC Publication 60410: Sampling Plans and Procedures for Inspection by Attributes.

ANNEX 9

METHOD FOR THE MEASUREMENT OF LUMINANCE CONTRAST AND LUMINANCE UNIFORMITY OF THE LIGHT EMITTING AREA

1. The luminance measurement equipment shall be capable to distinguish clearly whether the luminance contrast of the light emitting area is above or below the required level for the LED light source under test.

Further, this equipment shall have a resolution of 20 μm or smaller in an area that is larger than the light emitting area of the LED light source under test. In case this equipment has a resolution of less than 10 μm , adjacent luminance measurement values shall be arithmetically averaged so as to represent a luminance value of an area of between 10 μm and 20 μm .

2. The luminance measurements of an area shall be done in an equidistant grid in both directions.
3. Zone 1a and zone 1b shall be determined from luminance measurements of an area which consists of the nominal emitter box as specified in the relevant data sheet of Annex 1 and enlarged to all sides by 10 per cent of the corresponding box dimension (see figure 1). The value L_{98} is the 98th percentile of all values of these luminance measurements.
 - 3.1. Zone 1a (light emitting area) shall be the smallest circumferential rectangle having the same orientation as the nominal emitter box and containing all luminance measurements with a value of 10 per cent or more of the value L_{98} . The value L_1 shall be the arithmetic average of the values of all luminance measurements in zone 1a (see figure 2). The value of $R_{0,1}$ shall be the surface ratio of zone 1a where the luminance value is exceeding 10 per cent of the value L_1 . The value of $R_{0,7}$ shall be the surface ratio of zone 1a where the luminance value is exceeding 70 per cent of the value L_1 .
 - 3.2. Zone 1b shall be the smallest circumferential rectangle having the same orientation as the nominal emitter box and containing all luminance measurements with a value of 70 per cent or more of the value L_{98} .
4. Zone 2 shall have in both directions 1,5 times the size of the nominal emitter box as specified in the relevant data sheet of Annex 1 and it shall be positioned symmetrically to the nominal emitter box at a distance of $d_0 = 0,2 \text{ mm}$ to zone 1a, unless otherwise specified on the data sheet (see figure 3). The value L_2 shall be the arithmetic average of 1 per cent of all measured luminance values in zone 2 which represent the highest values.

In case in the relevant data sheet more than one side of zone 1a (light emitting area) is specified as to generate the cut-off, for each of these sides a value L_2 shall be determined as described above.

5. The luminance contrast value(s) shall be the ratio of the luminance value L_1 of zone 1a and the luminance value L_2 of zone(s) 2.
6. In case the nominal emitter box as specified in the relevant data sheet of Annex 1 is subdivided in n areas (e.g. $n = 1 \times 4$), the same subdivision shall also apply to zone 1a.
 - 6.1. For each of the n areas the value $L_{1,i}$ ($i = 1, \dots, n$) shall be the arithmetic average of the values of all luminance measurements in the corresponding area.
 - 6.2. The value ΔL shall be the maximum relative deviation of all luminance values $L_{1,i}$ from the luminance value L_1 .

$$\Delta L = \text{Max} \{ (L_{1,i} - L_1) / L_1; i = 1, \dots, n \}$$

Figure 1

Enlargement of the nominal emitter box

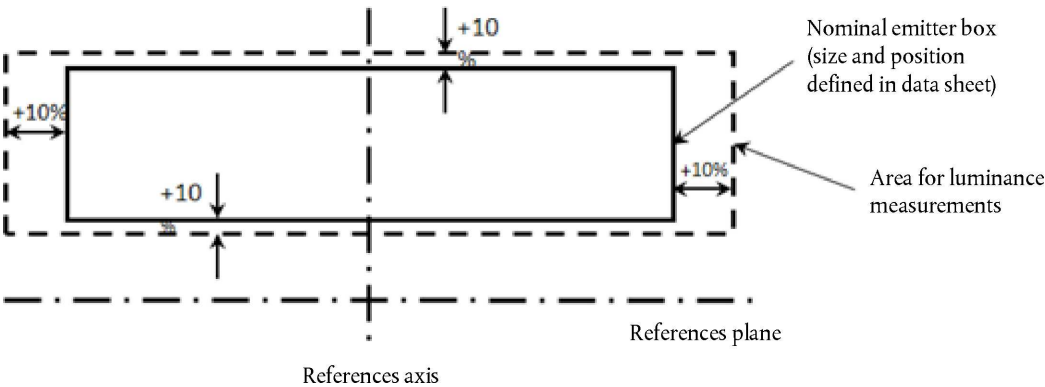


Figure 2

Definition of zones 1a and 1b

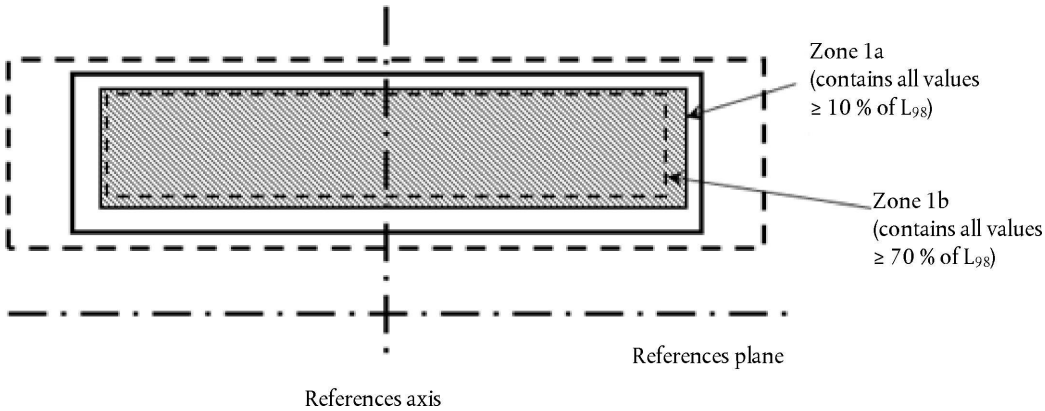


Figure 3

Definition of zone 2

