

91 Light signaling devices (LSD)

Refer to: R148 00

91.1 Effective date and Scope:

- 91.1.1 Effective date from 2025/1/1, new types of light signaling devices components using in vehicles of category symbols M, N, O and L, shall comply with this regulation and shall use the light source that is conform with “Filament lamps” and/or “LED light sources” of this Direction.
- 91.1.2 For the vehicles imported by authorities, organizations, institutes or individuals for self-use only may be exempt from regulation of “Light signaling devices (LSD)”. For the vehicles imported by authorities, organizations, institutes or individuals for self-use, if the vehicle registered and owned by the importer for more than six months from abroad, it could exempt from the regulation of " Light signaling devices (LSD)".
- 91.1.3 For the low volume type safety approval, maximum 20% deviation of the levels of intensity standard of this test is allowed, and if the light source is LED, it can omit the failure conditions test.
- 91.1.4 The applicants applying for low volume safety type approval may be exempt from regulation of “Rear fog lamps” and “Daytime running lamps” except for large passenger vehicle and child-only vehicle.
- 91.1.5 Applying for vehicle-by-vehicle low volume safety type approval, the vehicle may be exempt from regulation of “Rear fog lamps” and “Daytime running lamps”.
- 91.1.6 Technical Service can carry out test according to UN Regulations that this direction harmonized with: UN R148 00 Series of amendments and following amendments of above-mentioned regulations.

91.2 Definitions:

- 91.2.1 "Light signaling devices” means the devices include “Direction indicator lamps”, “Front position lamps”, “Rear position lamp”,

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“Parking lamps”, “Stop lamps”, “High mounted /S3/S4 lamp”, “End-outline marker lamps”, “Reversing lamps”, “Manoeuvring lamps”, “Rear fog lamps”, “Daytime running lamps”, and “Side marker lamps”. They are summarized under the expression "Light signaling devices ".

91.2.2 All the definitions given in the latest VSTD of “The installation of lighting and light-signaling devices” in force at the time of application for type approval shall apply, unless otherwise specified.

91.3 Light signaling devices shall according to suitable type and range of principle :

91.3.1 The same brand

91.3.1.1 Lamps bearing the same brand but produced by different manufacturers are considered as being of different types.

91.3.1.2 Lamps produced by the same manufacturer differing only by the brand are considered as being of the same type.

In the case of a type of lamp differing only by the brand (or mark) from a type that has already been approved it shall be sufficient to submit:

(a) A declaration by the lamp manufacturer that the type submitted is identical (except in the brand or mark) with and has been produced by the same manufacturer as the type already approved, the latter being identified by its approval code.

(b) Two samples bearing the new brand name or mark or equivalent documentation.

91.3.2 The same characteristics of the optical system (levels of intensity, light distribution angles, inclusion or elimination of components capable of altering the optical effects by reflection, refraction, absorption and/ or deformation during operation, etc).

91.3.3 The same category or categories of light source(s) used and/or the specific identification code (s) of the light source module(s);

91.3.4 The same category of the lamp, if any.

91.3.5 The same variable intensity control, if any.

91.3.6 The same sequential activation of light sources, if any. Nevertheless, direction indicators capable of being activated in different

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modes (sequential or not) without any modification of the optical characteristics of the lamp do not constitute "Direction indicators of different types.

A change of the colour of the light source or the colour of any filter does not constitute a change of type.

91.4 General technical requirements

Each lamp submitted for approval shall conform to the requirements set forth in paragraph 91.4 and 91.5.

91.4.1 The requirements contained in paragraph 91.4, 91.5, 91.6 of "The installation of lighting and light-signaling devices" of VSTD, are applicable to the lamps applying for this Regulation.

The requirements pertinent to each lamp and to the category/ies of vehicle on which the lamp is intended to be installed shall be applied, where its verification at the moment of lamp type approval is feasible.

91.4.2 The 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.

91.4.3 Light sources:

91.4.3.1 In the case of replaceable light source(s):

91.4.3.1.1 The device shall only be equipped with light source(s) approved according to "VSTD" of "Filament lamps" and/or "LED light sources" may be used, it's shall concern about relevant special restriction.

91.4.3.1.2 The design of the device shall be such that the light source can be fixed in no other position but the correct one.

91.4.3.1.3 The light source holder shall conform to the characteristics given in IEC Publication 60061. The holder data sheet relevant to the category of light source used, applies.

91.4.3.2 In the case of light source modules, it shall be checked that:

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91.4.3.2.1 The design of the light source module(s) shall be such as:

91.4.3.2.1.1 That each light source module can only be fitted in no other position than the designated and correct one and can only be removed with the use of tool(s).

91.4.3.2.1.2 If there are more than one light source module used in the housing for a lamp, light source modules having different characteristics cannot be interchanged within the same lamp housing.

91.4.3.2.2 The light source module(s) shall be tamperproof.

91.4.3.2.3 A light source module shall be so designed that regardless of the use of tool(s), it shall not be mechanically interchangeable with any replaceable approved light source.

91.4.4 Independent and interdependent lamps

91.4.4.1 An assembly of two independent lamps to be type approved as lamp marked "D" is applicable to front and rear position lamps (except for categories MA, MR, stop lamps except for category MS, front and rear end-outline marker lamps and direction indicator lamps except for categories 11, 11a, 11b, 11c and 12);

91.4.4.2 An interdependent lamp system to be type approved as lamps marked "Y" is applicable to front and rear position lamps, stop lamps, front and rear end-outline marker lamps, daytime running lamps and direction indicator lamps of categories 1, 1a, 1b, 2a, 2b.

91.4.5 Lamps as such or grouped, combined, reciprocally incorporated:

91.4.5.1 Lamps having been approved as front or rear position lamps, are deemed being also approved end-outline marker lamps.

91.4.5.2 Front and rear position lamps which are grouped or combined or reciprocally incorporated may also be used as end-outline marker lamps.

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91.4.5.3 Position lamps or daytime running lamps, which are reciprocally incorporated with another function, using a common light source, and designed to operate permanently with an additional system to regulate the intensity of the light emitted, are permitted.

91.4.5.4 However, in the case of rear position lamp reciprocally incorporated with a stop lamp, the lamp shall either:

- (a) Be a part of a multiple light source arrangement; or
- (b) Be intended for use in a vehicle equipped with a failure monitoring system for that function.

91.4.5.5 If the front position lamp incorporates one or more infrared radiation generators, the photometric and colour requirements for this front position lamp shall be met with and without the operation of the infrared radiation generator(s).

91.4.6 Failure provisions

91.4.6.1 Failure of a single lamp containing more than one light source

91.4.6.1.1 In a single lamp containing more than one light source, a group of light sources, wired so that the failure of any one of them causes all of them to stop emitting light, shall be considered to be one light source.

91.4.6.1.2 In case of failure of any one light source in a single lamp containing more than one light source, at least one of the following provisions shall apply:

- (a) The light intensity complies with the minimum intensity required in the pertinent table of standard light distribution in space as shown in paragraph 91.7 and when all light sources are illuminated the maximum intensities shall not be exceeded; or
- (b) A signal for activation of a tell-tale indicating failure, as indicated in "The installation of lighting and light-signaling devices" of VSTD, is produced, provided that the luminous intensity in the axis of reference is at least 50 per cent of the minimum intensity required. In this case a note in the communication form states that the lamp is only for use on a

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vehicle fitted with a tell-tale indicating failure.

91.4.6.1.3 The requirements of paragraph 91.4.6.1.2. do not apply to daytime running lamps that shall comply with the requirements of paragraph 91.5.4.4.

91.4.6.1.4 The requirements of paragraph 91.4.6.1.2. do not apply to direction indicator lamps of category 1, 1a, 1b, 2a, 2b, 11, 11a, 11b, 11c and 12 that shall comply with the requirements of paragraph 91.5.6.3.

91.4.6.1.5 The requirements of paragraph 91.4.6.1.2. (b) do not apply to stop- and position lamps for vehicles of category L.

91.4.6.2 In case of failure of the variable intensity control of:

- (a) A rear position lamp category R2 emitting more than the maximum value of category R1;
- (b) A rear end-outline marker lamp category RM2 emitting more than the maximum value of category RM1;
- (c) A stop lamp category S2 emitting more than the maximum value of category S1;
- (d) A stop lamp category S4 emitting more than the maximum value of category S3;
- (e) A direction indicator of category 2b emitting more than the maximum value of category 2a;
- (f) A rear fog lamp of category F2 emitting more than the maximum value of category F1.

91.4.7 Test conditions

91.4.7.1 All measurements, photometric and colorimetric, shall be made:

91.4.7.1.1 In case of a lamp with replaceable light source, if not supplied by an electronic light source control gear or a variable intensity control, with an uncoloured or coloured standard light source of the category prescribed for the device, supplied with the voltage:

- (a) In the case of filament light source(s), that is necessary to produce the reference luminous flux required for that category of filament light source;

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(b) In the case of LED light source(s) of 6.75 V, 13.5 V or 28.0 V; the luminous flux value produced shall be corrected.

The correction factor is the ratio between the objective luminous flux and the value of the luminous flux found at the voltage applied.

91.4.7.1.2 In the case of a light source, which is operated independently from vehicle supply voltage and fully controlled by the system, or in the case of a light source supplied by a special power supply, the test voltage as specified by the applicant shall be applied to the input terminals of the light source or 6.75 V, 13.5 V or 28.0 V shall be applied to the input terminals of that system/power supply. The test laboratory may require from the manufacturer this special power supply needed to supply the light sources.

91.4.7.1.3 In the case of a lamp equipped with non-replaceable light sources (filament light sources and other), with the light sources present in the lamp.

91.4.7.1.3.1 If operating directly under vehicle voltage system conditions all measurements on lamps equipped with non-replaceable light sources shall be made at 6.75 V, 13.5 V or 28.0 V, or at a voltage as specified by the applicant with respect to any other vehicle voltage system.

91.4.7.1.3.2 If operated independently from vehicle supply voltage and fully controlled by the system, or in the case of a light source supplied by a special power supply, the test voltage as specified in paragraph 91.4.7.1.3.1. shall be applied to the input terminals of that system/power supply. The test laboratory may require from the manufacturer this special power supply needed to supply the light sources.

91.4.7.1.4 In the case of a system that uses an electronic light source control gear or a variable intensity control, being part of the lamp applying at the input terminals of the lamp the voltage declared by the manufacturer or, if not indicated, 6.75 V, 13.5 V or 28.0 V respectively.

91.4.7.1.5 In the case of a system that uses an electronic light source control gear or a variable intensity control, not being part of the lamp the voltage declared by the manufacturer shall be applied to the input terminals of the lamp.

91.4.7.2 However, in the case of light sources operated by a variable intensity control to obtain variable luminous intensity, photometric measurements shall be performed according to the applicant's description.

91.4.7.3 The test laboratory shall require from the manufacturer the light source control gear or a variable intensity control needed to supply the light source and the applicable functions.

91.4.7.4 The limits of the apparent surface in the direction of the reference axis of a light-signalling lamp shall be determined.

However, in the case of category 5 and 6 direction indicators, the limits of the light emitting surface shall be determined.

91.4.7.5 In the case of a category S3 or S4 stop lamp, which is intended to be mounted inside the vehicle, a sample plate or sample plates (in case of different possibilities) as supplied shall be positioned in front of the lamp to be tested, in the geometrical position(s) as described in the application drawing(s).

91.4.8 Photometric measurements

91.4.8.1 Measurement provisions

91.4.8.1.1 During photometric measurements, stray reflections shall be avoided by appropriate masking.

91.4.8.1.2 In case the results of measurements should be challenged, measurements shall be carried out in such a way as to meet the following requirements:

91.4.8.1.2.1 The distance of measurement shall be such that the law of the inverse of the square of the distance is applicable;

91.4.8.1.2.2 The measuring equipment shall be such that the angular aperture of the receiver viewed from the reference centre of the light is comprised between 10' and 1 degree;

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91.4.8.1.2.3 The intensity requirement for a particular direction of observation shall be deemed to be satisfied if that requirement is met in a direction deviating by not more than one-quarter of a degree from the direction of observation.

91.4.8.1.3 In the case where the lamp may be installed on the vehicle in more than one or in a field of different positions the photometric measurements shall be repeated for each position or for the extreme positions of the field of the reference axis specified by the manufacturer.

91.4.8.2 Measurement methods

91.4.8.2.1 The photometric performance shall be checked in accordance with the relevant sub-paragraph of paragraph 91.4.7.

91.4.8.2.2 For multiple replaceable light sources:

When equipped with light source(s) at 6.75 V, 13.5 V or 28.0 V, the luminous intensity values produced shall be corrected. For these replaceable filament light sources the correction factor is the ratio between the reference luminous flux and the mean value of the luminous flux found at the voltage applied (6.75 V, 13.5 V or 28.0 V).

For LED light sources the correction factor is the ratio between the objective luminous flux and the mean value of the luminous flux found at the voltage applied (6.75 V, 13.5 V or 28.0 V).

The actual luminous fluxes of light source used shall not deviate more than 5 per cent from the mean value.

Alternatively, and in case of filament light sources only, a standard filament light source may be used in turn, in each of the individual positions, operated at its reference flux, the individual measurements in each position being added together.

91.4.8.2.3 For lamps except those equipped with filament light source(s)

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91.4.8.2.3.1 For reversing lamps and maneuvering lamps, the luminous intensities measured after one minute and after 10 minutes of operation, shall comply with the minimum and maximum requirements. The luminous intensity distribution after one and after 10 minutes of operation shall be calculated from the luminous intensity distribution measured after photometric stability has occurred by applying at each test point the ratio of luminous intensities measured at HV:

- (a) After one minute;
- (b) After 10 minutes; and
- (c) After photometric stability has occurred.

91.4.8.2.3.2 For all other lamps, the luminous intensities measured after 1min and after 30min of operation shall comply with the minimum and maximum requirements.

Operation of direction indicator lamps shall be done in flashing mode

($f = 1.5$ Hz, duty factor 50 per cent).

The luminous intensity distribution after 1min of operation can be calculated from the luminous intensity distribution after 30 min of operation by applying at each test point the ratio of luminous intensities measured at HV after 1 min and after 30 min of operation.

91.4.8.3 If not otherwise specified, each signalling lamp shall conform to the intensities of light emitted outside the reference axis and within the angular fields defined in the diagrams in paragraph 91.6, the intensity of the light emitted by each of the two lamps supplied shall:

91.4.8.3.1 In each direction corresponding to the points in the pertinent light distribution table reproduced in paragraph 91.7, be not less than the product of the minimum specified in the paragraph 91.5 of each function below, by the percentage

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specified in the said table of the direction in question;

91.4.8.3.2 In no direction within the space from which the light-signalling lamp is visible, exceed the maximum specified in the pertinent table of each function;

91.4.8.4 When an assembly of two independent lamps, to be type approved as lamps marked "D" and having the same function, is deemed to be a single lamp, it shall comply with the requirements for:

- (a) Maximum intensity if all lamps together are lit;
- (b) Minimum intensity if either lamp has failed.

91.4.8.5 An interdependent lamp system shall meet the requirements when all its interdependent lamps are operated together.
However:

- (a) If the interdependent lamp system providing the rear position lamp is partly mounted on the fixed component and partly mounted on a movable component, the interdependent lamp(s) specified by the applicant shall meet the outboard geometric visibility colorimetric and photometric requirement, at all fixed positions of the movable component(s). In this case, the inboard geometric visibility requirement is deemed to be satisfied if this (these) interdependent lamp(s) still conform to the photometric values prescribed in the field of light distribution for the approval of the device, at all fixed positions of the moveable component(s);
- (b) If the interdependent lamp system providing the rear direction indicator function is partly mounted on the fixed component and partly mounted on a movable component, the interdependent lamp(s) specified by the applicant shall meet the geometric visibility, colorimetric and photometric requirement, at all fixed positions of the movable component(s).

This does not apply to interdependent direction indicator lamp(s) intended for fitting on vehicle(s) where, to fulfil or

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complete the geometric visibility angle, additional lamps are activated when the movable component is in any fixed open position, provided that these additional lamps satisfy all the position, photometric and colorimetric requirements applicable to the direction indicator lamps installed on the movable component.

91.4.8.6 The provisions of the relevant paragraphs of 91.7 on local variations of intensity must be observed.

91.4.8.7 If not otherwise specified, the intensities shall be measured with the light source continuously alight and, in the case of lamps emitting red light, in coloured light.

91.4.8.8 In the case of lamps of categories R2, RM2, S2, S4, F2 and 2b, the time that elapses between energising the light source(s) and the light output measured on the reference axis to reach 90 per cent of the value measured in accordance with paragraph 91.5. shall be measured for the extreme levels of luminous intensity produced by the lamp. The time measured to obtain the lowest luminous intensity shall not exceed the time measured to obtain the highest luminous intensity.

91.4.8.9 The variable intensity control shall not generate signals which cause luminous intensities:

91.4.8.9.1 Outside the range specified in paragraph 91.5.; and

91.4.8.9.2 Exceeding the respective steady luminous intensity maximum specified in paragraph 91.5. for the specific lamp:

(a) For systems depending only on daytime and night time conditions: under night time conditions;

(b) For other systems: under standard conditions.

91.4.8.10 Particulars of the methods of measurement to be used are given in paragraphs 91.7.

91.4.8.11 If a rear position lamp and/or a rear end-outline marker lamp is reciprocally incorporated with a stop lamp producing either steady or variable luminous intensity, the ratio between the luminous intensities actually measured of the two lamps when turned on simultaneously at the intensity of the rear position lamp or end-outline marker lamp when turned on alone

should be at least 5: 1 in the field delimited by the straight horizontal lines passing through $\pm 5^\circ$ V and the straight vertical lines passing through $\pm 10^\circ$ H of the light distribution table.

If the one or both of the two reciprocally incorporated lamps contain(s) more than one light source and is (are) considered as a single lamp, the values to be considered are those obtained with all sources in operation;

91.4.9 Colour of light emitted

The colour of the light emitted shall be measured inside the field of the light distribution grid defined for the specific function in the relevant paragraph of 91.7.

To check these colorimetric characteristics, the test procedure described in paragraph 91.4.7. shall be applied.

Outside this field no sharp variation of colour shall be observed.

However, for lamps equipped with non-replaceable light sources, the colorimetric characteristics should be verified with the light sources present in the lamp, in accordance with relevant subparagraphs of paragraph 91.4.7.

91.5 Specific technical requirements

91.5.1 Technical requirements concerning front position lamps, (symbols A, MA) and front end-outline marker lamps, (symbols AM)

91.5.1.1 The light emitted by each of the two lamps supplied shall meet the requirements in Table 1.

| Lamps of category | Minimum luminous intensity in HV (values in cd) | Maximum luminous intensity in any direction when used as (values in cd) | |
|--|---|---|---------------------------|
| | | A single lamp | A lamp marked "D"(single) |
| Front position lamps, front end-outline marker lamp, A or AM | 4 | 140 | 70 |

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| Luminous intensity (values in cd) Lamps of category | Minimum luminous intensity in HV (values in cd) | Maximum luminous intensity in any direction when used as (values in cd) | |
|---|---|--|------------------------------|
| | | A single lamp | A lamp marked "D"(single) |
| Front position lamps (motorcycle), MA | 4 | 140 | N.A. |
| Front position lamps A incorporated in a headlamp or in a front fog lamp | 4 | 140 | N.A. |

Table 1:Luminous intensities for front position and front end-outline marker lamps

91.5.1.2 Outside the reference axis and within the angular fields defined in the diagrams in paragraph 91.6.1, the intensity of the light emitted by each lamp must in each direction corresponding to the points in the table of standard light distribution reproduced in paragraph 91.7.2 be not less than the minimum specified in paragraph 91.5.1.1., multiplied by the percentage specified in the said table of the direction in question.

91.5.1.3 Throughout the fields defined in the diagrams in paragraph 91.6.1, the luminous intensity of the light emitted must be not less than 0.05 cd for front position lamps and front end-outline marker lamps;

91.5.1.4 The colour of the light emitted shall be white, however the lamp identified by symbol 'MA' may be amber.

91.5.2 Technical requirements concerning rear position lamps (symbols R1, R2, MR) and rear end-outline marker lamps (symbols RM1, RM2)

91.5.2.1 The light emitted by each of the two lamps supplied shall meet the requirements in Table 2.

| Luminous intensity (values in cd) Categories of lamps | Minimum luminous intensity in HV (values in cd) | Maximum luminous intensity in any direction when used as (values in cd) | |
|--|---|---|---------------------------|
| | | A single lamp | A lamp marked "D"(single) |
| Rear position lamps, rear end-outline marker lamp R1 or RM1 (steady) | 4 | 140 | 70 |
| MR | 4 | 140 | N.A. |
| R2 or RM2 (variable) | 4 | 140 | N.A. |

Table 2: Luminous intensities for rear position and rear end-outline marker lamps

91.5.2.2 Outside the reference axis and within the angular fields defined in the diagrams in paragraph 91.6.1, the intensity of the light emitted by each lamp must in each direction corresponding to the points in the table of standard light distribution reproduced in paragraph 91.7.2, be not less than the minimum specified in paragraph 5.2.1., multiplied by the percentage specified in the said table for the direction in question.

91.5.2.3 However, a luminous intensity of 60 cd shall be permitted for rear position lamps reciprocally incorporated with stop lamps below a plane forming an angle of 5° with and downward from the horizontal plane.

91.5.2.4 Throughout the fields defined in the diagrams in paragraph 91.6.1, the luminous intensity of the light emitted must be not less than 0.05 cd for rear position lamps and end-outline marker lamps ;

91.5.2.5 The colour of light emitted shall be red.

This requirement shall also apply within the range of variable luminous intensity produced by:

- (a) Rear position lamps of category R2;
- (b) Rear end-outline marker lamps of category RM2.

91.5.3 Technical requirements concerning parking lamps (symbol 77R)

91.5.3.1 The light emitted by each of the two lamps supplied shall meet the requirements in Table 3.

| | <i>Minimum luminous intensity in H-V (values in cd)</i> | <i>Maximum luminous intensity in any direction (values in cd)</i> |
|-------------------------------|---|---|
| Forward facing parking lamps | 2 | 60 |
| Rearward facing parking lamps | 2 | 30 |

Table 3: Luminous intensities for parking lamps

91.5.3.2 However, a luminous intensity of 60 cd shall be permitted for parking lamps directed to the rear incorporated with stop lamps below a plane forming an angle of 5° with and downward from the horizontal plane.

91.5.3.3 Outside the reference axis and within the angular fields defined in the diagrams in paragraph 91.6.1, the intensity of the light emitted by each lamp shall, in each direction corresponding to the points in the table of standard light distribution reproduced in paragraph 91.7.2, be not less than the minimum specified in paragraph 5.3.1., multiplied by the percentage specified in the said table for the direction in question.

91.5.3.4 Throughout the fields defined in the diagrams in paragraph 91.6.2, the luminous intensity of the light emitted must be not less than 0.05 cd for front and rear parking lamps;

91.5.3.5 The colour of light emitted shall:

- (a) For forward facing parking lamps be white;
- (b) For rearward facing parking lamps be red;
- (c) For side facing parking lamps be amber.

91.5.4 Technical requirements concerning daytime running lamps (symbols RL)

91.5.4.1 The light emitted by each of the two lamps supplied shall meet the requirements in Table 4.

| | <i>Minimum luminous intensity in H-V (values in cd)</i> | <i>Maximum luminous intensity in any direction (values in cd)</i> |
|-----------------------|---|---|
| Daytime running lamps | 400 | 1200 |

Table 4: Luminous intensities for daytime running lamps

91.5.4.2 Outside the reference axis the intensity of the light emitted by each lamp must, in each direction corresponding to the points in the table of standard light distribution reproduced in paragraph 91.7.2, be not less than the minimum specified in paragraph 91.5.4.1., multiplied by the percentage specified in the said table of the direction in question.

91.5.4.3 Moreover, throughout the field defined in the diagram in paragraph 91.6.1, the intensity of the light emitted shall not be less than 1.0 cd.

91.5.4.4 Light source failure

91.5.4.4.1 In the case of a daytime running lamp containing more than one light source, the daytime running lamp shall comply with the minimum intensity required and the maximum intensity shall not be exceeded when all light sources are activated.

91.5.4.4.2 In case of failure of any one light source in a single lamp containing more than one light source, one of the following provisions shall apply:

- (a) The light intensity at the points of standard light distribution defined in paragraph 91.7.2.2 shall be at least 80 per cent of the minimum intensity required; or

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(b) The light intensity in the axis of reference shall be at least 50 per cent of the minimum intensity required, provided that a note in the communication form states that the lamp is only for use on a vehicle fitted with an operating tell-tale.

91.5.4.5 The colour of the light emitted shall be white.

91.5.4.6 The area of the apparent surface in the direction of the axis of reference of the daytime running lamp shall be not less than 25 cm² and not more than 200 cm².

91.5.4.7 The daytime running lamp shall be subjected to the heat resistance test specified in paragraph 91.8.

91.5.5 Technical requirements concerning stop lamps (symbols S1, S2, S3, S4, MS)

91.5.5.1 The light emitted by each of the two lamps supplied shall meet the requirements in Table 5.

| Stop lamp of category | Minimum luminous intensity in H-V (values in cd) | Maximum luminous intensity in any direction when used as (values in cd) | |
|-----------------------|--|---|-------------------|
| | | A single lamp | A lamp marked "D" |
| S1 (steady) | 60 | 260 | 130 |
| S2 (variable) | 60 | 730 | 365 |
| S3 (steady) | 25 | 110 | 55 |
| S4 (variable) | 25 | 160 | 80 |
| MS (steady) | 40 | 260 | N.A. |

Table 5: Luminous intensities for stop lamps

91.5.5.2 Outside the reference axis the intensity of the light emitted by each lamp shall, in each direction corresponding to the points in the table of standard light distribution reproduced in paragraph 91.7.2, be not less than the minimum specified in paragraph 5.5.1., multiplied by the percentage specified in the said table of the direction in question.

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91.5.5.3 Throughout the fields defined in the diagrams in paragraph 91.6.1, the luminous intensity of the light emitted shall be not less than 0.3 cd for devices of categories S1, S3 and MS and for those of categories S2 and S4 by day; it shall not be less than 0.07 cd for devices of categories S2 and S4 by night.

91.5.5.4 The colour of the light emitted shall be red.

In the case of a category S3 or S4 stop lamp, which is intended to be mounted inside the vehicle, the colorimetric characteristics shall be verified with the worst case combination(s) of lamp and rear window(s) or sample plate(s).

These requirements shall also apply within the range of variable luminous intensity produced by stop lamps of categories S2 and S4.

91.5.6 Technical requirements concerning direction-indicator lamps (Symbols 1, 1a, 1b, 2a, 2b, 5, 6, 11, 11a, 11b, 11c, 12)

91.5.6.1 The light emitted by each of the two lamps supplied shall meet the requirements in Table 6 where the minimum luminous intensities shall be fulfilled:

- (a) In the case of direction indicators of categories 1, 1a, 1b, 2a, 2b, 11, 11a, 11b, 11c and 12 in the reference axis; or
- (b) In the case of direction indicators of categories 5 and 6 in direction A according to paragraph 91.6.

| <i>Direction indicator lamp of category</i> | <i>Minimum luminous intensity (values in cd)</i> | <i>Maximum luminous intensity in any direction when used as (values in cd)</i> | |
|---|--|--|--------------------------|
| | | <i>A single lamp</i> | <i>A lamp marked "D"</i> |
| 1 | 175 | 1000 | 500 |
| 1a | 250 | 1200 | 600 |
| 1b | 400 | 1200 | 600 |
| 2a (steady) | 50 | 500 | 250 |
| 2b (variable) | 50 | 1000 | 500 |
| 5 | 0.6 | 280 | 140 |

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| <i>Direction indicator lamp of category</i> | <i>Minimum luminous intensity (values in cd)</i> | <i>Maximum luminous intensity in any direction when used as (values in cd)</i> | |
|---|--|--|--------------------------|
| | | <i>A single lamp</i> | <i>A lamp marked "D"</i> |
| 6 | 50 | 280 | 140 |
| 11 | 90 | 1000 | N.A. |
| 11a | 175 | 1000 | N.A. |
| 11b | 250 | 1200 | N.A. |
| 11c | 400 | 1200 | N.A. |
| 12 | 50 | 500 | N.A. |

Table 6: Luminous intensities for direction indicator lamps

91.5.6.2 Outside the reference axis the intensity of the light emitted by each lamp shall, in each direction corresponding to the points in the table of standard light distribution reproduced in:

- (a) Paragraph 91.7.2.1 for categories 1, 1a, 1b, 2a, 2b, 11, 11a, 11b, 11c and 12.; or
- (b) Paragraph 91.7.2.4 for category 6.

91.5.6.3 Failure provisions

For direction-indicator lamps of categories 1, 1a, 1b, 2a and 2b a signal for activation of the tell-tale shall be produced if:

- (a) Any one light source has failed; or
- (b) In the case of a lamp designed for only two light sources, the intensity in the axis of reference is less than 50 per cent of the minimum intensity; or
- (c) As a consequence of a failure of one or more light sources, the intensity in one of the following directions, is less than the minimum intensity required:

- (i) $H=0^\circ$, $V=0^\circ$
- (ii) $H=20^\circ$ to the outside of the vehicle, $V=+5^\circ$
- (iii) $H=10^\circ$ to the inside of the vehicle, $V=0^\circ$.

91.5.6.4 Test procedure:

For category 5 direction indicators, to the rear, a minimum value of 0.6 cd is required throughout the fields specified in Figure 1 and Table 10.

91.5.6.5 Throughout the fields defined in Figure 1 and Table 10, the intensity of the light emitted shall be not less than 0.7 cd for lamps of category 1b, not less than 0.3 cd for lamps of categories 1, 1a, 2a, 11, 11a, 11b, 11c, 12 and for those of category 2b by day; it shall not be less than 0.07 cd for lamps of category 2b by night;

91.5.6.6 The intensities shall be measured with the light source(s) continuously alight.

However, depending on the construction of the lamp, for example, the use of light-emitting diodes (LED), or the need to take precautions to avoid overheating, it is allowed to measure the lamps in flashing mode.

- (a) This shall be achieved by switching with a frequency of $f = 1.5 \pm 0.5$ Hz with the pulse width greater than 0.3 s, measured at 95 per cent peak light intensity. In all other cases the voltage as required in paragraph 91.4.7.1. shall be switched with a rise time and fall time shorter than 0.01 s; no overshoot is allowed;
- (b) In the case of measurements taken in flashing mode the reported luminous intensity shall be represented by the maximum intensity.

91.5.6.7 In the case of lamps of category 2b the time that elapses between energizing the light source(s) and the light output measured on the reference axis to reach 90 per cent of the value measured in accordance with paragraph 91.5.6.2. shall be measured for the extreme levels of luminous intensity produced by the direction indicator. The time measured to obtain the

lowest luminous intensity shall not exceed the time measured to obtain the highest luminous intensity.

91.5.6.8 The variable intensity control shall not generate signals which cause luminous intensities outside the range specified in paragraph 91.5.6.1. and exceeding the category 2a maximum specified in paragraph 91.5.6.1:

- (a) For systems depending only on daytime and night time conditions: under night time conditions;
- (b) For other systems: under reference conditions as demonstrated by the manufacturer.

91.5.6.9 The colour of the light emitted shall be amber. This requirement shall also apply within the range of variable luminous intensity produced by rear direction indicator lamps of category 2b.

91.5.6.10 For any direction indicator lamp except those equipped with filament light source(s), the luminous intensities measured after one minute and after 30 minutes of operation in flashing mode ($f = 1.5$ Hz, duty factor 50 per cent), shall comply with the minimum and maximum requirements. The luminous intensity distribution after one minute of operation can be calculated by applying at each test point the ratio of luminous intensity measured in HV after one minute and after 30 minutes of operation as above described.

91.5.6.11 For direction indicator lamps of categories 1, 1a, 1b, 2a or 2b the flash may be produced by sequential activation of their light sources if the following conditions are met:

- (a) Each light source, after its activation, shall remain lit until the end of the ON cycle;
- (b) The sequence of activation of the light sources shall produce a signal which proceeds in a uniform progressive manner from inboard towards the outboard edge of the light emitting surface;
- (c) It shall be one signal with no interruption and no vertical oscillations (e.g. not more than one change of direction along the vertical axis). The distance between two adjacent/tangential distinct parts of the light emitting surface of the sequential direction indicator shall not exceed 50mm, when measured perpendicularly to the reference axis, instead of

the values defined in paragraph “Single lamp” of “The installation of lighting and light-signaling devices” of VSTD. These interruptions of the signal shall not create any overlap in the vertical axis between the different parts, from inboard towards the outboard of the vehicle, and shall not be used for any other lighting or light signalling functions;

- (d) The variation shall finish no more than 200ms after the beginning of the ON cycle.
- (e) The orthogonal projection of the light emitting surfaces of the direction indicator in the direction of the axis of reference shall be circumscribed by a rectangle on a plane normal to the axis of reference and having its longer sides parallel to the H-plane. The ratio of the horizontal to the vertical sides shall not be less than 1.7.

Compliance to the conditions mentioned above shall be verified in flashing mode.

91.5.7 Technical requirements concerning side marker lamps (symbols SM1, SM2)

91.5.7.1 The light emitted by each of the two lamps supplied shall meet the requirements in Table 7.

| Side marker lamp of category | | SM1 | SM2 |
|------------------------------|--|----------|----------|
| Minimum intensity | In the axis of reference | 4.0 cd | 0.6 cd |
| | Within the specified angular field, other than above | 0.6 cd | 0.6 cd |
| Maximum intensity | Within the specified angular field ¹ | 25.0 cd | 25.0 cd |
| Angular field | Horizontal | ±45 deg. | ±30 deg. |
| | Vertical | ±10 deg. | ±10 deg. |

Table 7: Luminous intensities for side marker lamps

In addition, for red side marker lamp, in the angular field from 60° to 90° in horizontal direction and ±20° in vertical direction towards the front of the vehicle, the maximum intensity is limited to 0.25 cd.

91.5.7.2 Outside the reference axis and within the angular fields defined in the diagrams in paragraph 91.6.3, the intensity of the light emitted by each of the two side marker lamps supplied shall:

- (a) In each direction corresponding to the points in the light distribution table reproduced in paragraph 91.7.2.7, be not less than the product of the minimum specified in paragraph 91.5.7.1. by the percentage specified in the said table for the direction in question.
- (b) In no direction within the space from which the side marker lamp is visible, exceed the maximum specified in paragraph 91.5.7.1.

91.5.7.3 For SM1 and SM2 categories of side marker lamps it may be sufficient to check only five points selected by the Technical Service.

91.5.7.4 The colour of the light emitted shall be amber. However, it can be red, if the rearmost side marker lamp is grouped or combined or reciprocally incorporated with the rear position lamp, the rear end-outline marker lamp, the rear fog lamp, the stop lamp, or is grouped with or has part of the light emitting surface in common with the rear retro-reflector.

91.5.8 Technical requirements concerning reversing lamps (symbols AR)

91.5.8.1 The light emitted by each of the two lamps supplied shall meet the requirements in Table 8.

| | Minimum luminous intensity in H-V (values in cd) | Maximum luminous intensity in any direction (values in cd) | | |
|-----------------|--|--|--------------------------------|-----------|
| | | in or above the h plane | below the h plane, down to 5°D | below 5°D |
| Reversing lamps | 80 | 300 | 600 | 8000 |

Table 8: Luminous intensities for reversing lamps

91.5.8.2 In every other direction of measurement shown in paragraph 91.7.2.5 the luminous intensity shall be not less than the minima specified in that paragraph.

However, in the case where the reversing lamp is intended to be installed on a vehicle exclusively in a pair of devices, the photometric intensity may be verified only up to an angle of 30° inwards where a photometric value of at least 25 cd shall be satisfied.

91.5.8.3 The colour of the light emitted shall be white.

91.5.9 Technical requirements concerning rear fog lamps (symbols F1, F2)

91.5.9.1 The light emitted by each of the two lamps supplied shall meet the requirements in Table 9.

| Rear fog lamps of category | Minimum luminous intensity along the axis HH and VV (values in cd) | Maximum luminous intensity in any direction (values in cd) |
|----------------------------|--|--|
| F1 (steady) | 150 | 300 |
| F2 (variable) | 150 | 840 |

Table 9: Luminous intensities for rear fog lamps

91.5.9.2 The minimum light intensity at all other points of standard light distribution is defined in paragraph 91.7.2.6.

91.5.9.3 The variable intensity control shall not generate signals which cause luminous intensities outside the range specified in paragraph 91.5.9.1. and exceeding the category F1 maximum specified in paragraph 91.5.9.1.:

- (a) For systems depending only on daytime and night time conditions: under night time conditions;
- (b) For other systems: under standard conditions

91.5.9.4 The apparent surface in the direction of the reference axis shall not exceed 140 cm².

91.5.9.5 The colour of the light emitted shall be red.

91.5.9.6 The rear fog lamp shall be subjected to the test specified in paragraph 91.8.

91.5.10 Technical requirements concerning manoeuvring lamps (symbols ML)

91.5.10.1 The intensity of light emitted shall not exceed 500 cd in all directions in which the light can be observed, when installed in any mounting position specified by the applicant.

91.5.10.2 The lamp must be so designed that the light emitted directly towards the side, the front or the rear of the vehicle does not exceed 0.5 cd within the angular field as defined below.

(a) The vertical minimum angle φ_{\min} (in degrees) is:

$$\varphi_{\min} = \arctan (1\text{-mounting height}/10; \text{ where } h \text{ is mounting height in m.}$$

(b) The vertical maximum angle φ_{\max} (in degrees) is: $\varphi_{\max} = \varphi_{\min} + 11.3$

The measurement shall be limited to a horizontal angle ranging from +90° to -90° with respect to the line which cuts the reference axis and which is perpendicular to the vertical longitudinal plane of the vehicle.

The measurement distance shall be 3.0 m minimum.

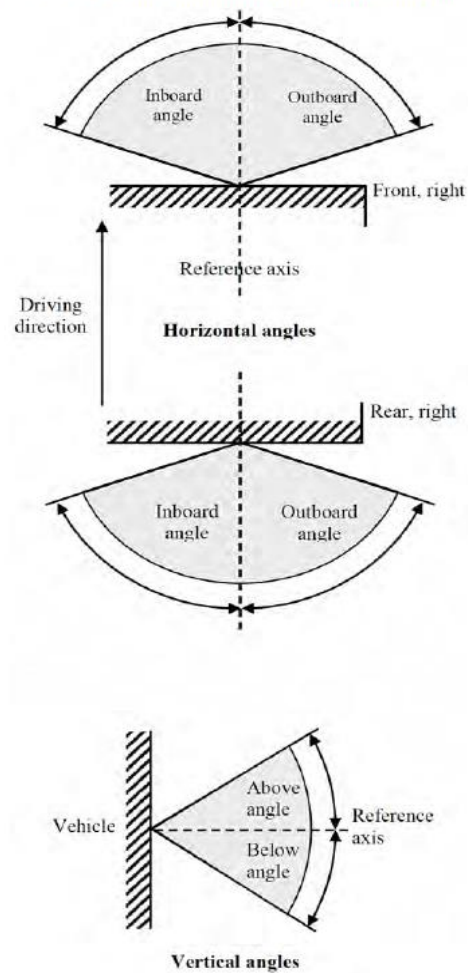
91.5.10.3 The colour of the light emitted shall be white.

91.6 Light distribution in space, horizontal and vertical

The angles shown in these arrangements are correct for lamps to be mounted on the right side of the vehicle.

91.6.1 Part A: Position, end-outline marker, stop, front and rear direction indicators, daytime running and front and rear parking lamps

Figures A2-I: Light-distribution in space, horizontal and vertical



Figures 1: Light-distribution in space, horizontal and vertical of position, end-outline marker, stop, front and rear direction indicators, daytime running and front and rear parking lamps

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| Lamp | Minimum horizontal angles (inboard / outboard) | Minimum vertical angles (above / below) | Additional information |
|--|---|---|---------------------------|
| Front direction indicator (1, 1a, 1b) | 45° / 80° 20° / 80° ¹ | 15° / 15° 15° / 5° ² | - |
| Rear direction indicator (2a, 2b) | 45° / 80° 20° / 80° ¹ | 15° / 15° 15° / 5° ² 5° / 15° ³ | - |
| Front direction indicator (11, 11a, 11b, 11c) Rear direction indicator (12) | 20° / 80° | 15° / 15° 15° / 5° ² | - |
| Front position singular (MA) Rear position singular (MR) | 80° / 80° | 15° / 10° 15° / 5° ² | - |
| Front position pair (MA) | 20° / 80° | 15° / 10° 15° / 5° ² | - |
| Rear position pair (MR) | 45° / 80° 20° / 80° ¹ | 15° / 10° 15° / 5° ² | - |
| Stop singular (MS) | 45° / 45° | 15° / 10° 15° / 5° ² | - |
| Stop pair (MS) | 0°/45° | 15° / 10° 15° / 5° ² | - |
| Front position (A) Rear position (R, R1, R2) | 45° / 80° 20° / 80° ¹ | 15° / 15° 15° / 5° ² 5° / 15° ³ | - |

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| | | | |
|---|-------------------------------------|---|---|
| Front parking (77R) Rear parking (77R) | 0° / 45° | 15° / 15° 15° / 5° ² | - |
| Front end-outline marker (AM) Rear end-outline marker (RM1, RM2) | 0° / 80° | 15° / 15° 15° / 5° ² 5° / 15° ³ | - |
| Stop lamp (S1, S2) | 45° / 45° 20° / 45° ¹ | 15° / 15° 15° / 5° ² 5° / 15° ³ | - |
| High mounted stop lamp (S3, S4) | 10° / 10° | 10° / 5° | - |
| Daytime running lamps (RL) | 20° / 20° | 10° / 5° | - |

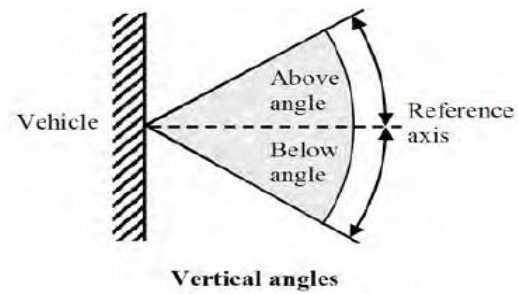
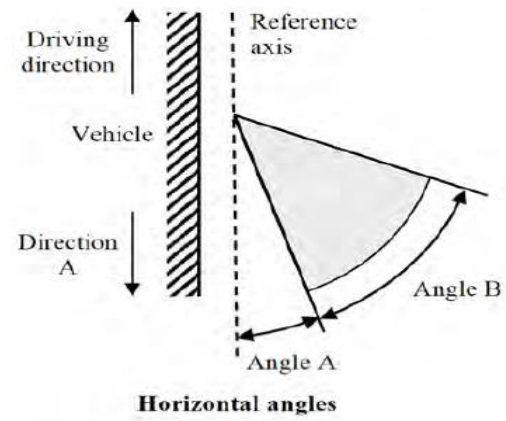
1 Reduced angles used only below the H-plane for lamps mounted with the H-plane below 750 mm.

2 For lamps to be installed with the H-plane of the lamp at a mounting height of less than 750 mm.

3 Optional lamps to be installed with the H-plane of the lamp at a mounting height of more than 2100 mm.

Table 10: Light-distribution in space, horizontal and vertical of position, end-outline marker, stop, front and rear direction indicators, daytime running and front and rear parking lamps

91.6.2 Part B: Side direction indicators and side parking lamps



Figures 2: Light-distribution in space, horizontal and vertical of side direction indicators and side parking lamps

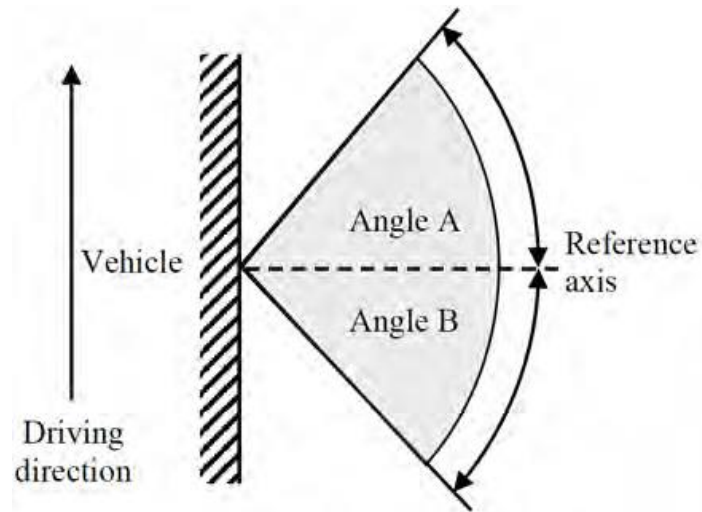
| Lamp | Horizontal angles (A/B) | Min. vertical angle (above/below) | Additional information |
|-------------------------------|-------------------------|--------------------------------------|--|
| Side direction indicators (5) | 5° / 55° | 15° / 15° 15° / 5° ² | Horizontal angles apply to direction A |
| Side direction indicators (6) | 5° / 55° | 30° / 5° | |
| Side parking ⁴ | 0° / 45° | 15° / 15° 15° / 5° ² | Horizontal angles apply to front and rear |

2 For lamps to be installed with the H-plane of the lamp at a mounting height of less than 750 mm.

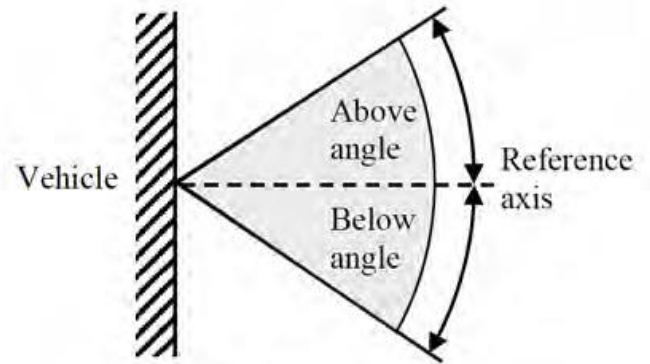
4 Side parking lamps are a combination of front and rear facing parking lamps.

Table 11; Light-distribution in space, horizontal and vertical of side direction indicators and side parking lamps

91.6.3 Part C: Side marker lamps



Horizontal angles



Vertical angles

Figures 3: Light-distribution in space, horizontal and vertical of side marker lamps

| <i>Lamp</i> | <i>Min. horizontal angles (A/B)</i> | <i>Min. vertical angles (above/below)</i> | <i>Additional information</i> |
|-------------------|---|---|-----------------------------------|
| Side marker (SM1) | 45° / 45° | 10° / 10° 10° / 5° ² | |
| Side marker (SM2) | 30° / 30° | 10° / 10° 10° / 5° ² | |

2 For lamps to be installed with the H-plane of the lamp at a mounting height of less than 750 mm.

Table 12: Light-distribution in space, horizontal and vertical of side marker lamps

91.7 Standard light distributions

91.7.1 If not otherwise specified:

91.7.1.1 The direction $H = 0$ deg. and $V = 0$ deg. corresponds to the reference axis. (On the vehicle, it is horizontal, parallel to the median longitudinal plane of the vehicle and oriented in the required direction of visibility.) It passes through the centre of reference.

Unless specified otherwise, the values shown in Figures 4 to 11 give, for the various directions of measurement, the minimum intensities as a percentage of the minimum intensities required.

91.7.1.2 Within the field of light distribution schematically shown as a grid, the light pattern should be substantially uniform, i.e. the light intensity in each direction of a part of the field formed by the grid lines shall meet at least the lowest minimum value being shown on the grid lines surrounding the questioned direction as a percentage.

91.7.1.3 However, in the case where one of the following lamps is intended to be installed at a mounting height (using the H plane specified by the manufacturer) equal to or less than 750 mm above the ground, the photometric intensity is verified

only up to an angle of 5 deg. downwards:

- (a) Front and rear direction indicators lamps;
- (b) Front and rear position lamps;
- (c) Front and rear end-outline marker lamps;
- (d) Parking lamps;
- (e) Stop lamps of category S1, S2 and MS;
- (f) Side marker lamps;

91.7.2 Standard light distribution.

91.7.2.1 Standard light distribution for front and rear position lamps, parking lamps, front and rear end-outline marker lamps, stop lamps (S1, S2 and MS) and direction indicator lamps of categories 1, 1a, 1b, 2a, 2b, 11, 11a, 11b, 11c, 12.

The values shown give in Figure 4, for the various directions of measurement, the minimum intensities as a percentage of the minimum intensities required (see Tables 1, 2, 3, 5 and 6).

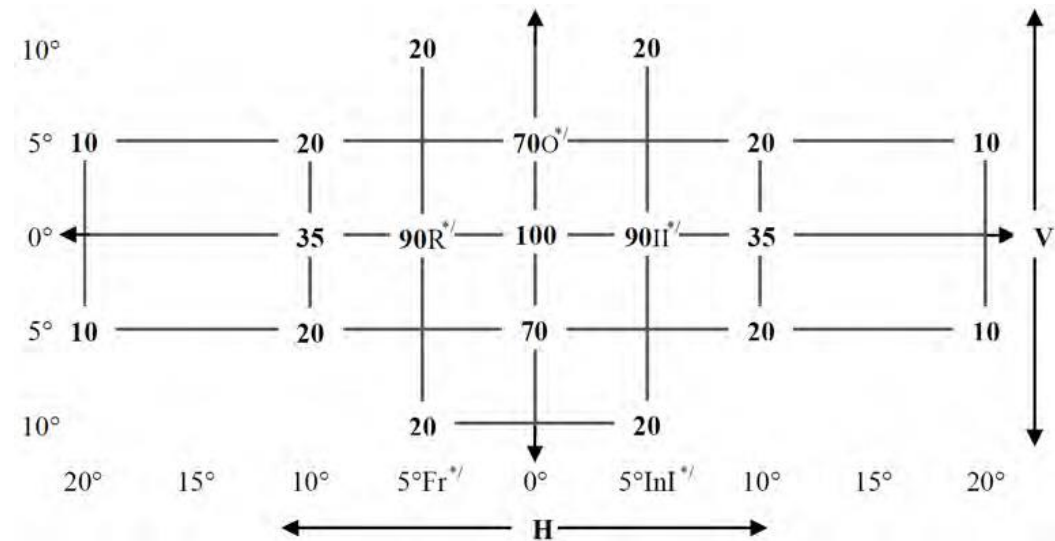


Figure 4: Standard light distribution for front and rear position-, parking-, end-outline marker-, stop- and direction indicator lamps

91.7.2.2 Standard light distribution for daytime running lamps

The values shown give in Figure 5, for the various directions of measurement, the minimum intensities as a percentage of the minimum intensity required (see Table 4).

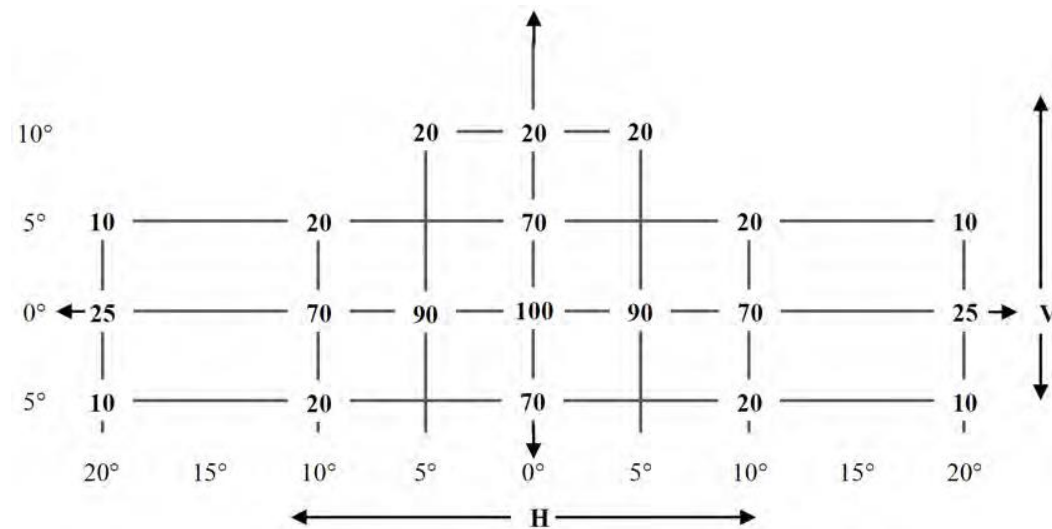


Figure 5: Light distribution for daytime running lamps

91.7.2.3 Standard light distribution for category S3 and S4 stop lamps

The values shown give in Figure 6, for the various directions of measurement, the minimum intensities as a percentage of the minimum intensities required (see Table 5).

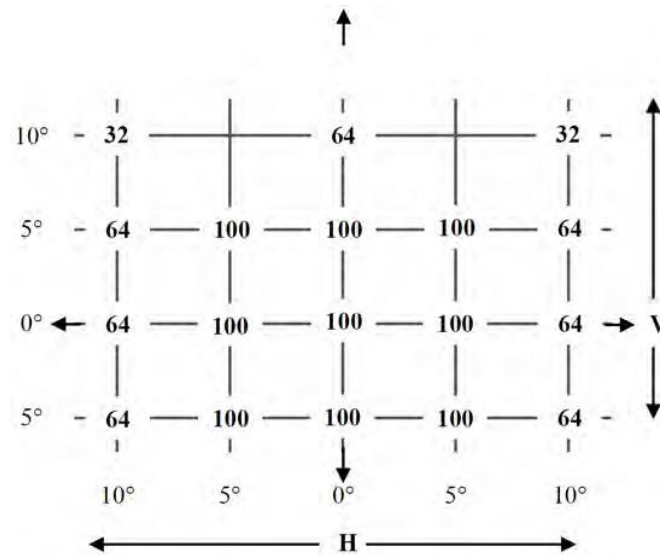


Figure 6: Light distribution for S3 and S4 stop lamps

91.7.2.4 Standard light distribution for direction indicators lamps of category 6

The reference axis, $H = 5^\circ$ and $V = 0^\circ$, corresponds to the direction A.

The values shown give in Figure 7, for the various directions of measurement, the minimum intensities as a percentage of the minimum intensity required (see Table 6).

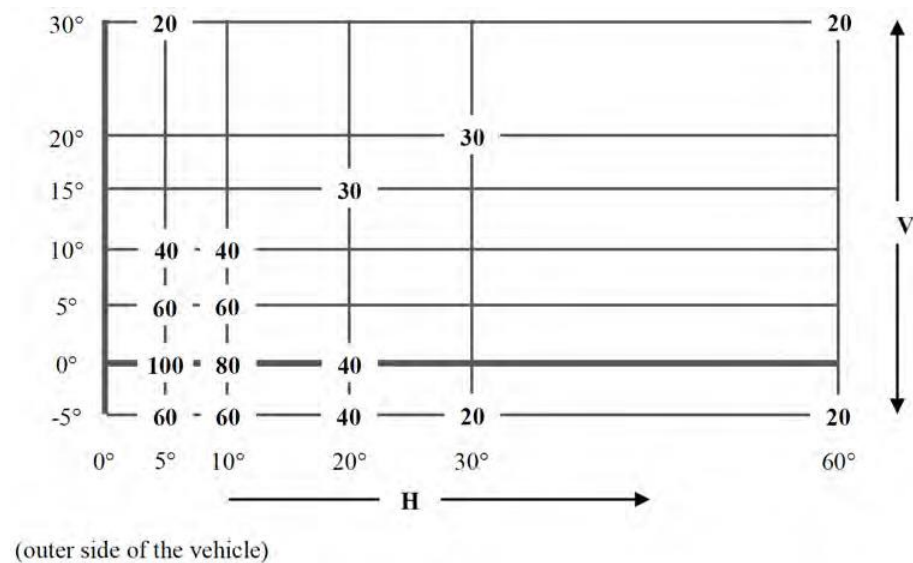


Figure 7: Light distribution for direction indicator lamps category 6

91.7.2.5 Standard light distribution for reversing lamps

The values shown give in Figure 8, for the various directions of measurement, the minimum intensities as a percentage of the minimum intensity required (see Table 8).

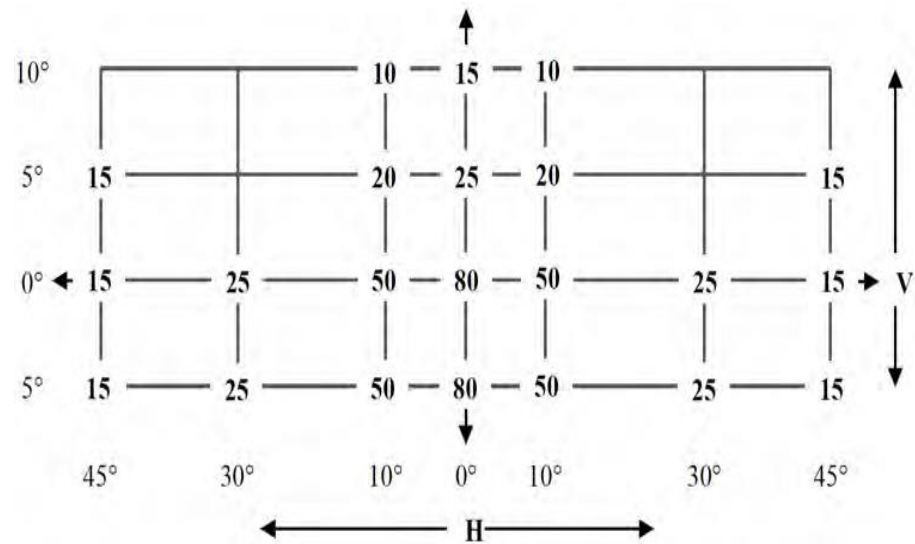


Figure 8: Light distribution for reversing lamps

91.7.2.6 Standard light distribution for rear fog lamps

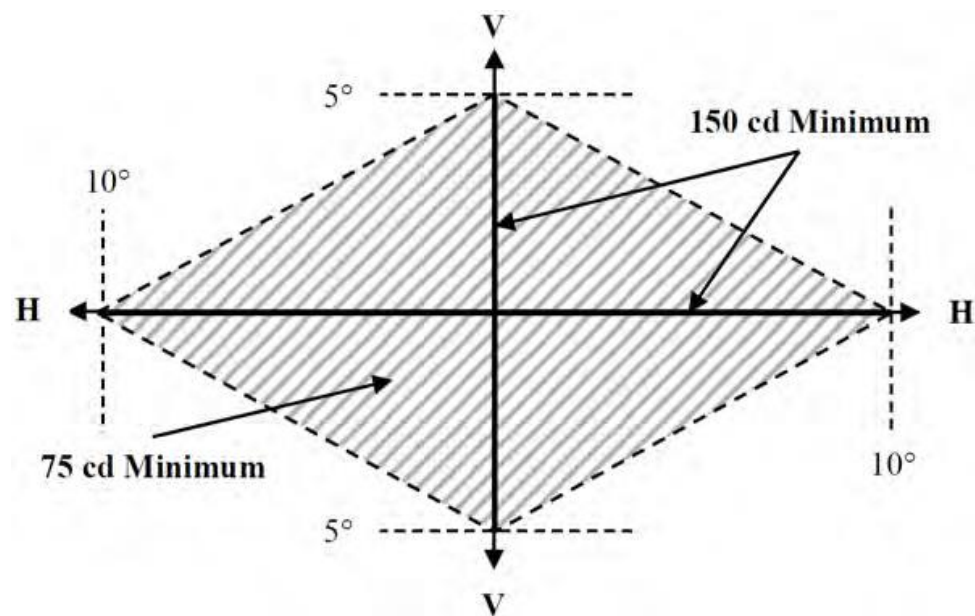


Figure 9: Light distribution for rear fog lamps

If visual examination of a light appears to reveal substantial local variations of intensity, a check shall be made to ensure that, outside the axes, no intensity measured within the rhombus defined by the extreme directions of measurement is below 75 cd (see figure 9 above).

91.7.2.7 Standard light distribution for side marker lamps

91.7.2.7.1 SM1 category of side marker lamps

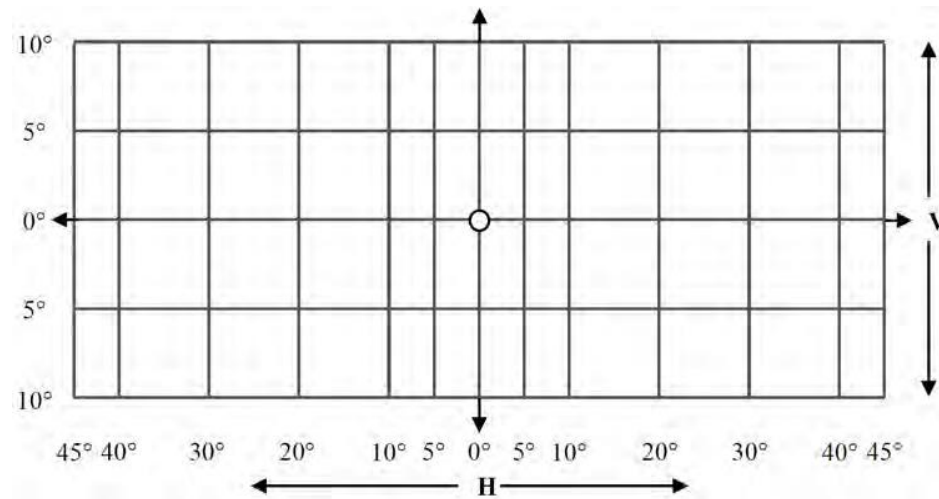


Figure 10: Light distribution for side marker lamps SM1

Minimum values: 0.6 cd at any point other than the reference axis, at which it shall be 4.0 cd.

Maximum values: 25 cd at any point.

91.7.2.7.2 SM2 category of side marker lamps

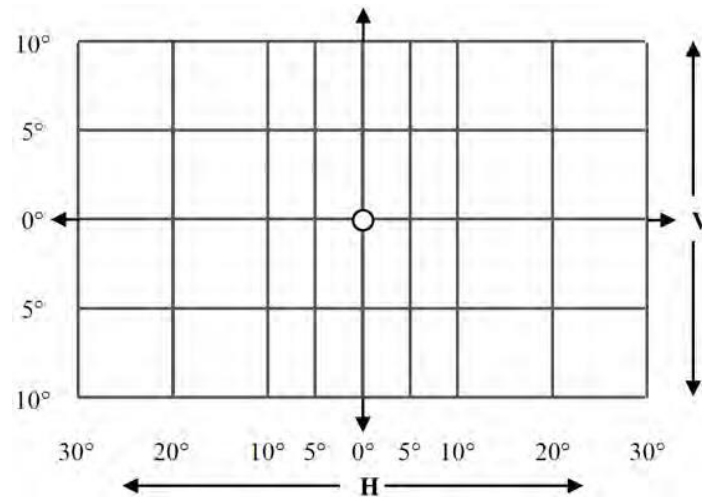


Figure11: Light distribution for side marker lamps SM2

91.7.2.7.3 SM1 and SM2 category of side marker lamps

For SM1 and SM2 category of side marker lamps it may be sufficient to check only five points selected by the Technical Service.

91.8 Heat resistance test for rear fog lamps and daytime running lamps

91.8.1 The lamp shall be subjected to a one-hour test of continuous operation following a warm-up period of 20 minutes. The ambient temperature shall be $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$. The light source used shall be a light source of the category specified for the lamp, and shall be supplied with a current at a voltage such that it gives the specified average power at the corresponding test voltage.

However, for lamps equipped with non-replaceable light sources (filament light sources and other), the test shall be made with the light sources present in the lamp, in accordance with paragraph 91.5.4.1. of this Regulation.

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- 91.8.2 Where only the maximum power is specified, the test shall be carried out by regulating the voltage to obtain a power equal to 90 per cent of the specified power. The specified average or maximum power referred to above shall in all cases be chosen from the voltage range of 6, 12 or 24 V at which it reaches the highest value; for lamps equipped with non-replaceable light sources the test conditions set in paragraph 91.5.9.1. of this Regulation shall be applied.
- 91.8.3 After the lamp has been stabilized at the ambient temperature, no distortion, deformation, cracking or colour modification shall be perceptible. In case of doubt the intensity of light shall be measured according to paragraph 91.5 of this Regulation. At that measurement the values shall reach at least 90 per cent of the values obtained before the heat resistance test on the same lamp.