Second draft and the first update of the Informal document No. **GRE-66-14**

This document is not yet a final version it requires a further update and review!

DRAFT PROPOSAL FOR HORIZONTAL REFERENCE DOCUMENT
(signalling lamps for motor vehicles and trailers)

Based on the Informal document No. **GRE-66-14** submitted by the expert from Canada

CONTENTS

A. ADMINISTRATIVE PROVISIONS

1. SCOPE

This Horizontal Reference Document contains definitions, requirements, methods of measurement and other characteristics common to signalling lamps for motor vehicle (and trailer). Unique requirements specific to individual signalling devices are indicated in Regulations regarding respective individual devices.

For the Regulations 3, (4), 6, 7,.19, 23, 27, (37), 38, (~~45~~), 48, 50, 53, (65), 69, 70, 74, 77, 87, (88), 91, 98, (99), 104, 112, 113, 119, 123, (128), …

2. DEFINITIONS

For the purpose of the above mentioned Regulations:

2.1. General definitions and definitions with regard to the installation of lighting and light-signalling devices on vehicles:

~~2.1. The definitions given in Regulation No. 48 and its series of amendments in force at the time of application for type approval shall apply to this Horizontal reference Document.~~

2.1.1. "*Approval of a vehicle*" means the approval of a vehicle type with regard to the number and mode of installation of the lighting and light-signalling devices.

2.1.2. "*Vehicle type with regard to the installation of lighting and light-signalling devices*" means vehicles which do not differ in the essential respects mentioned in paragraphs 2.1.2.1. to 2.1.2.4.**below;**

The following are likewise considered not to be "vehicles of a different type": vehicles which differ within the meaning of paragraphs 2.1.2.1. to 2.1.2.4. **below**, but not in such a way as to entail a change in the kind, number, positioning and geometric visibility of the lamps and the inclination of the dipped-beam prescribed for the vehicle type in question, and vehicles on which optional lamps are fitted or are absent:

2.1.2.1. The dimension and the external shape of the vehicle;

2.1.2.2. The number and positioning of the devices;

2.1.2.3. The headlamp-levelling system;

2.1.2.4. The suspension system.

2.1.3. "*Transverse plane*" means a vertical plane perpendicular to the median longitudinal plane of the vehicle.

2.1.4. "*Unladen vehicle*" means a vehicle without driver, crew, passengers and load, but with a full supply of fuel, spare wheel and the tools normally carried.

2.1.5. "*Laden vehicle*" means a vehicle loaded to its technically permissible maximum mass, as stated by the manufacturer, who shall also fix the distribution of this mass between the axles in accordance with the method described in Annex 5 **in Regulation 48**.

2.1.6. "*Ground*" means the surface on which the vehicle stands which should be substantially horizontal.

2.1.7. "*Movable components*" of the vehicle mean those body panels or other vehicle parts the position(s) of which can be changed by tilting, rotating or sliding without the use of tools. They do not include tiltable driver cabs of trucks.

2.1.8. "*Normal position of use of a movable component*" means the position(s) of a movable component specified by the vehicle manufacturer for the normal condition of use and the park condition of the vehicle.

2.1.9. "*Normal condition of use of a vehicle*" means:

2.1.9.1. For a motor vehicle, when the vehicle is ready to move with its propulsion engine running and its movable components in the normal position(s) as defined in paragraph **2.1.8. above**;

2.1.9.2. And for a trailer, when the trailer is connected to a drawing motor vehicle in the conditions as prescribed in paragraph **2.1.10. above** and its movable components are in the normal position(s) as defined in paragraph **2.1.8. above**.

2.1.10. "*Park condition of a vehicle*" means:

2.1.10.1. For a motor vehicle, when the vehicle is at standstill and its propulsion engine is not running and its movable components are in the normal position(s) as defined in paragraph **2.1.8. above**

2.1.10.2. And for a trailer, when the trailer is connected to a drawing motor vehicle in the condition as described in paragraph **2.1.10.1.above** and its movable components are in the normal position(s) as defined in paragraph **2.1.8. above**.

2.2. Definition with regard to type:

2.2.1. **Signalling** Lamps, head lamps, retro-reflectors, **devices** of different types:

(general)

2.2.1.1. The trade name or mark;

(i) lamps bearing the same trade name or mark but produced by different manufacturers shall be considered as being of different types;

(ii) lamps produced by the same manufacturer differing only by the trade name or mark shall be considered as being of the same type.

2.2.1.2. The characteristics of the optical system (levels of intensity, light distribution angles, category of filament lamp, light source module, etc.);

2.2.2. "***Signalling** Lamps of different types*" **(see Paragraph 2.8. below)** means lamps, which differ in such essential respects as:

~~(b) The characteristics of the optical system (levels of intensity, light distribution angles, category of filament lamp, light source module, etc.);~~

2.2.2.1. The category of the lamp, if any;

2.2.2.2. The variable intensity control, if any.

A change of the colour of the filament lamp or the colour of any filter does not constitute a change of type.

2.2.3. "Headlamps of different types" **(see Paragraph 2.6. below)** means headlamps which differ in such essential respects as:

~~2.15.2.1. The trade name or mark;~~

~~2.15.2.2. The characteristics of the optical system;~~

2.2.3.1. The inclusion or elimination of components capable of altering the optical effects by reflection, refraction, absorption and/ or deformation during operation;

2.2.3.2. Suitability for right-hand or left-hand traffic or for both traffic systems;

2.2.3.3. The kind of beam produced (passing beam, driving beam or both);

2.2.3.4.. The category of filament lamp used and/ or the LED module specific identification code(s);
2.2.3.5. However, a device intended for the installation on the left side of the vehicle and the corresponding device intended for the installation on the right side of the vehicle shall be considered to be of the same type.

2. 2.4. "Systems of different types" **(as defined in Paragraph 2.7. below)** means systems which differ in such essential respects as:

~~2. 2.4.1. The trade name or mark(s);~~

2.2.4.1. The inclusion or elimination of components capable of altering optical characteristics/ photometric properties of the system;

2.2.4.2. Suitability for right-hand or left-hand traffic or for both traffic systems;

2.2.4.3. The front-lighting function(s), mode(s) and classes produced;

2.2.4.4. The characteristic(s) of the signal(s), specified for the system;

2.3. A type of "retro-reflecting device" **(as defined in Paragraph 2.9. below)** is defined by the models and descriptive literature submitted with the application for approval.
Retro-reflecting devices can be considered as belonging to the same type if they have one or more "retro-reflecting optical units" which are identical with those of the standard model, or if not identical are symmetrical and suitable for mounting one on the left and one on the right side of the vehicle, and if their other parts differ from those of the standard model only in ways not affecting the properties to which this Regulation
applies.

2.4. **Rear Marking Plates or Rear Marking Plates for SMV or** Marking materials of the different types means materials which differ in such essential respects as:

~~2.4.1. The trade name or trade mark;~~

2.4.1. The characteristics of the retro-reflective material **or device**;

2.4.2. The parts affecting the properties of the retro-reflective materials or devices.
2.4.3. The characteristics of the fluorescent material, **if applicable**;

2..4.4. **In the case of Regulation 27 and 69** the distinctive geometrical and mechanical features of the design;

2.4.5. **In the case of Regulation 70 and 104 are** differences in the shape and dimensions of the ~~(rear)~~ marking shall not constitute a different type;

2.5. General definitions to lighting and light-signalling devices:

2.5.1. *Device*" means an element or an assembly of elements used to perform one or more functions.

2.5.2. "*Lighting function*" means the light emitted by a device to illuminate the road and objects in the direction of vehicle movement.

2.5.3. "*Light-signalling function*" means the light emitted or reflected by a device to give to other road users visual information on the presence, identification and/or the change of movement of the vehicle.

2.5.4. "*Lamp*" means a device designed to illuminate the road or to emit a light signal to other road users. Rear registration plate lamps and retro-reflectors are likewise to be regarded as lamps. For the purpose of this Regulation, light-emitting rear registration plates and the service-door-lighting system according to the provisions of Regulation No. 107 on vehicles of categories M_2 and M_3 are not considered as lamps.

2.5.4.1. "*Equivalent lamps*" means lamps having the same function and authorized in the country in which the vehicle is registered; such lamps may have different characteristics from those installed on the vehicle when it is approved on condition that they satisfy the requirements of this Regulation.

2.5.4.2. "*Independent lamps*" means devices having separate apparent surfaces in the direction of the reference axis[1], separate light sources and separate lamp bodies.

2.5.5. "*Axis of reference*" (or "*reference axis*") means the characteristic axis of the lamp determined by the manufacturer (of the lamp) for use as the direction of reference (H = 0°, V = 0°) for angles of field for photometric measurements and for installing the lamp on the vehicle.

2.5.6. "*Centre of reference*" means the intersection of the axis of reference with the exterior light-emitting surface; it is specified by the manufacturer of the lamp.

2.5.7. **"H plane"** means the horizontal plane containing the centre of reference of the lamp.

2.5.8. "*Sequential activation*" means an electrical connection where the individual light sources of a lamp are wired such that they are activated in a predetermined sequence."

2.5.9. "*Angles of geometric visibility*" means the angles which determine the field of the minimum solid angle in which the apparent surface of the lamp is visible. That field of the solid angle is determined by the segments of the sphere of which the centre coincides with the centre of reference of the lamp and the equator is parallel with the ground. These segments are determined in relation to the axis of reference. The horizontal angles ß correspond to the longitude and the vertical angles α to the latitude.

2.5.10. "*Extreme outer edge*" on either side of the vehicle, means the plane parallel to the median longitudinal plane of the vehicle and touching its lateral outer edge, disregarding the projection:

2.5.10.1. Of tyres near their point of contact with the ground, and of connections for tyre-pressure gauges;

2.5.10.2. Of any anti-skid devices mounted on the wheels;

2.5.10.3. Of devices for indirect vision;

2.5.10.4. Of side direction-indicator lamps, end-outline marker lamps, front and rear position lamps, parking lamps, retro-reflectors and side-marker lamps.

2.5.10.5. Of customs seals affixed to the vehicle, and of devices for securing and protecting such seals.

2.5.10.6. Of service-door lighting systems on vehicles of categories M_2 and M_3 as specified in paragraph **2.5.4..**

2.5.11. "*Overall dimensions*" means the distance between the two vertical planes defined in paragraph **2.5.10.** above.

2.5.11.1. "*Overall width*" means the distance between the two vertical planes defined in paragraph **2.5.10.** above.

2.5.11.2. "*Overall length*" means the distance between the two vertical planes perpendicular to the median longitudinal plane of the vehicle and touching its front and rear outer edge, disregarding the projection:

(a) Of devices for indirect vision;

(b) Of end-outline marker lamps;

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[1] In the case of lighting devices for the rear registration plate and direction-indicators of categories 5 and 6, the "light-emitting surface" shall be used.

(c) Of coupling devices, in the case of motor vehicles.

For trailers in the "overall length" and in any measurement in length the drawbar shall be included, except when specifically excluded.

2.5.12. *"Lamps marked "D""* means independent lamps, approved as separate devices in such a way that they are allowed to be used either independently or in an assembly of two lamps to be considered as a "single lamp"."

2.5.13. "*Light emitting surface*" of a "lighting device", "light-signalling device" or a retro-reflector means the surface as declared in the request for approval by the manufacturer of the device on the drawing, see **Annex 8 of this Horizontal Reference Document** (see e.g. Parts 1, and 4).

This shall be declared according to one of the following conditions:

(a) In the case where the outer lens is textured, the declared light emitting surface shall be all or part of the exterior surface of the outer lens;

(b) In the case where the outer lens is non-textured the outer lens may be disregarded and the light emitting surface shall be as declared on the drawing, see **Annex 8 of this Horizontal Reference Document** (see e.g. Part 5).

2.5.13.1. "*Textured outer lens*" or "*Textured outer lens area*" means all or part of an outer lens, designed to modify or influence the propagation of light from the light source(s), such that the light rays are significantly diverted from their original direction.

2.5.14. "*Illuminating surface*" (see **Annex 8 of this Horizontal Reference Document**).

2.5.14.1. "*Illuminating surface of a lighting device*" **(paragraphs 2.6.1., 2.6.2., 2.6.3., 2.8.8. and 2.8.13. below)** means the orthogonal projection of the full aperture of the reflector, or in the case of headlamps with an ellipsoidal reflector of the "projection lens", on a transverse plane. If the lighting device has no reflector, the definition of paragraph **2.5.14.2. below** shall be applied. If the light emitting surface of the lamp extends over part only of the full aperture of the reflector, then the projection of that part only is taken into account.

In the case of a dipped-beam headlamp, the illuminating surface is limited by the apparent trace of the cut-off on to the lens. If the reflector and lens are adjustable relative to one another, the mean adjustment should be used.

In the case of AFS being installed: where a lighting function is produced by two or more simultaneously operated lighting units on a given side of the vehicle, the individual illuminating surfaces, taken together, constitute the illuminating surface to be considered (for example, in the figure of paragraph 6.22.4. **of Regulation 48**, the individual illuminating surfaces of the lighting units 8, 9 and 11, regarded together and taking into account their respective location, constitute the illuminating surface to be considered for the right hand side of the vehicle).

2.5.14.2. "*Illuminating surface of a light-signalling device other than a retro-reflector*" **(paragraphs 2.8.1. to 2.8.7. and 2.8.9. to 2.8.12)** means the orthogonal projection of the lamp in a plane perpendicular to its axis of reference and in contact with the exterior light-emitting surface of the lamp, this projection being bounded by the edges of screens situated in this plane, each allowing only 98 per cent of the total luminous intensity of the light to persist in the direction of the axis of reference.

To determine the lower, upper and lateral limits of the illuminating surface only screens with horizontal or vertical edges shall be used to verify the distance to the extreme edges of the vehicle and the height above the ground.

For other applications of the illuminating surface, e.g. distance between two lamps or functions, the shape of the periphery of this illuminating surface shall be used. The screens shall remain parallel, but other orientations are allowed to be used.

In the case of a light-signalling device whose illuminating surface encloses either totally or partially the illuminating surface of another function or encloses a non-lighted surface, the illuminating surface may be considered to be the light emitting surface itself (see e.g. **Annex 8 to this Document.**, Parts 2, 3, 5 and 6).

2.5.14.3. "*Illuminating surface of a retro-reflector*" **(paragraph 2.9.1.)** means, as declared by the applicant during the component approval procedure for the retro-reflectors, the orthogonal projection of a retro-reflector in a plane perpendicular to its axis of reference and delimited by planes contiguous to the declared outermost parts of the retro-reflectors' optical system and parallel to that axis. For the purposes of determining the lower, upper and lateral edges of the device, only horizontal and vertical planes shall be considered.

2.5.15. The "*apparent surface*" for a defined direction of observation means, at the request of the manufacturer or his duly accredited representative, the orthogonal projection of:

Either the boundary of the illuminating surface projected on the exterior surface of the lens;

Or the light-emitting surface;

Only in the case of a light-signalling device producing variable luminous intensities, its apparent surface that may be variable as specified in paragraph **2.12.1.3.** shall be considered under all conditions permitted by the variable intensity control, if applicable.

In a plane perpendicular to the direction of observation and tangential to the most exterior point of the lens. Different examples of the application of apparent surface can be found in **Annex 8 to this Horizontal Reference Document.**

2.5.16. "*Single and multiple lamps*"

2.5.16.1. "*A single lamp*" means:

(a) A device or part of a device having one lighting or light-signalling function, one or more light source(s) and one apparent surface in the direction of the reference axis, which may be a continuous surface or composed of two or more distinct parts; or

(b) Any assembly of two lamps marked "D", whether identical or not, having the same function; or

(c) Any assembly of two independent retro-reflectors, whether identical or not, that have been approved separately; or

(d) Any interdependent lamp system composed of two or three interdependent lamps marked "Y" approved together and providing the same function."

2.5.16.2. "*Two lamps*" or "*an even number of lamps*" in the shape of a band or strip, means two lamps with a single light emitting surface, providing such a band or strip is placed symmetrically in relation to the median longitudinal plane of the vehicle."

2.5.17. "*Distance between two lamps*" which face in the same direction means the shortest distance between the two apparent surfaces in the direction of the reference axis. Where the distance between the lamps clearly meets the requirements of the Regulation, the exact edges of apparent surfaces need not be determined.

2.5.18. "*Interdependent lamp system*" means an assembly of two or three interdependent lamps providing the same function.

2.5.18.1. "*Interdependent lamp marked "Y"*" means a device operating as part of an interdependent lamp system. Interdependent lamps operate together when activated, have separate apparent surfaces in the direction of the reference axis and separate lamp bodies, and may have separate light source(s).

2.5.19. "*Grouped lamps*" means devices having separate apparent surfaces in the direction of the reference axis[2] and separate light sources, but a common lamp body.

2.5.20. "*Combined lamps*" means devices having separate apparent surfaces in the direction of the reference axis[2], but a common light source and a common lamp body.

2.5.21. "*Reciprocally incorporated lamps*" means devices having separate light sources or a single light source operating under different conditions (for example, optical, mechanical, electrical differences), totally or partially common apparent surfaces in the direction of the reference axis[2] and a common lamp body[2].

2.5.22. "*Single-function lamp*" means a part of a device which performs a single lighting or light-signalling function.

2.5.23. "*Concealable lamp*" means a lamp capable of being partly or completely hidden when not in use. This result may be achieved by means of a movable cover, by displacement of the lamp or by any other suitable means. The term "*retractable*" is used more particularly to describe a concealable lamp the displacement of which enables it to be inserted within the bodywork.

2.5.24. "*Optional lamp*" means a lamp, the installation of which is left to the discretion of the manufacturer.

2.5.25. "*Pair*" means the set of lamps of the same function on the left- and right-hand side of the vehicle.

2.5.25.1. "*Matched pair*" means the set of lamps of the same function on the left- and right-hand side of the vehicle, which, as a pair, complies with the photometric requirements.

2.5.26. "*Sequential activation*" means an electrical connection where the individual light sources of a lamp are wired such that they are activated in a predetermined sequence."

2.6. Definition with regard to head lamps:

2.6.1. "*Driving-beam (main-beam) headlamp*" means the lamp used to illuminate the road over a long distance ahead of the vehicle.

2.6.2. "*Passing-beam (dipped-beam) headlamp*" means the lamp used to illuminate the road ahead of the vehicle without causing undue dazzle or discomfort to oncoming drivers and other road-users.

2.6.2.1. "*Principal passing-beam (principal dipped-beam)*" means the dipped-beam produced without the contribution of infrared (IR) emitter and/or additional light sources for bend lighting.

2.6.3. "*Front fog lamp*" means a lamp used to improve the illumination of the road ahead of the vehicle in case of fog or any similar condition of reduced visibility.

2.6.4. "*Bend lighting*" means a lighting function to provide enhanced illumination in bends.

2.6.5. "Lens" means the outermost component of the headlamp (unit) which transmits light through the illuminating surface;

2.6.6. "Coating" means any product or products applied in one or more layers to the outer face of a lens;

2.7. Definition with regard to adaptive front lighting systems:

[2] Examples to enable a decision regarding reciprocal incorporation of lamps can be found in Annex 3, Part 7.

2.7.1. "*Adaptive front lighting system*" (or "system") (or "AFS") means a lighting device type-approved according to Regulation No. 123, providing beams with differing characteristics for automatic adaptation to varying conditions of use of the dipped-beam (passing-beam) and, if it applies, the main-beam (driving-beam) **with a minimum functional content as indicated in paragraph 6.1.1. of Regulation 123; such systems consist of the "system control", one or more "supply and operating device(s)", if any, and the "installation units" of the right and of the left side of the vehicle;.**

2.7.1.1. "*Lighting unit*" means a light-emitting component designed to provide or contribute to one or more front lighting function(s) provided by the AFS.

2.7.1.2. "*Installation unit*" means an indivisible housing (lamp body) which contains one or more lighting unit(s).

2.7.1.3. "*Lighting mode*" or "*mode*" means a state of a front lighting function provided by the AFS, as specified by the manufacturer and intended for adaptation to specific vehicle and ambient conditions.

2.7.1.4. "*System control*" means that part(s) of the AFS receiving the AFS control signals from the vehicle and controlling the operation of the lighting units automatically.

2.7.1.5. "*AFS control signal*" (V, E, W, T) means the input to the AFS in accordance with the paragraph 6.22.7.4. **of the Regulation 48.**

2.7.1.6. "*Neutral state*" means the state of the AFS when a defined mode of the class C passing-beam ("basic passing-beam") or of the main beam in the maximum condition of activation, if any, is produced, and no AFS control signal applies.

2.7.1.7. "*Adaptive main-beam*" means a main-beam of the AFS that adapts its beam pattern to the presence of oncoming and preceding vehicles in order to improve the long-range visibility for the driver without causing discomfort, distraction or glare to other road users.

2.7.1.8. "Class" of a passing beam (C, V, E or W) means the designation of a passing beam, identified by particular provisions according to this Regulation and Regulation No. 48 2/;

2.7.1.9. "Mode" of a front-lighting function provided by a system means a beam within the provisions (see paragraphs 6.2. and 6.3. of this Regulation) either for one of the passing beam classes or for the main beam, designed and specified by the manufacturer for adaptation to dedicated vehicle and ambient conditions;

2.7.1.9.1. "Bending mode" means the designation of a mode of a front-lighting function with its illumination being laterally moved or modified (to obtain an equivalent effect), designed for bends, curves or intersections of the road, and, identified by particular photometric provisions;

2.7.1.9.2. "Category 1 bending mode" means a bending mode with horizontal movement of the kink of the cut-off;

2.7.1.9.3. "Category 2 bending mode" means a bending mode without horizontal movement of the kink of the cut-off;

2.7.1.10. "Lighting unit" means a light emitting part of the system, which may consist of optical, mechanical and electrical components, designed to provide or contribute to the beam of one or more front-lighting function(s) provided by the system;

2.7.1.11. "Installation unit" means an indivisible housing (lamp body) which contains one or more lighting unit(s);

2.7.1.12. "Right side" respectively "left side" means the combined total of the lighting units intended to be installed to that side of the longitudinal median plane of the vehicle, relative to its forward motion;

2.7.1.13. "System control" means that part(s) of the system receiving the signals from the vehicle and controlling the operation of the lighting units automatically;

2.7.1.14. "Neutral state" means the state of the system when a defined mode of the class C passing beam ("basic passing beam") or of the main beam, if any, in the maximum condition of activation is produced, and no AFS control signal applies;

2.7.1.15. "Signal" means any AFS control signal as defined in **Paragraph 2.7.1.5. of this document** or, any additional control input to the system or, a control output from the system to the vehicle;

2.7.1.16. "Signal generator" means a device, reproducing one or more of the signals for system tests;

2.7.1.17. "Supply and operating device" means one or more components of a system providing power to one or more parts of the system, including such as power and/or voltage control(s) for one or more light sources as e.g. electronic light source control gears;

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. - www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html

2/ For explanation only. The provisions of the passing beam classes are dedicated to conditions as follows: C for the basic passing beam, V for use in lit areas such as towns, E for use on roads such as motorways, W for use in adverse conditions such as wet road.

2.7.1.18. "System reference axis" means the intersection line of the vehicle's longitudinal median plane with the horizontal plane through the centre of reference of one lighting unit specified in the drawings according to paragraph 2.2.1. below;

2.7.1.19. "Lens" means the outermost component of an installation unit, which transmits light through the illuminating surface;

2.7.1.20. "Coating" means any product(s) applied in one or more layers to the outer face of a lens;

2.7.1.21. "Aiming" means the positioning of the beam or part thereof on an aiming screen according to the relevant criteria;

2.7.1.22. "Adjustment" means the use of the means provided by the system for vertical and/or horizontal aiming of the beam;

2.7.1.23. "Traffic-change function" means any front-lighting function or a mode thereof, or part(s) thereof only, or any combination of these, intended to avoid glare and provide sufficient illumination in case where a vehicle being equipped with a system designed for one traffic direction only is temporarily used in a country with the opposite direction of traffic.

2.7.1.24. "Substitute function" means any specified front-lighting and/or front light-signalling, be it a front-lighting and/or a front light-signalling function, or a mode thereof, or part(s) thereof only, or any combination of it, intended to replace a front-lighting function/ mode in case of failure.

2.8. Definition with regard to Signalling lamps:

2.8.1. "*Direction-indicator lamp*" means the lamp used to indicate to other road-users that the driver intends to change direction to the right or to the left.

A direction-indicator lamp or lamps may also be used according to the provisions of Regulation No. 97.

2.8.2. "*Stop lamp*" means a lamp used to indicate to other road users to the rear of the vehicle that the longitudinal movement of the vehicle is intentionally retarded.

2.8.3. "*Rear-registration plate illuminating device*" means the device used to illuminate the space reserved for the rear registration plate; such a device may consist of several optical components.

2.8.4. "*Front position lamp*" means the lamp used to indicate the presence and the width of the vehicle when viewed from the front.

2.8.5. "*Rear position lamp*" means the lamp used to indicate the presence and width of the vehicle when viewed from the rear.

2.8.6. "*Hazard warning signal*" means the simultaneous operation of all of a vehicle's direction-indicator lamps to show that the vehicle temporarily constitutes a special danger to other road-users.

2.8.7. "*Rear fog lamp*" means a lamp used to make the vehicle more easily visible from the rear in dense fog.

2.8.8. "*Reversing lamp*" means the lamp used to illuminate the road to the rear of the vehicle and to warn other road-users that the vehicle is reversing or about to reverse.

2.8.9. "*Parking lamp*" means a lamp which is used to draw attention to the presence of a stationary vehicle in a built-up area. In such circumstances it replaces the front and rear position lamps.

2.8.10. "*End-outline marker lamp*" means the lamp fitted near to the extreme outer edge and as close as possible to the top of the vehicle and intended to indicate clearly the vehicle's overall width. This lamp is intended, for certain vehicles and trailers, to complement the vehicle's front and rear position lamps by drawing particular attention to its bulk.

2.8.11. "*Side marker lamp*" means a lamp used to indicate the presence of the vehicle when viewed from the side.

2.8.12. "*Daytime running lamp*" means a lamp facing in a forward direction used to make the vehicle more easily visible when driving during daytime.

2.8.13. "*Cornering lamp*" means a lamp used to provide supplementary illumination of that part of the road which is located near the forward corner of the vehicle at the side towards which the vehicle is going to turn.

2.8.14. "*Rear position lamp*" means the lamp used to indicate the presence and width of the vehicle when viewed from the rear.

2.8.15. "*Exterior courtesy lamp*" means a lamp used to provide supplementary illumination to assist the entry and exit of the vehicle driver and passenger or in loading operations;

2.8.16. "*Manoeuvring lamp*" means a lamp used to provide supplementary illumination to the side of the vehicle to assist during slow manoeuvres.

2.8.17. "*Emergency stop signal*" means a signal to indicate to other road users to the rear of the vehicle that a high retardation force has been applied to the vehicle relative to the prevailing road conditions.

2.9. Definition with regard to retro - reflectors:

"*Retro-reflection* " means the reflection in which radiation is returned in directions close to the direction from which it came, this property being maintained even over wide variations of the direction of the incident radiation:

2.9.1. "*Retro-reflector*" means a device used to indicate the presence of a vehicle by the reflection of light emanating from a light source not connected to the vehicle, the observer being situated near the source.

2.9.2. "*Conspicuity marking*" means a device intended to increase the conspicuity of a vehicle, when viewed from the side or rear (or in the case of trailers, additionally from the front), by the reflection of light emanating from a light source not connected to the vehicle, the observer being situated near the source.

2.9.3. "*Contour marking*" means a conspicuity marking intended to indicate the horizontal and vertical dimensions (length, width and height) of a vehicle.

2.9.4. "*Full contour marking*" means a contour marking that indicates the outline of the vehicle by a continuous line.

2.9.5. "*Partial contour marking*" means a contour marking that indicates the horizontal dimension of the vehicle by a continuous line, and the vertical dimension by marking the upper corners.

2.9.6. "*Line marking*" means a conspicuity marking intended to indicate the horizontal dimensions (length and width) of a vehicle by a continuous line.

2.9.7. "*Retro-reflecting device*" an assembly ready for use and comprising one or more retro-reflecting optical units;

2.9.7.1. Retro-reflecting devices are divided into three classes according to their photometric characteristics: Class IA or IB, Class IIIA or IIIB, and Class IVA.

2.9.8. Retro-reflecting devices of Classes IB and IIIB are devices combined with other signal lamps which are not watertight according to Annex 8, paragraph 1.1., and which are integrated into the body of a vehicle.

2.9.9. "SMV rear marking plate" a triangular plate with truncated corners with a characteristic pattern faced with retro-reflective and fluorescent material or devices (class 1); or with retro-reflective materials or devices only (class 2).

2.9.10. "Rear marking plate" a plate faced with retro-reflective and fluorescent material or devices intended to increase the visibility and permit easy identification of heavy and long vehicles.

2.9.11. "Retro-reflective marking material" means a surface or a device from which, when directionally illuminated, a relatively large portion of the incident radiation is retro-reflected.

2.9.12. "Sample unit" a complete, finished SMV plate ready to be mounted on a vehicle and representative of current production.

2.9.13. **"Fluorescence" means** when certain substances are brought near to a source of ultraviolet or blue radiations, they emit radiations which are nearly always of longer wave-length than those producing the effect. This phenomenonis called fluorescence. By day and in twilight, fluorescent colours are brighter than normal colours because they reflect part of the light falling upon them, and in addition they emit light. At night they are not brighter than ordinary colours.

2.10. Definition with regard to Definition with regard to **Colour of the light emitted are defined in Annex 5** *"COLOUR OF LIGHTS"*

2.11. **Further definitions:**

2.11.1. **"Rear-end collision alert signal (RECAS)**[2] means an automatic signal given by the leading vehicle to the following vehicle. It warns that the following vehicle needs to take emergency action to avoid a collision.

2.11.2. "*Operating tell-tale*" means a visual or auditory signal (or any equivalent signal) indicating that a device has been switched on and is operating correctly or not.

2.11.3.. "*Closed-circuit tell-tale*" means a visual (or any equivalent signal) indicating that a device has been switched on, but not indicating whether it is operating correctly or not.

2.12. Definition with regard to light sources:

2.12.1. *Light source* (for clarification see Annex 10)

2.12.1.1. "*Light source*" means one or more elements for visible radiation, which may be assembled with one or more transparent envelopes and with a base for mechanical and electrical connection.

A light source may also be constituted by the extreme outlet of a light-guide, as part of a distributed lighting or light-signalling system not having a built-in outer lens.

2.12.1.1.1. "*Replaceable light source*" means a light source which is designed to be inserted in and removed from the holder of its device without tool.

2.12.1.1.2. "*Non-replaceable light source*" means a light source which can only be replaced by replacement of the device to which this light source is fixed.

(a) In case of a light source module: a light source which can only be replaced by replacement of the light source module to which this light source is fixed;

(b) In case of adaptive front-lighting systems (AFS): a light source which can only be replaced by replacement of the lighting unit to which this light source is fixed.

2.12.1.1.3. "*Light source module*" means an optical part of a device which is specific to that device. It contains one or more non-replaceable light sources and it may optionally contain one or more holders for approved replaceable light sources.

2.12.1.1.4. "*Filament light source*" (filament lamp) means a light source where the element for visible radiation is one or more heated filaments producing thermal radiation.

2.12.1.1.5. "*Gas-discharge light source*" means a light source where the element for visible radiation is a discharge arc producing electro-luminescence/fluorescence.

2.12.1.1.6. "*Light-emitting diode (LED) light source*" means a light source where the element for visible radiation is one or more solid state junctions producing injection-luminescence/fluorescence.

2.12.1.1.7. "*LED module*" means a light source module containing as light sources only LEDs. However it may optionally contain one or more holders for approved replaceable light sources.

2.12.1.2. "*Electronic light source control gear*" means one or more components between supply and light source, whether or not integrated with the light source or the applied lamp, to control voltage and/ or electrical current of the light source.

2.12.1.2.1. "*Ballast*" means an electronic light source control gear between supply and light source, whether or not integrated with the light source or applied lamp, to stabilise the electrical current of a gas-discharge light source.

2.12.1.2.2. "*Ignitor*" means an electronic light source control gear to start the arc of a gas-discharge light source.

2.12.1.3. "*Variable intensity control*" means the device which automatically controls rear light signalling devices producing variable luminous intensities to assure the unvarying perception of their signals. The variable intensity control is part of the lamp, or part of the vehicle, or split between the said lamp and the vehicle.

2.12.2. "*Objective luminous flux*" means:

(a) In the case of a light source:

The value of the objective luminous flux, not including any tolerances, as indicated in the relevant data sheet of the applicable light source Regulation according to which the light source is approved;

(b) In the case of an LED module:

The value of the objective luminous flux as indicated in the technical specification submitted with the LED module for approval of the lamp of which the LED module is a part;

2.12.3. References made in this Horizontal reference Document to standard (étalon) filament light sources and to Regulation No. 37 shall refer to Regulation No. 37 and its series of amendments in force at the time of application for type approval.

2.12.4. References made in this Horizontal reference Document to gas-discharge light sources and to Regulation No. 99 shall refer to Regulation No. 99 and its series of amendments in force at the time of application for type approval.

2.12.5. References made in this Horizontal reference Document to LED light sources and to Regulation No. 128 shall refer to Regulation No. 128 and its series of amendments in force at the time of application for type approval.

2.13. **"Gonio(photo)meter system (If not otherwise specified in a particular Regulation)"** means a system used for the photometric measurements specified by the angular coordinates in degrees on a sphere with a vertical polar axis according to CIE publication No. 70, Vienna 1987, i.e. corresponding to a gonio(photo)meter system with a horizontal ("elevation") axis fixed to the ground and a second, moveable ("rotation") axis perpendicular to the fixed horizontal axis **(see Annex 15 to this Horizontal Reference Document).** Note: The above mentioned CIE publication specifies a procedure to correct the angular coordinates in the case where an alternative gonio(photo)meter system is used.

3. APPLICATION FOR APPROVAL

3.1. The application for approval of a type of lamp shall be submitted by the holder of the trade name or mark or by his duly accredited representative.

If applicable, the application shall specify the category of the device, and some of its characteristics.

At the discretion of the applicant, it may specify if the device may be installed on the vehicle with different inclinations of the reference axis in respect to the vehicle reference planes and to the ground, or rotate around its reference axis; these different conditions of installation shall be indicated in the communication form.

3.2 For each type of lamp the application shall be accompanied by the following:

3.2.1. Drawings, in triplicate, sufficiently detailed to permit identification of the type and if applicable the category of the lamp, and showing geometrically in what position(s) it may be mounted on the vehicle; the axis of observation to be taken as the axis of reference in the tests (horizontal angle H = 0°, vertical angle V = 0°); and the point to be taken as the centre of reference during the tests. The drawings shall show the position intended for the approval number and the additional symbols in relation to the circle of the approval mark;

3.2.2. A brief technical description stating in particular, with the exception of lamps with non-replaceable light sources:

(a) The category or categories of filament lamp(s) prescribed; this filament lamp category shall be one of those contained in Regulation No. 37; and/or

(c) The category or categories of LED lamp(s) prescribed; this LED lamp category shall be one of those contained in Regulation No. 128; and/or

(b) The light source module specific identification code.

3.2.3. For a lamp with variable intensity, a concise description of the variable intensity control. For a double-intensity lamp, an arrangement diagram and a specification of the characteristics of the system ensuring the two levels of intensity;

3.2.4. Two complete samples of the device; if application is made for the approval for devices which are not identical but are symmetrical and suitable for mounting one on the left and one on the right side of the vehicle, the two samples submitted may be identical and be suitable for mounting only on the right or only on the left side of the vehicle. For a variable-intensity lamp, the application shall also be accompanied by variable intensity control or a generator providing the same signal(s).

"**3.2.5.** **If applicable in the relevant Regulation and in the case of a non-replaceable filament lamp(s) or light source module(s) equipped with non-replaceable filament lamp(s): the documents according to paragraph 5.6 of this Regulation.**"

"**3.2.6.** **In the case of a type of lamp differing only by the trade name or mark from a type that has already been approved it shall be sufficient to submit:**

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

3.2.6.2. **two samples bearing the new trade name or mark or equivalent documentation.**"

4. MARKINGS

Devices submitted for approval shall:

4.1. Bear on the lens the trade name or mark of the applicant; this marking shall be clearly legible and indelible;

4.2. With the exception of lamps with non-replaceable light sources, bear a clearly legible and indelible marking indicating:

(a) The category or categories of filament lamp(s) prescribed; and/or

(b) The light source module specific identification code;

4.3. Comprise a space of sufficient size for the approval marking and the additional symbols prescribed in paragraph 5.2 below; this space shall be shown in the drawings mentioned in paragraph 3.2.1 above;

4.4. In case of lamps with:

(a) An electronic light source control gear; or

(b) A variable intensity control; and/or

(c) Non-replaceable light sources; and/or

(d) Light source module(s);

bear the marking of the rated voltage or range of voltage and rated maximum wattage;

4.5 In the case of lamps with light source module(s), the light source module(s) shall bear:

4.5.1. The trade name or mark of the applicant; this marking must be clearly legible and indelible;

4.5.2. The specific identification code of the module; this marking must be clearly legible and indelible. This specific identification code shall comprise the starting letters “MD” for “MODULE” followed by the approval marking without the circle as prescribed in paragraph 5.2.1.1 below; this identification code shall be shown in the drawings mentioned in paragraph 3.2.1 above. The approval marking does not have to be the same as the one on the
lamp in which the module is used, but both markings shall be from the same applicant;

4.5.3. The marking of the rated voltage or range of voltage and rated maximum wattage.

4.6. An electronic light source control gear or a variable intensity control being part of the lamp but not included into the lamp body shall bear the name of the manufacturer and its identification number.

5. APPROVAL

5.1. General

5.1.1. If the two devices submitted for approval in pursuance of paragraph 3.2.4 above meet the requirements of the Regulation corresponding to their function, approval shall be granted.

5.1.2. Where grouped, combined or reciprocally incorporated lamps have been found to comply with the requirements of several Regulations annexed to the 1958 Agreement, a single international approval mark may be applied. The approval may only be granted if such lamps are not grouped, combined or reciprocally incorporated with a lamp or lamps not satisfying any one of these Regulations.

5.1.3. An approval number shall be assigned to each type approved. Its first two digits shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation under which approval has been granted; at the time of issue of the approval (00 identifies a Regulation in its original form). The same Contracting Party shall not assign the same number to another type of device covered by the same device Regulation.

5.1.4. Notice of approval or of extension or refusal or withdrawal of approval of a type of a device pursuant to the Regulation, under which the device has been approved, shall be communicated to the Parties to the 1958 Agreement which apply this device's Regulation, by means of a form conforming to the model in **Annex x** to the Regulation under which the device has been approved.

5.1.5 Every device conforming to a type approved under this device's Regulation shall bear in the space referred to in paragraph 4.3, above, and in addition to the markings prescribed in paragraphs 4.1 and 4.2 or 4.4 respectively, an approval mark as described in paragraphs 5.2 and 5.3, below.

5.2 Composition of the approval mark

The approval mark shall consist of:

5.2.1 An international approval marking, comprising:

5.2.1.1 A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval;[3]

5.2.1.2 The approval number prescribed in paragraph 5.1.3, above.

5.2.2 The additional symbol (or symbols) indicated in the Regulation under which the approval has been granted.

5.2.3 The two digits of the approval number which indicate the series of amendments in force at the time of issue of the approval and, if necessary, the required arrow, may be marked close to the above additional symbols.

5.2.4 The marks and symbols referred to in paragraphs 5.2.1 and 5.2.2, above, shall be clearly legible and be indelible even when the device is fitted in the vehicle (see paragraph 5.4).

5.2.5. Additional marking required by pertinent Regulation under which the device is being approved.

5.3 Arrangement of the approval mark

5.3.1 Independent lamps

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[3] **1 for Germany, 2 for France, 3 for Italy, 4 for the Netherlands, 5 for Sweden, 6 for Belgium, 7 for Hungary, 8 for the Czech Republic, 9 for Spain, 10 for Serbia, 11 for the United Kingdom, 12 for Austria, 13 for Luxembourg, 14 for Switzerland, 15 (vacant), 16 for Norway, 17 for Finland, 18 for Denmark, 19 for Romania, 20 for Poland, 21 for Portugal, 22 for the Russian Federation, 23 for Greece, 24 for Ireland, 25 for Croatia, 26 for Slovenia, 27 for Slovakia, 28 for Belarus, 29 for Estonia, 30 (vacant), 31 for Bosnia and Herzegovina, 32 for Latvia, 33 (vacant), 34 for Bulgaria, 35 (vacant), 36 for Lithuania, 37 for Turkey, 38 (vacant), 39 for Azerbaijan, 40 for The former Yugoslav Republic of Macedonia, 41 (vacant), 42 for the European Community (Approvals are granted by its member States using their respective ECE symbol), 43 for Japan, 44 (vacant), 45 for Australia, 46 for Ukraine, 47 for South Africa, 48 for New Zealand, 49 for Cyprus, 50 for Malta, 51 for the Republic of Korea, 52 for Malaysia, 53 for Thailand, 54 and 55 (vacant), 56 for Montenegro, 57 (vacant) and 58 for Tunisia. Subsequent numbers shall be assigned to other countries in the chronological order in which they ratify or accede to the Agreement Concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions, and the numbers thus assigned shall be communicated by the Secretary-General of the United Nations to the Contracting Parties to the Agreement.**

Annex 1 gives an example of arrangement of the approval mark with the above-mentioned additional symbols. For exact marking to be inserted into the generic scheme of Annex 1 of this Horizontal Reference Document see **Annex y**, Figure 1, of each Regulation pertaining to individual devices

If different types of lamps complying with the requirements of several Regulations, use the same outer lens having the same or different colour, a single international approval mark may be affixed, consisting of a circle surrounding the letter "E" followed by the distinguishing number of the country which has granted the approval, and an approval number. This approval mark may be located anywhere on the lamp, provided that:

5.3.1.1 It is visible after their installation (see paragraph 5.4);

5.3.1.2 The identification symbol for each lamp appropriate to each Regulation under which approval has been granted, together with the corresponding series of amendments incorporating the most recent major technical amendments to the Regulation at the time of issue of the approval and if necessary, the required arrow, shall be marked;

5.3.1.3 The size of the components of a single approval mark shall not be less than the minimum size required for the smallest of the individual marks under which approval has been granted;

5.3.1.4 The main body of the lamp shall include the space described in paragraph 4.3, above, and shall bear the approval mark of the actual function(s);

5.3.1.5 Point 4 in Annex 3 to this Horizontal Reference Document gives examples of an approval mark with the above-mentioned additional symbols.

5.3.2 Grouped, combined or reciprocally incorporated lamps

5.3.2.1 Where grouped, combined or reciprocally incorporated lamps have been found to comply with the requirements of several Regulations, a single international approval mark may be applied consisting of a circle surrounding the letter "E" followed by the distinguishing number of the country which has granted the approval, and an approval number. This approval mark may be located anywhere on the grouped, combined or reciprocally incorporated lamps, provided that:

5.3.2.1.1 It is visible after the installation of the lamps (see paragraph 5.4);

5.3.2.1.2 No part of the grouped, combined or reciprocally incorporated lamps that transmits light can be removed without at the same time removing the approval mark.

5.3.2.2 An identification symbol for each lamp appropriate to each Regulation under which approval has been granted, together with the corresponding series of amendments incorporating the most recent major technical amendments to the Regulation at the time of issue of the approval and, if necessary, the required arrow, shall be marked:

5.3.2.2.1 Either on the appropriate light-emitting surface;

5.3.2.2.2 Or in a group, in such a way that each lamp of the grouped, combined or reciprocally incorporated lamps may be clearly identified.

5.3.2.3 The size of the components of a single approval mark shall not be less than the minimum size required for the smallest of the individual marks by the Regulation under which approval has been granted.

5.3.2.4 An approval number shall be assigned to each type approved. The same Contracting Party may not assign the same number to another type of grouped, combined or reciprocally incorporated lamps covered by a Regulation.

5.3.2.5 Annex 1, point 2, to this Horizontal Reference Document gives examples of the arrangement of the approval marks for grouped, combined or reciprocally incorporated lamps with all the above-mentioned additional symbols.

5.3.3 Lamps reciprocally incorporated with other lamps, of which the lens may also be used for other types of headlamps. The provisions laid down in paragraph 5.3.2, above, are applicable.

5.3.3.1 In addition, where the same lens is used, the latter may bear the different approval marks relating to the different types of headlamps or units of lamps, provided that the main body of the headlamp, even if it cannot be separated from the lens, also comprises the space described in paragraph 4.3, above, and bears the approval marks of the actual functions. If different types of headlamps comprise the same main body, the latter may bear the different approval marks.

5.3.3.2 Annex 1, point 3, to this Horizontal Reference Document gives examples of approval marks for lamps reciprocally incorporated with a headlamp.

5.4 Position of the approval marking

The approval marking shall be clearly legible and indelible. It may be placed on an inner or outer part (transparent or not) of the device which cannot be separated from the transparent part of the device emitting the light. In any case the marking shall be visible when the device is fitted on the vehicle or when a movable part such as the hood or boot lid or a door is opened.

B. TECHNICAL REQUIREMENTS

6. GENERAL SPECIFICATIONS

6.1 Each device supplied shall conform to the specifications set forth in the Regulation pertained to this device.

6.2 The devices must be so designed and constructed that under 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 Horizontal Reference Document and the Regulation under which they have been approved.

6.3 For a device equipped with a light source module:

6.3.1 The design of the light source module(s) shall be such that even in darkness the light source module(s) can be fitted in no position but the correct one;

6.3.2 The light source module(s) shall be

- tamperproof.
- Only removable from its device with the use of tools, unless it is stated in the communication sheet that the LED module is non-replaceable, and
- So designed that regardless of the use of tool(s), it is not mechanically interchangeable with any replaceable approved light source.

6.3.3. A LED module does not need to be replaceable, if so stated in the communication sheet of the component type approval.

6.4. In the case of replaceable filament lamp(s):

6.4.1. Any category or categories of filament lamp(s) approved according to Regulation No. 37 may be used, provided that no restriction on the use is made in Regulation No. 37 and its series of amendments in force at the time of application for type approval.

6.4.2. The design of the device shall be such that the filament lamp can be fixed in no other position but the correct one.

6.4.3. The filament lamp holder shall conform to the characteristics given in IEC Publication 60061. The holder data sheet relevant to the category of filament lamp used, applies.

"**6.5. In the case of non-replaceable filament lamp(s) or light source module(s) equipped with non-replaceable filament lamp(s), the applicant shall annex to the type approval documentation a report, acceptable to the Authority responsible for type approval, that demonstrates compliance of these non-replaceable filament lamp(s) with the requirements as specified in paragraph 2.11 of IEC 60809, Edition 3.**"

7. GENERAL SPECIFICATIONS WITH REGARD TO SIGNALLING LAMPS

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

7.2. Devices, which are reciprocally incorporated with another function, using a common light source, and designed to operate permanently with an electronic light source control gear to regulate the intensity of the light emitted, are permitted.

See revised version

7.3. Grouped, combined or reciprocally incorporated or single lamps

7.3..1. Lamps may be grouped, combined or reciprocally incorporated with one another provided that all requirements regarding colour, position, orientation, geometric visibility, electrical connections and other requirements, if any, are fulfilled.

7.3..1.1. The photometric and colorimetric requirements of a lamp shall be fulfilled when all other functions with which this lamp is grouped, combined or reciprocally incorporated are switched OFF.

However, when a front or rear position lamp is reciprocally incorporated with one or more other function(s) which can be activated together with them, the requirements regarding colour of each of these other functions shall be fulfilled when the reciprocally incorporated function(s) and the front or rear position lamps are switched ON.

7.3..1.2. Stop lamps and direction-indicator lamps are not permitted to be reciprocally incorporated.

7.3..1.3. Where stop lamps and direction-indicator lamps are grouped, the following conditions shall be met:

7.3..1.3.1. Any horizontal or vertical straight line passing through the projections of the apparent surfaces of these functions on a plane perpendicular to the reference axis, shall not intersect more than two borderlines separating adjacent areas of different colour;

7.3..1.3.2. Their apparent surfaces in the direction of the reference axis, based upon the areas bounded by the outline of their light emitting surfaces, do not overlap.

7.3..2. Single lamps: ~~Where the apparent surface of a single lamp is composed of two or more distinct parts, it shall satisfy the following requirements:~~

7.3..2.1. Single lamps as defined in paragraph **2.5.16.1. (a),** composed of two or more distinct parts, shall be installed in such a way that:

(a) Either the total area of the projection of the distinct parts on a plane tangent to the exterior surface of the outer lens and perpendicular to the reference axis shall occupy not less than 60 per cent of the smallest quadrilateral circumscribing the said projection; or

(b) The minimum distance between the facing edges of two adjacent/tangential distinct parts shall not exceed 75 mm when measured perpendicularly to the reference axis.

These requirements shall not apply to a single retro-reflector."

7.3..2.2. Single lamps as defined in paragraph **2.5.16.1. (b) or (c),** composed of two lamps marked "D" or two independent retro reflectors, shall be installed in such a way that:

(a) Either the projection of the apparent surfaces in the direction of the reference axis of the two lamps or retro reflectors occupies not less than 60 per cent of the smallest quadrilateral circumscribing the projections of the said apparent surfaces in the direction of the reference axis; or

(b) The minimum distance between the facing edges of the apparent surfaces in the direction of the reference axis of two lamps or two independent retro reflectors does not exceed 75 mm when measured perpendicularly to the reference axis."

7.3..2.3. Single lamps as defined in paragraph **2.5.16.1. (d)** shall fulfil the requirements of paragraph 6.7.2.1.

Where two or more lamps and/or two or more separate apparent surfaces are included into the same lamp body and/or have a common outer lens these shall not be considered as an interdependent lamp system.

However, a lamp in the shape of a band or strip may be part of an interdependent lamp system."

"7.3..2.4. Two lamps or an even number of lamps in the shape of a band or strip shall be placed symmetrically in relation to the median longitudinal plane of the vehicle, extending on both sides to within at least 0.4 m of the extreme outer edge of the vehicle, and are not less than 0.8 m long; the illumination of such a surface shall be provided by not less than two light sources placed as close as possible to the ends; the light-emitting surface may be constituted by a number of juxtaposed elements on condition that these individual light-emitting surfaces, when projected on a transverse plane fulfil the requirements of paragraph 6.7.2.1."

7.4. However, if a front or rear position lamp is reciprocally incorporated with a direction-indicator the electrical connection of the front position lamp on the relevant side of the vehicle or the reciprocally incorporated part of it may be such that it is switched off during the entire period (both ON and OFF cycle) of activation of the direction-indicator lamp.

7.5. In the absence of specific instructions, the photometric characteristics (e.g. intensity, colour, apparent surface, etc.) of a lamp shall not be intentionally varied during the period of activation of the lamp.

7.5..1. Direction-indicator lamps, the vehicle-hazard warning signal, amber side-marker lamps complying with paragraph 6.18.7. below, and the emergency stop signal shall be flashing lamps.

7.5..2. The photometric characteristics of any lamp may vary:

(a) In relation to the ambient light;

(b) As a consequence of the activation of other lamps; or

(c) When the lamps is being used to provide another lighting function;

provided that any variation in the photometric characteristics is in compliance with the technical provisions for the lamp concerned.

7.5..3. The photometric characteristics of a direction indicator lamp of categories 1, 1a, 1b, 2a or 2b may be varied during a flash by sequential activation of light sources as specified in paragraph 5.6. of Regulation No. 6.

This provision shall not apply when direction indicator lamps of categories 2a and 2b are operated as emergency stop signal according to paragraph 6.23.1**. of the Regulation 48.**"

7.6. In all cases, the distance between the rear fog-lamp and each stop-lamp shall be greater than 100 mm.

7.7. COLOUR OF LIGHT EMITTED

The colour of the light emitted inside the field of the light distribution grid defined in **paragraph xx of Annex xx** of each Regulation shall be within the limits of the coordinates prescribed in **Annex 5** to this Horizontal Reference Document. Outside this field, no sharp variation of colour shall be observed. These requirements shall also apply within the range of variable luminous intensity produced by variable intensity lamps.

7.8 The test procedures for Signalling lamps are described in Annex 5 to this Horizontal Reference Document.

7.9. In the case of signalling lamps, the heat resistance test, if applicable in the individual Regulation, shall be carried out **in accordance to part A in Annex 10 of this HRD.**

8. GENERAL SPECIFICATIONS WITH REGARD TO HEAD LAMPS

8.1. Headlamps shall be fitted with a device enabling them to be so adjusted on the vehicles as to comply with the rules applicable to them. Such a device need not be fitted on units in which the reflector and the diffusing lens cannot be separated, provided the use of such units is confined to vehicles on which the headlamp setting can be adjusted by other means.

Where a headlamp providing a principal passing-beam and a headlamp providing a driving beam, each equipped with its own filament lamp or LED module(s), the adjusting device shall enable the principal passing-beam and the driving-beam to be adjusted individually.

8.1..1. However, these provisions shall not apply to headlamp assemblies whose reflectors are indivisible. For this type of assembly the requirements of paragraph 6.3. of this Regulation apply.

8.2. In the case of LED module(s) Paragraph 6.3. above shall apply and in addition:

8.2..1. Electronic light source control gear(s), if applicable, shall be considered to be part of the headlamp; they may be part of the LED module(s);

8.2..2. The headlamp, if equipped with LED modules, and the LED module(s) themselves shall comply with the relevant requirements specified in Annex 10 to this Regulation. The compliance with the requirements shall be tested.

8.2..3. In the case of a replaceable LED module the removal and replacement of this LED module, as described in Annex 10, paragraph 1.4.1. shall be demonstrated to the satisfaction of the Technical Service.

8.3. Headlamps designed to satisfy the requirements both of right hand and of left hand traffic may be adapted for traffic on a given side of the road either by an appropriate initial setting when fitted on the vehicle or by selective setting by the user. Such initial or selective setting may consist, for example, of fixing either the optical unit at a given angle on the vehicle or the filament lamp or LED module(s) producing the principal passing-beam at a given angle/position in relation to the optical unit. In all cases, only two different and clearly distinct settings, one for right hand and one for left-hand traffic, shall be possible, and the design shall preclude inadvertent shifting from one setting to the other or setting in an intermediate position. Where two different setting positions are provided for the filament lamp or LED module(s) producing the principal passing-beam, the components for attaching the filament lamp or LED module(s) producing the principal passing-beam to the reflector must be so designed and made that, in each of its two settings, this filament lamp or LED module(s) will be held in position with the precision required for headlamps designed for traffic on only one side of the road. Conformity with the requirements of this paragraph shall be verified by visual inspection and, where necessary, by a test fitting.

8.4. Light transmitting components made of plastic material shall be tested according to the requirements of Annex 6.

8.5. On headlamps designed to provide alternately a driving-beam and a passing-beam, or a passing-beam and/or a driving-beam designed to become bend lighting, any mechanical, electromechanical or other device incorporated in the headlamp for these purposes shall be so constructed that:

8.5..1. The device is robust enough to withstand 50,000 operations under normal conditions of use. In order to verify compliance with this requirement, the Technical Service responsible for approval tests may:

(a) Require the applicant to supply the equipment necessary to perform the test;

(b) Forego the test if the headlamp presented by the applicant is accompanied by a test report, issued by a Technical Service responsible for approval tests for headlamps of the same construction (assembly), confirming compliance with this requirement.

8.5..2. In the case of failure, the luminous intensity above the line H-H shall not exceed the values of a passing-beam according to paragraph 6.2.4.; in addition, on headlamps designed to

provide a passing and/or a driving-beam to become a bend lighting, a minimum luminous intensity of at least 2,500 cd. shall be fulfilled in test point 25 V (VV line, 1.72D).

When performing the tests to verify compliance with these requirements, the Technical Service responsible for approval tests shall refer to the instructions supplied by the applicant.

8.5..3. Either the principal passing-beam or the driving-beam shall always be obtained without any possibility of the mechanism stopping in between two positions;

8.5..4. The user cannot, with ordinary tools, change the shape or position of the moving parts.

8.6. Illumination configuration for different traffic conditions (for head lamps with asymmetrical beam patterns only)

8.6..1. In the case of headlamps designed to meet the requirements of traffic moving on one side of the road (either right or left) only, appropriate measures shall be taken to prevent discomfort to road-users in a country where traffic moves on the side of the road opposite to that of the country for which the headlamp was designed[4]. Such measures may be:

(a) Occulting a part of the outer headlamp lens area;

(b) Downward movement of the beam. Horizontal movement is allowed;

(c) Any other measure to remove or reduce the asymmetrical part of the beam.

8.6..2. Following the application of this (these) measure(s) the following requirements regarding the luminous intensity of the headlamp shall be met with the adjustment left unchanged compared to that for the original traffic direction:

8.6.2.1. Passing-beam designed for right-hand traffic and adapted to left-hand traffic:

at 0.86D-1.72L at least 2,500 cd;

at 0.57U-3.43R not more than 880 cd.

8.6..2.2. Passing-beam designed for left-hand traffic and adapted to right-hand traffic:

at 0.86D-1.72R at least 2,500 cd;

at 0.57U-3.43L not more than 880 cd.

8.7. In case of a passing-beam headlamp incorporating a light source or LED module(s) producing the principal passing-beam and having a total objective luminous flux which exceeds 2,000 lumens, a reference shall be made in item 9. of the communication form in Annex 1. The objective luminous flux of LED modules shall be measured as described in paragraph 5. of Annex 10.

8.8. The definitions in paragraphs 2.7.1.1.3. and 2.7.1.1.7. in Regulation No. 48 allow the use of LED modules, which may contain holders for other light sources. Notwithstanding this provision a mixture of LED'(s) and other light sources for the principal dipped beam or the contributor to the bend lighting or each driving-beam, as specified by this Regulation is not allowed.

8.9. COLOUR OF LIGHT EMITTED

The colour of the light emitted for any head lamp shall be white and shall be within the limits of the coordinates prescribed in **Annex 5** to this Horizontal Reference Document.

8.10. The test procedures for head lamps and/ or front fog lamps are described in Annex 6 to this Horizontal Reference Document.

8.11. In the case of head lamps and/or front fog lamps complementary tests shall be done according to the requirements **of Part B of** Annex 10 of this Horizontal Reference Document to ensure that in use there is no excessive change in photometric performance.

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[4] Instructions on the installation of lamps fitted with the measures are given in Regulation No. 48.

9. GENERAL SPECIFICATIONS WITH REGARD TO RETRO – REFLECTING DEVICES

9.1. Retro-reflecting devices or retro-reflective marking materials must be so constructed that they function satisfactorily and will continue to do so in normal use. In addition, they must not have any defect in design or manufacture that is detrimental to their efficient operation or to their maintenance in good condition.

9.2. The components of retro-reflecting devices or retro-reflective marking materials or parts thereof shall not be capable of being easily dismantled.

9.3. The means of attachment of the marking materials shall be durable and stable.

~~6.3. Retro-reflecting optical units may not be replaceable.~~

9.4.. The outer surface of retro-reflecting devices or retro-reflective marking materials shall be easy to clean. The surface shall therefore not be rough and any protuberances they may exhibit shall not prevent easy cleaning.

~~6.5. For devices of Class IVA their means of fixation shall be such that they allow a stable and durable connection between the device and the vehicle.~~

9.5. There shall be no access to the inner surface of the retro-reflectors when in normal use.

9.6. The test procedures for retro - reflecting devices or retro – reflecting marking materials are described in Annex 7 to this Horizontal Reference Document.

C. FURTHER ADMINISTRATIVE PROVISIONS

10. MODIFICATIONS OF A TYPE OF LAMP FOR MOTOR VEHICLES AND THEIR TRAILERS AND EXTENSION OF APPROVAL

10.1 Every modification of a type of lamp shall be notified to the administrative department which approved the type. The department may then either:

10.1.1 Consider that the modifications made are unlikely to have an appreciable adverse effect and that in any case the device still complies with the requirements; or

10.1.2 Require a further test report from the technical service responsible for conducting the tests.

10.2 Confirmation or refusal of approval, specifying the alterations, shall be communicated by the procedure specified in paragraph 5.1.4, above, to the Parties to the Agreement applying individual device Regulations.

10.3 The Competent Authority issuing the extension of approval shall assign a series number for such an extension and inform thereof the other Parties to the 1958 Agreement applying the Regulation under which the approval has been granted by means of a communication form conforming to the model in **Annex y** to each Regulation.

11. CONFORMITY OF PRODUCTION

The conformity of production procedures shall comply with those set out in the Agreement, Appendix 2 (E/ECE/324-E/ECE/TRANS/505/Rev.2), with the following requirements:

"11.1. **Lamps shall be so manufactured as to conform to the type approved under the relevant Regulation. The compliance with the requirements ~~set forth in paragraphs 6 and 8 above~~ of the relevant Regulation and of this HRD shall be verified as follows:**

11.1.1 The minimum requirements for conformity of production control procedures set forth in **Annex 2** to this HRD shall be complied with;

11.1.2 The minimum requirements for sampling by an inspector set forth in **Annex 3** to this Horizontal Reference Document shall be complied with;

"11.2. In the case of non-replaceable filament lamp(s) or light source module(s) equipped with non-replaceable filament lamps, a report (by the light source manufacturer indicated in the type approval documentation) shall demonstrate compliance of these non-replaceable filament lamp(s) with lifetime requirements and, in the case of colour coated filament lamps, also with colour endurance requirements, as specified in paragraph 2.11 of IEC 60809, Edition 3."

11.3. The authority which has granted type approval may at any time verify the conformity control methods applied in each production facility. The normal frequency of these verifications shall be once every two years.

12. PENALTIES FOR NON-CONFORMITY OF PRODUCTION

12.1 The approval granted in respect of a device pursuant to a Regulation may be withdrawn if the foregoing requirements are not met;

12.2 If a Contracting Party to the Agreement which applies a Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying individual device Regulations, by means of a communication form conforming to the model in **Annex y** to each Regulation.

13. PRODUCTION DEFINITELY DISCONTINUED

If the holder of the approval completely ceases to manufacture a device approved in accordance with the individual device Regulations, he shall so inform the authority which granted the approval. Upon receiving the relevant communication, that authority shall inform thereof the other Parties to the 1958 Agreement applying individual device Regulations by means of a communication form conforming to the model in **Annex xy** to each Regulation.

14. NAMES AND ADDRESSES OF TECHNICAL SERVICES RESPONSIBLE FOR CONDUCTING APPROVAL TESTS, AND OF ADMINISTRATIVE DEPARTMENTS

The Parties to the 1958 Agreement which apply a Regulation shall communicate to the United Nations Secretariat the names and addresses of the Technical Services responsible for conducting approval tests and of the Administrative Departments which grant approval and to which forms certifying approval or extension or refusal or withdrawal of approval, or the definitive discontinuation of production issued in other countries, are to be sent.

Annex 1

ARRANGEMENT OF APPROVAL MARKS

1. MARKING OF INDEPENDENT LAMPS

See **Annex xxx, point xxx**, of each Regulation.

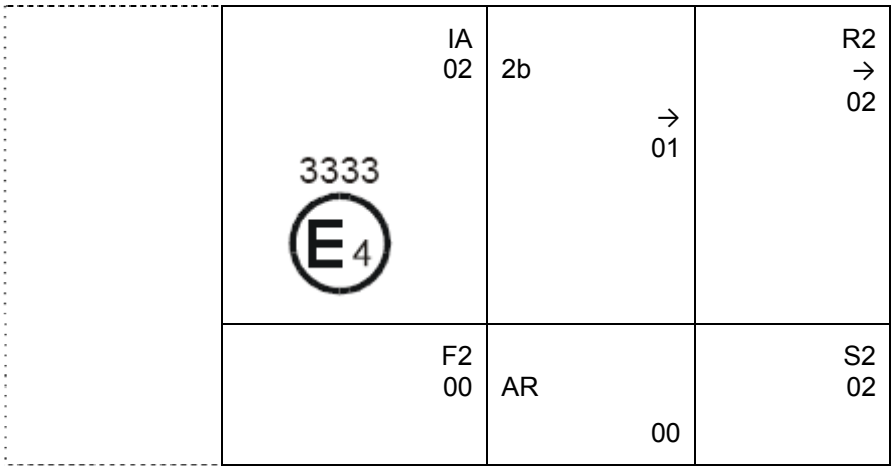
Note: The approval number and the additional symbols shall be placed close to the circle and either above or below the letter "E", or to the right or left of that letter. The digits of the approval number shall be on the same side of the letter "E" and face the same direction. The use of Roman numerals as approval numbers should be avoided so as to prevent any confusion with other symbols.

2. SIMPLIFIED MARKING OF GROUPED, COMBINED OR RECIPROCALLY INCORPORATED LAMPS WHEN TWO OR MORE LAMPS ARE PART OF THE SAME ASSEMBLY

The vertical and horizontal lines schematize the shape of the light-signalling device. These are not part of the approval mark.

2.1 Devices in rear

Model A



Model B

		IA 2b R2 02 → → 01 02 F2 AR S2 00 00 02 	

Model C

IA 2b R2 02 → → 01 02 F2 AR S2 00 00 02 			

Note: These three examples of approval marks (models A, B and C) represent three possible variables for the marking of a lighting device when two or more lamps are part of the same assembly of grouped, combined or reciprocally incorporated lamps.

They indicate that the device was approved in the Netherlands (E4) under approval number 3333 and comprises:

(a) A reflex-reflector of class 1A approved in accordance with the 02 series of amendments to Regulation No. 3;

(b) A rear direction indicator lamp with variable luminous intensity (category 2b) approved in accordance with the 01 series of amendments to Regulation No. 6;

(c) A ~~red~~ rear position lamp with variable luminous intensity (R2) approved in accordance with the 02 series of amendments to Regulation No. 7;

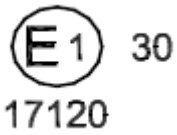
(d) A rear fog lamp with variable luminous intensity (F2) approved in accordance with Regulation No. 38 in its original version;

(e) A reversing lamp (AR) approved in accordance with Regulation No. 23 in its original version;

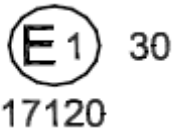
(f) A stop-lamp with variable luminous intensity (S2) approved in accordance with the 02 series of amendments to Regulation No. 7.

2.2 Devices in front

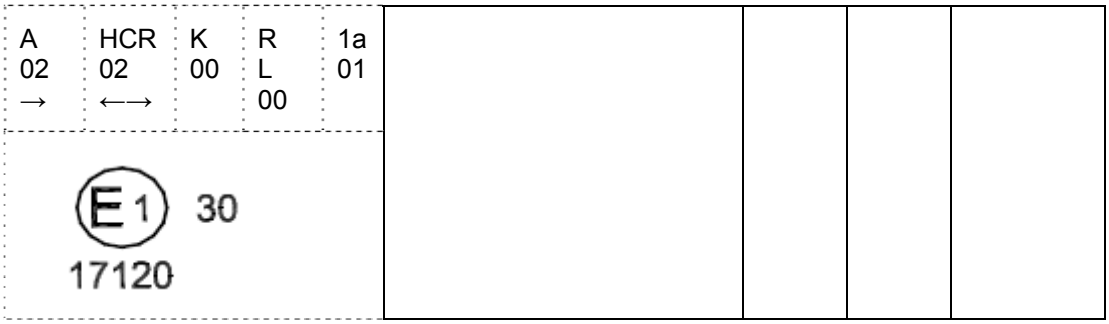
Model D

	 02 A → 02 HCR ←→	02 B →	00 RL	01 1a

Model E

	02 A → 02 HCR ←→ 02 B 00 RL 01 1a 			

Model F



Note: These three examples of approval marks above, models D, E and F, correspond to a lighting device approved in Germany (E1) under approval number 17120, and incorporating:

(a) A front position lamp (A) approved in accordance with the 02 series of amendments to Regulation No. 7;

(b) A headlamp (HCR) with a passing beam designed for right-hand and left-hand traffic and a driving beam with a maximum intensity comprised between 86,250 and 101,250 candelas (indicated by the figure 30), approved in accordance with the 02 series of amendments to Regulation No. 20;

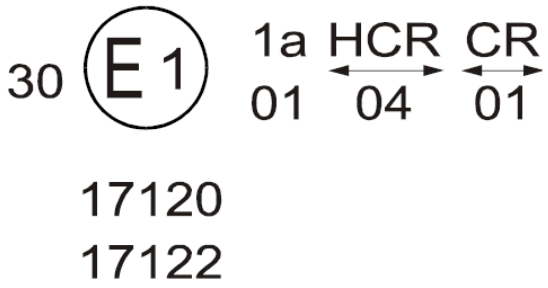
(c) A front direction indicator lamp (of category 1a) approved in accordance with the 01 series of amendments to Regulation No. 6;

(d) Daytime running lights (RL) approved in accordance with the 00 series of amendments to Regulation No. 87;

(e) A front fog lamp (B) approved in accordance with the 02 series of amendments to Regulation No. 19 in models D and E;

(f) A cornering lamp (K) approved in accordance with the 00 series of amendments to Regulation No. 119 in model F.

3. MARKING OF A LAMP RECIPROCALLY INCORPORATED WITH A HEADLAMP



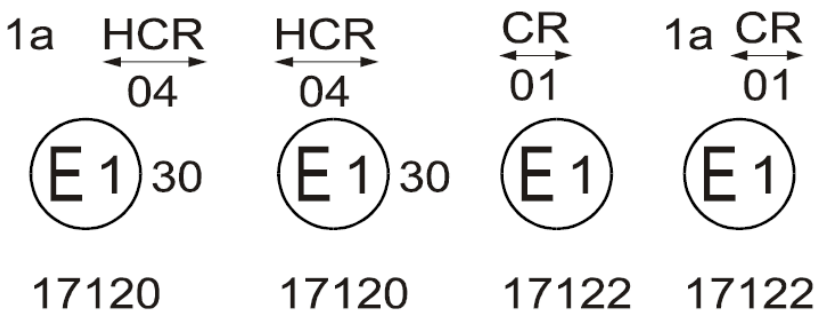
The above example corresponds to the marking of a lens intended to be used in different types of headlamps, namely either:

(a) A headlamp with a passing beam designed for right-hand and left-hand traffic and a driving beam with a maximum intensity comprised between 86,250 and 101,250 candelas (indicated by the number 30), approved in Germany (E1) in accordance with the requirements of Regulation No. 8 as amended by the 04 series of amendments; which is reciprocally incorporated with a front direction indicator (category 1a) approved in accordance with the 01 series of amendments to Regulation No. 6; or

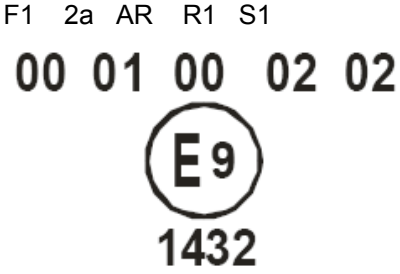
(b) A headlamp with a passing beam designed for right-hand and left-hand traffic and a driving beam, approved in Germany (E1) in accordance with the requirements of Regulation No. 1 as amended by the 01 series of amendments, which is reciprocally incorporated with the same front direction indicator as above; or even

(c) Either of the above-mentioned headlamps approved as a single lamp.

The main body of the headlamp shall bear the only valid approval number, for instance:



4. MARKING OF INDEPENDENT LAMPS USING THE SAME LENS



The above example corresponds to the marking of a lens intended to be used in different types of lamps. The approval marks indicate that the device was approved in Spain (E9) under approval number 1432 and comprises:

(a) A rear fog lamp (F) of category F1 (steady luminous intensity) approved in accordance with Regulation No. 38 in its original version;

(b) A rear direction indicator lamp of category 2a (steady luminous intensity) approved in accordance with the 01 series of amendments to Regulation No. 6;

(c) A reversing lamp (AR) approved in accordance with Regulation No. 23 in its original version;

(d) A ~~red~~ rear position lamp of category R1 (steady luminous intensity) approved in accordance with the 02 series of amendments to Regulation No. 7;

(e) A stop-lamp ~~with one level of illumination~~ of category S1 (steady luminous intensity) approved in accordance with the 02 series of amendments to Regulation No. 7.

5. MARKING OF LIGHT SOURCE MODULES

MD E3 17325

The light source module bearing the identification code shown above has been approved together with a lamp approved in Italy (E3) under approval number 17325.

Annex 2

MINIMUM REQUIREMENTS FOR CONFORMITY OF PRODUCTION CONTROL PROCEDURES

Paragraph 1 amend to read:

1. General

1.1. The conformity requirements shall be considered satisfied from a mechanical and geometric standpoint, if the differences do not exceed inevitable manufacturing deviations within the requirements of this Regulation.

1.2. With respect to photometric performances, the conformity of mass-produced lamps shall not be contested if, when testing **according to paragraph 7 of this Regulation, the** photometric performances **as set forth in Paragraph 6 of this Regulation** of any lamp chosen at random ~~according to paragraph 7. of this Regulation, respectively~~:

1.2.1. No measured value deviates unfavourably by more than 20 per cent from the values prescribed in this Regulation.
For the minimum values required throughout the fields specified in Annex 1 the respective maximum deviations of the measured values shall correspond to the values shown in the table below:

Required minimum value	**Equivalent 20 per cent**	**Equivalent 30 per cent**
cd	**cd**	**cd**
0,3	**0,2**	**0,1**
0,05	**0,03**	**0,02**

1.2.2. In the case of a direction indicator equipped with a replaceable light source if results of the test described above do not meet the requirements, tests shall be repeated using another standard filament lamp.

1.3. With respect to colorimetric performance, the requirements set out in paragraph 8. of this Regulation shall be complied with.

1. GENERAL

1.1 The conformity requirements shall be considered satisfied from a mechanical and geometric standpoint, if the differences do not exceed inevitable manufacturing deviations within the requirements of this Horizontal Reference Document and the Regulation under which the lamp has been approved.

1.2 With respect to photometric performances, the conformity of mass-produced lamps shall not be contested if, when testing photometric performances of any lamp chosen at random according to paragraph 8 of this Horizontal Reference Document:

1.2.1 **Deviations: If not otherwise specified in the specific Regulation**, no measured value deviates unfavourably by more than 20% from the values prescribed in the Regulation under which the lamp has been approved;

1.2.2 If, in the case of a lamp equipped with a replaceable light source and if results of the test described above do not meet the requirements, tests on lamps shall be repeated using another standard filament lamp.

1.3 The chromaticity coordinates shall be complied with when tested under conditions of paragraph 8 of this Horizontal Reference Document.

"**1.4.** **In the case of non-replaceable filament lamp(s) or light source module(s) equipped with non-replaceable filament lamps, at any conformity of production check:**

1.4.1. **the holder of the approval mark shall demonstrate the use in normal production and show the identification of the non-replaceable filament lamp(s) as indicated in the type approval documentation;**

1.4.2. **in the case where doubt exists in respect to compliance of the non-replaceable filament lamp(s) with lifetime requirements and/or, in the case of colour coated filament lamps, with colour endurance requirements, as specified in paragraph 2.11 of IEC 60809, Edition 3, conformity shall be checked (by the light source manufacturer indicated in the type approval documentation) as specified in paragraph 2.11 of IEC 60809, Edition 3.**"

2. MINIMUM REQUIREMENTS FOR VERIFICATION OF CONFORMITY BY THE MANUFACTURER

For each type of lamp the holder of the approval mark shall carry out at least the following tests, at appropriate intervals. The tests shall be carried out in accordance with the provisions of this Horizontal Reference Document and the Regulation under which the lamp has been approved.

If any sampling shows non-conformity with regard to the type of test concerned, further samples shall be taken and tested. The manufacturer shall take steps to ensure the conformity of the production concerned.

2.1 Nature of tests

Tests of conformity in this Horizontal Reference Document shall cover the photometric and colorimetric 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 Horizontal Reference Document and in Regulation pertaining to the specific device.

2.2.2 In any test of conformity carried out by the manufacturer, equivalent methods may be used with the consent of the competent authority responsible for approval tests. The manufacturer is responsible for proving that the applied methods are equivalent to those laid down in this Horizontal Reference Document.

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

2.2.4 In all cases the reference methods shall be those of this Horizontal Reference Document and in Regulation pertaining to the specific device, particularly for the purpose of administrative verification and sampling.

2.3 Nature of sampling

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

The assessment shall in general cover series production from individual factories. However, a manufacturer may group together records concerning the same type from several factories, provided these operate under the same quality system and quality management.

2.4 Measured and recorded photometric characteristics

The sampled lamp shall be subjected to photometric measurements for the minimum values at the points listed in Annex 4, and the chromaticity coordinates listed in Annex 5, provided for in this Horizontal Reference Document and the Regulation under which it has been approved.

2.5 Criteria governing acceptability

The manufacturer is responsible for carrying out a statistical study of the test results and for defining, in agreement with the competent authority, criteria governing the acceptability of his products in order to meet the specifications laid down for verification of conformity of products in paragraph 11.1 of this Horizontal Reference Document.

The criteria governing the acceptability shall be such that, with a confidence level of 95%, the minimum probability of passing a spot check in accordance with Annex 7 (first sampling) would be 0.95.

Annex 3

MINIMUM REQUIREMENTS FOR SAMPLING BY AN INSPECTOR

1. GENERAL

1.1. The conformity requirements shall be considered satisfied from a mechanical and a geometric standpoint, in accordance with the requirements of this Regulation, if any, if the differences do not exceed inevitable manufacturing deviations.

1.2. With respect to photometric performance, the conformity of mass-produced lamps shall not be contested if, when testing **according to paragraph 7 of the relevant Regulation, the** photometric performances **as set forth in Paragraph 6 of the relevant Regulation** of any lamp chosen at random:

1.2.1. **according to the requirements in paragraph 1.2.1. of Annex 5 to this HDR are met.**

1.2.2. If, in the case of a lamp equipped with a replaceable light source and if results of the test described above do not meet the requirements, tests on lamps shall be repeated using another standard filament lamp.

1.2.3. Lamps with apparent defects are disregarded.

1.3. The chromaticity coordinates shall be complied when tested under conditions of paragraph 7. of **of the relevant Regulation.**

2. First sampling

In the first sampling four lamps are selected at random. The first sample of two is marked A, the second sample of two is marked B.

2.1. The conformity **of mass-produced lamps ~~is~~ shall** not **be** contested **if the deviation of**

any specimen of samples A and B (all four lamps) is not more than 20 per cent.

In the case, that the deviation of both lamps of sample A is not more than 0 per cent the measurement can be closed.

2.2. The conformity of mass-produced lamps ~~is~~ shall be contested **if the deviation of at least**

one specimen of samples A or B is more than 20 per cent.

The manufacturer shall be requested to bring his production in line with the requirements (alignment) and a repeated sampling according to paragraph 3. below shall be carried out within two months' time after the notification The samples A and B shall be retained by the Technical Service until the entire COP process is finished.

3. **FIRST REPEATED SAMPLING**

A sample of four lamps, is selected at random from stock manufactured after alignment.
The first sample of two is marked C, the second sample of two is marked D.

3.1. **The conformity of mass-produced lamps ~~is~~ shall** not **be** contested **if the deviation of**

any specimen of samples C and D (all four lamps) is not more than 20 per cent.

In the case, that the deviation of both lamps of sample C is not more than 0 per cent the measurement can be closed.

3.2. **The conformity of mass-produced lamps ~~is~~ shall be** contested **if the deviation of at least**

3.2.1 one specimen of samples C or D is more than 20 per cent but the deviation of all specimen of these samples is not more than 30 per cent.

The manufacturer shall be requested again to bring his production in line with the requirements (alignment).

A second repeated sampling according to paragraph 4. below shall be carried out within two months' time after the notification shall. The samples C and D shall be retained by the Technical Service until the entire COP process is finished.

3.2.2 **one specimen of samples C or D is more than 30 per cent.**

In this case the approval shall be withdrawn and paragraph 5 below shall be applied.

~~4.~~ **SECOND REPEATED SAMPLING**

A sample of four lamps, is selected at random from stock manufactured after alignment. The first sample of two is marked E, the second sample of two is marked F.

4.1. **The conformity of mass-produced lamps ~~is~~ shall** not **be** contested **if the deviation of**

any specimen of samples E and F (all four lamps) is not more than 20 per cent.

In the case, that the deviation of both lamps of sample E is not more than 0 per cent the measurement can be closed.

4.2. **The conformity of mass-produced lamps shall be contested if the deviation of at least**

one specimen of samples E or F is more than 20 per cent.

In this case the approval shall be withdrawn and paragraph 5 below shall be applied.

5. **Approval withdrawn**

Approval shall be withdrawn according to paragraph 10. of this Regulation.

Annex 4

COLOUR OF LIGHTS

1. Colour of the light emitted from a device

1.1 "White" means the chromaticity coordinates (x,y) [5]/ of the light emitted that lie inside the chromaticity areas defined by the boundaries:

W_{12}	green boundary:	y = 0.150 + 0.640 x
W_{23}	yellowish green boundary:	y = 0.440
W_{34}	yellow boundary:	x = 0.500
W_{45}	reddish purple boundary:	y = 0.382
W_{56}	purple boundary:	y = 0.050 + 0.750 x
W_{61}	blue boundary:	x = 0.310

With intersection points:

	x	y
W_1:	0.310	0.348
W_2:	0.453	0.440
W_3:	0.500	0.440
W_4:	0.500	0.382
W_5:	0.443	0.382
W_6:	0.310	0.283

1.2. "Selective-yellow" means the chromaticity coordinates (x,y) 3/ of the light emitted that lie inside the chromaticity areas defined by the boundaries:

SY_{12}	green boundary:	y = 1.290 x - 0.100
SY_{23}	the spectral locus	
SY_{34}	red boundary:	y = 0.138 + 0.580 x
SY_{45}	yellowish white boundary:	y = 0.440
SY_{51}	white boundary:	y = 0.940 - x

With intersection points:

	x	y
SY_1:	0.454	0.486
SY_2:	0.480	0.519
SY_3:	0.545	0.454
SY_4:	0.521	0.440
SY_5:	0.500	0.440

1.3. "Amber" means the chromaticity coordinates (x,y) 3/ of the light emitted that lie inside the chromaticity areas defined by the boundaries:

A_{12}	green boundary:	y = x - 0.120
A_{23}	the spectral locus	
A_{34}	red boundary:	y = 0.390
A_{41}	white boundary:	y = 0.790 - 0.670 x

With intersection points:

	x	y
A_1:	0.545	0.425
A_2:	0.560	0.440
A_3:	0.609	0.390
A_4:	0.597	0.390

[5]/ CIE Publication 15.2, 1986, Colorimetry, the CIE 1931 standard colorimetric observer.

1.4. "Red" means the chromaticity coordinates (x,y) 3/ of the light emitted that lie inside the chromaticity areas defined by the boundaries:

R_{12}	yellow boundary:	y = 0.335
R_{23}	the spectral locus	
R_{34}	the purple line:	(its linear extension across the purple range of colours between the red and the blue extremities of the spectral locus).
R_{41}	purple boundary:	y = 0.980 – x

With intersection points:

	x	y
R_1:	0.645	0.335
R_2:	0.665	0.335
R_3:	0.735	0.265
R_4:	0.721	0.259

2. Night-time Colour of the light retro-reflected from a device excluding retro-reflective tires according to Regulation No. 88

2.1. "White" means the chromaticity coordinates (x,y) 3/ of the light reflected that lie inside the chromaticity areas defined by the boundaries:

W_{12}	blue boundary:	y = 0.843 - 1.182 x
W_{23}	violet boundary:	y = 0.489 x + 0.146
W_{34}	yellow boundary:	y = 0.968 - 1.010 x
W_{41}	green boundary:	y = 1.442 x - 0.136

With intersection points:

	x	y
W_1	0.373	0.402
W_2	0.417	0.350
W_3	0.548	0.414
W_4	0.450	0.513

2.2. "Yellow" means the chromaticity coordinates (x,y) 3/ of the light reflected that lie inside the chromaticity areas defined by the boundaries:

Y_{12}	green boundary:	y = x - 0.040
Y_{23}	the spectral locus	
Y_{34}	red boundary:	y = 0.200 x + 0.268
Y_{41}	white boundary:	y = 0.970 - x

With intersection points:

	x	y
Y_1	0.505	0.465
Y_2	0.520	0.480
Y_3	0.610	0.390
Y_4	0.585	0.385

2.3. "Amber" means the chromaticity coordinates (x,y) 3/of the light reflected that lie inside the chromaticity areas defined by the boundaries:

A_{12}	green boundary:	y = 1.417 x - 0.347
A_{23}	the spectral locus	
A_{34}	red boundary:	y = 0.390
A_{41}	white boundary:	y = 0.790 - 0.670 x

With intersection points:

	x	y
A_1	0.545	0.425
A_2	0.557	0.442
A_3	0.609	0.390
A_4	0.597	0.390

2.4. "Red" means the chromaticity coordinates (x,y) 3/ of the light reflected that lie inside the chromaticity areas defined by the boundaries:

R_{12}	yellow boundary:	y = 0.335
R_{23}	the spectral locus	
R_{34}	the purple line	
R_{41}	purple boundary:	y = 0.978 - x

With intersection points:

	x	y
R_1	0.643	0.335
R_2	0.665	0.335
R_3	0.735	0.265
R_4	0.720	0.258

3. Day-time Colour of the light reflected from a device

3.1. "White" means the chromaticity coordinates (x,y) 3/ of the light reflected that lie inside the chromaticity areas defined by the boundaries:

W_{12}	violet boundary	y = x - 0.030
W_{23}	yellow boundary	y = 0.740 – x
W_{34}	green boundary	y = x + 0,050
W_{41}	blue boundary	y = 0.570 – x

With intersection points:

	x	y
W_1	0.300	0.270
W_2	0.385	0.355
W_3	0.345	0.395
W_4	0.260	0.310

3.2. "Yellow" means the chromaticity coordinates (x,y) 3/ of the light reflected that lie inside the chromaticity areas defined by the boundaries:

Y_{12}	red boundary	y = 0.534 x + 0.163
Y_{23}	white boundary	y = 0.910 - x
Y_{34}	green boundary	y =1.342 x - 0.090
Y_{41}	the spectral locus	

With intersection points:

	x	y
Y_1	0.545	0.454
Y_2	0.487	0.423
Y_3	0.427	0.483
Y_4	0.465	0.534

3.3. "Red" means the chromaticity coordinates (x,y) 3/ of the light reflected that lie inside the chromaticity areas defined by the boundaries:

R_{12}	red boundary	y = 0.346 – 0.053 x
R_{23}	purple boundary	y = 0.910 – x
R_{34}	yellow boundary	y = 0.350
R_{41}	the spectral locus	

With intersection points:

	x	y
R_1	0.690	0.310
R_2	0.595	0.315
R_3	0.560	0.350
R_4	0.650	0.350

4. Day-time Colour of the fluorescent a device

4.1. "Red" means the chromaticity coordinates (x,y) 3/ of the light reflected that lie inside the chromaticity areas defined by the boundaries:

FR_{12}	red boundary	y = 0.346 – 0.053 x
FR_{23}	purple boundary	y = 0.910 – x
FR_{34}	yellow boundary	y = 0.315 + 0.047 x
FR_{41}	the spectral locus	

With intersection points:

	x	y
FR_1	0,690	0,310
FR_2	0,595	0,315
FR_3	0,569	0,341
FR_4	0,655	0,345

For checking these colorimetric characteristics, the test procedure described in paragraph 8.1 of this Horizontal Reference Document shall be applied.

However, for lamps equipped with non-replaceable light sources (filament lamps and other), the colorimetric characteristics should be verified with the light sources present in the lamp, in accordance with the relevant subparagraph of paragraph 8.1. of this Horizontal Reference Document.

Annex 5

PHOTOMETRIC MEASUREMENTS OF SIGNALLING LAMPS

1. MEASUREMENT METHODS

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

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:

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

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;

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.

1.3 In the case where the device 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 axes specified by the manufacturer.

2. PHOTOMETRIC MEASUREMENT OF LAMPS

2.1 For any lamp except those equipped with filament lamp(s) **and if not otherwise specified in the individual Regulation,** the luminous intensities measured after one minute and after 30 minutes of operation:

(a) In flashing mode (f = 1.5 Hz, duty factor 50%) for direction indicator lamps;

(b) In steady mode for other lamps;

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 described above.

2.2. In the case of a lamp with replaceable light source, if not supplied by an electronic light source control gear or a variable intensity control,

with a colourless or coloured standard filament lamp of the category prescribed for the device, supplied with the voltage necessary to produce the reference luminous flux required for that category of filament lamp;

2.3 The photometric performance of lamps incorporating several light sources shall be checked:

2.3.1 For lamps equipped with non-replaceable light sources (filament lamps and other):

with the light sources present in the lamp, in accordance with the relevant subparagraph of paragraph 8 of this Horizontal Reference Document;

2.3.2 For lamps equipped with replaceable filament lamps:

with lamps supplied with 6.75 V, 13.5 V or 28.0 V.

The luminous intensity values produced shall then be corrected. 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). The actual luminous fluxes of each filament lamp used shall not deviate more than ± 5% from the mean value. Alternatively a standard filament lamp 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.

2.3 In any event, all light sources connected in series shall be considered as a single light source.

2.4. In the case of a system that uses an electronic light source control gear or a variable intensity control, being part of the lamp[6] 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;

2.5. 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 with the voltage declared by the manufacturer applied to the input terminals of the lamp.

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

2.7. 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.

2.8. The voltage to be applied to the lamp shall be noted in the communication form in **Annex y** of the Regulation under which the device has been approved.

[6] For the purpose of this Regulation "being part of the lamp" means to be physically included in the lamp body or to be external, separated or not, but supplied by the lamp manufacturer as part of the lamp system.

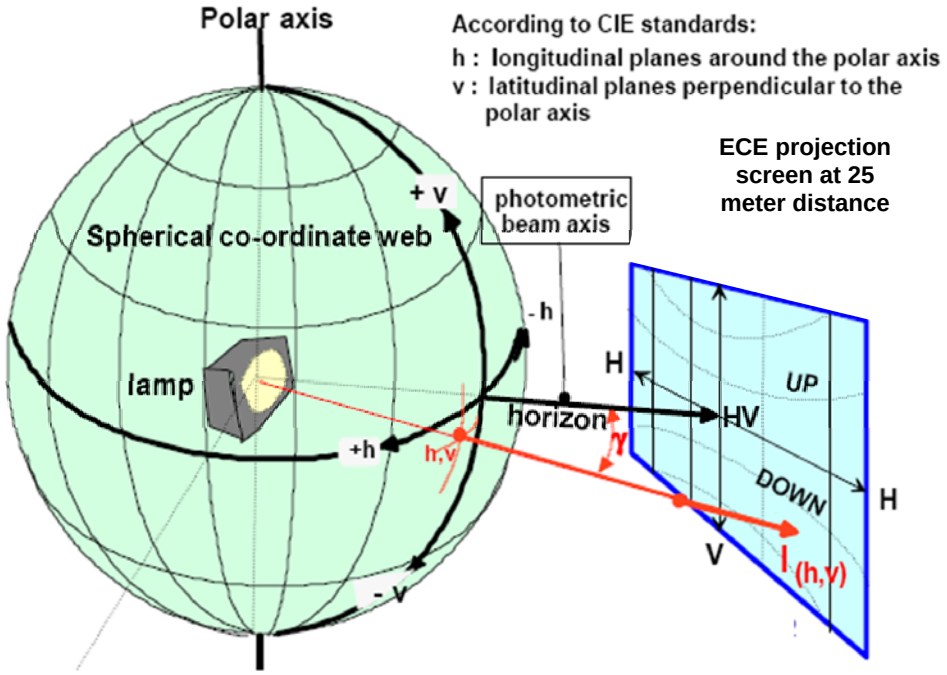
Annex 6

PHOTOMETRIC MEASUREMENTS OF HEAD LAMPS

Spherical coordinate measuring system and test point locations

FIGURE A

SPHERICAL COORDINATE MEASURING SYSTEM



$$E_{25m} = I_{(h,v)} \times \cos \gamma / r^2$$

Photometric measurement provisions

1. General provisions

1.1. The system or part(s) thereof shall be mounted on a goniometer with a fixed horizontal axis and moveable axis perpendicular to the fixed horizontal axis.

1.2. The luminous intensity values shall be determined by means of a photoreceptor contained within a square of 65 m side and set up to a distance of at least 25 m forward of the centre of reference of each lighting unit perpendicular to the measurement axis from the origin of the goniometer.

1.3. During photometric measurements, stray reflections should be avoided by appropriate masking.

1.4. The luminous intensities are measured at a nominal distance of 25 m.

1.5. The angular co-ordinates are specified in deg on a sphere with a vertical polar axis according to the gonio-photometer as defined in paragraph 2.13 of the horizontal reference document (see diagram A above).

1.6. Any equivalent photometric method is acceptable, if the accordingly applicable correlation is observed.

1.7. Any offset of the centre of reference of each lighting unit, with respect to the goniometer rotation axes, should be avoided. This applies especially to the vertical direction and to lighting units producing a "cut-off".

An aiming screen shall be used and may be located at a shorter distance than that of the photoreceptor.

1.8. The photometric requirements for each single measuring point (angular position) of a lighting function or mode as specified in this Regulation apply to half of the sum of the respective measured values from all lighting units of the system applied for this function or mode, or, from all lighting units as indicated in the respective requirement;

1.8.1. However in those cases where a provision is specified for one side only, the division by the factor of 2 does not apply. These cases are: paragraphs 6.2.5.3., 6.2.8.1., 6.3.2.1.1., 6.3.2.1.2., 6.4.6., and note 4 of Table 1 of Annex 3.1.9.

1.9. The lighting units of the system shall be measured individually; however, simultaneous measurements may be performed on two or more lighting units of an installation unit, being equipped with the same light source types with respect to their power supply (either power controlled or not), if they are sized and situated such, that their illuminating surfaces are completely contained in a rectangle of not more than 300 mm in horizontal extend and not more than 150 mm vertical extend, and, if a common centre of reference is specified by the manufacturer.

1.10. The system shall prior to the subsequent test procedures be set to the neutral state.

1.11. The system or part(s) thereof shall be so aimed before starting the measurements that the position of the "cut–off" complies with the requirements indicated in the Table 2 of Annex 3 to this Regulation. Parts of a system measured individually and having no "cut-off" shall be installed on the goniometer under the conditions (mounting position) specified by the applicant.

2. Measurement conditions with respect to light sources

2.1. In the case of replaceable filament lamps operated directly under vehicle voltage system conditions:

The system or parts thereof shall be checked by means of an uncoloured standard (étalon) filament lamp(s) designed for a rated voltage of 12 V. During checking of the system or part of, the voltage at the terminals of the filament lamp(s) shall be regulated so as to obtain the reference luminous flux 13.2 volts as indicated at the relevant data sheet of Regulation No. 37.

For the measurements, the flux of this filament lamp may differ from the reference luminous flux at 13.2 V specified in Regulation No. 37. In this case, the luminous intensity shall be corrected accordingly by the individual factor of the standard (étalon) filament lamp ($F = \Phi_{obj.} / \Phi$ (Voltage)).

The system or parts thereof shall be considered acceptable if the requirements of **paragraph 6. of the Individual Regulation** are met with at least one standard (étalon) filament lamp, which may be submitted with the system.

2.2. In the case of a replaceable gas-discharge light source:
The voltage applied to the terminals of the ballast(s) is 13.2 V +/- 0.1 for 12 V systems.
The system or parts thereof using a replaceable gas-discharge light source shall comply with the photometric requirements set out in the relevant paragraphs of this Regulation with at least one standard (étalon) light source, which has been aged during at least 15 cycles, as specified in Regulation No. 99.
The luminous flux of this gas-discharge light source may differ from the objective luminous flux specified in Regulation No. 99.
In this case, the measured photometric values shall be corrected accordingly.

2.3. In the case of a non-replaceable light source operating directly under vehicle voltage system conditions:

All measurements on lamps equipped with non-replaceable light sources (filament lamps and other) shall be made at 6.3 V, 13.2 V or 28.0 V, or at a voltage as specified by the applicant with respect to any other vehicle voltage system.

2.4. In the case of a light source, replaceable or non-replaceable, 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 in paragraph 2.3. above 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.

2.5. LED module(s) shall be measured at 6.3 V, 13.2 V or 28.0 V respectively, if not otherwise specified within this Regulation. LED module(s) operated by an electronic light source control gear, shall be measured as specified by the applicant.

3. Measurement conditions with respect to bending modes

3.1. In the case of a system or part(s) thereof, which provide a bending mode, the requirements of paragraphs 6.2. (passing beam), and/or 6.3. (driving beam) of this Regulation apply for all states, corresponding to the turn radius of the vehicle. For verification with respect to the passing beam and the driving beam the following procedure shall be used:

3.1.1. The system shall be tested in the neutral state (central/straight), and, in addition in the state(s) corresponding to the smallest turn radius of the vehicle in both directions using the signal generator, if applicable.

3.1.1.1. Compliance with the requirements of paragraphs 6.2.5.2., 6.2.5.3. and 6.2.5.5.1. of this Regulation shall be checked for both category 1 and category 2 bending modes without additional horizontal re-aim.

3.1.1.2. Compliance with the requirements of paragraphs 6.2.5.1. and 6.3. of this Regulation, whichever applies, shall be checked:

(a) In case of a category 2 bending mode: without additional horizontal re-aim;

(b) In case of a category 1 or a driving beam bending mode: after having horizontally re-aimed the relevant installation unit (by means of the goniometer for example) in the corresponding opposite direction.

3.1.2. When testing a category 1 or category 2 bending mode, for a turn radius of the vehicle other than specified in paragraph 3.1.1. above: it shall be observed whether the light distribution is substantially uniform and no undue glare occurs. If this can not be confirmed the compliance with the requirement laid down in Table 1 of Annex 3 to this Regulation shall be checked.

Annex 7

PHOTOMETRIC MEASUREMENTS OF RETRO – REFLECTORS AND RETRO – REFLECTING DEVICES

For the purpose of this Annex:

1. "Retro-reflection" means the reflection in which light is reflected in directions close to the direction from which it came. This property is maintained over wide variations of the illumination angle.

1.1. "Retro-reflecting optical unit" means a combination of optical components producing retro-reflection.

1.2. "Retro-reflecting device" 1/ means an assembly ready for use and comprising one or more retro-reflecting optical units.

1.3. "Angle of divergence" means the angle between the straight lines connecting the centre of reference to the centre of the receiver and to the centre of the source of illumination.

1.4. "Illumination angle" means the angle between the axis of reference and the straight line connecting the centre of reference to the centre ofthe source of illumination.

1.5. "Angle of rotation" means the angle through which the retro-reflecting device is rotated about its axis of reference starting from one given position.

1.6. "Angular diameter of the retro-reflecting device" means the angle subtended by the greatest dimension of the visible area of the illuminating surface, either at the centre of the source of illumination or at the centre of the receiver.

1.7. "Illumination of the retro-reflecting device" is the abbreviated expression used conventionally to designate the illumination measured in a plane perpendicular to the incident rays and passing through the centre of reference.

1.8. "Coefficient of luminous intensity (CIL)" means the quotient of the luminous intensity reflected in the direction considered, divided by the illumination of the retro-reflecting device for given angles of illumination, divergence and rotation.

2.0. Geometric definitions (see Annex 1, figure 1)

2.0.1. "Reference centre" means a point on or near a retro-reflective area which is designated to be the centre of the device for the purpose of specifying its performance;

2.0.2. "Illumination axis (symbol I)" means a line segment from the reference centre to the light source.

2.0.3. "Observation axis (symbol O)" means a line segment from the reference centre to the photometer head;

2.0.4. "Observation angle (symbol α)" means the angle between the illumination axis and the observation axis. The observation angle is always positive and, in the case of retro-reflection, is restricted to small angles;

2.0.5. "Observation on half-plane" means the half-plane which originates on the illumination axis and which contains the observation axis;

2.0.6. "Reference axis (symbol R)" means a designated line segment originating on the reference centre which is used to describe the angular position of the retro-reflective device;

2.0.7. "Entrance angle (symbol β)" means the angle from the illumination axis to the reference axis. The entrance angle is usually not larger than 90° but, for completeness, its full range is defined as $0° < \beta < 180°$. In order to specify the orientation in full, this angle is characterised by two components, β_1 and β_2;

2.0.8. "Rotation angle (symbol ε)" means the angle indicating the orientation of the retro-reflecting material by an appropriate symbol with respect to rotation about the reference axis. If retro-reflective materials or devices have a marking (e.g.TOP), this marking governs the starting position.
The angle of rotation ε lies in the range $-180° < \varepsilon < +180°$.

2.0.9. "First axis (symbol 1)" means an axis through the reference centre and perpendicular to the observation half-plane;

2.0.10. "First component of the entrance angle (symbol β_1)" means the angle from the illumination axis to the plane containing the reference axis and the first axis; range: $-180° < \beta_1 < 180°$;

2.0.11. "Second component of the entrance angle (symbol β_2)" means the angle from the plane containing the observation half-plane to the reference axis; range $-90° < \beta_2 < 90°$;

2.0.12. "Second axis (symbol 2)" means an axis through the reference centre and perpendicular to both the first axis and the reference axis. The positive direction of the second axis lies in the observation half-plane when $-90° < \beta_1 < 90°$ as shown in Annex 1, figure 1.

2.1. Definition of photometric terms

2.1.1. "Coefficient of retro-reflection (symbol R')" means the quotient of the coefficient of luminous intensity R of a plane retro-reflecting surface and its area A

$\left(R' = \frac{R}{A} \right)$ The coefficient of retro-reflection R' is expressed in candelas per m^2 per lx ($cd.m^{-2}.lx^{-1}$)

$\left(R' = \frac{I}{E_{\perp}.A} \right)$ (Luminance / Illumination);

2.1.2. "Angular diameter of the retro-reflector sample (symbol η_1)" means the angle subtended by the greatest dimension of the retro-reflective sample, either at the centre of the source of illumination or at the centre of the receiver ($\beta_1 = \beta_2 = 0°$);

2.1.3. "Angular diameter of the receiver (symbol η_2)" means the angle subtended by the greatest dimension of the receiver as seen from the reference centre ($\beta_1 = \beta_2 = 0°$);

2.1.4. "Luminance factor (symbol ß)" means the ratio of the luminance of the body to the luminance of a perfect diffuser under identical conditions of illumination and observation;

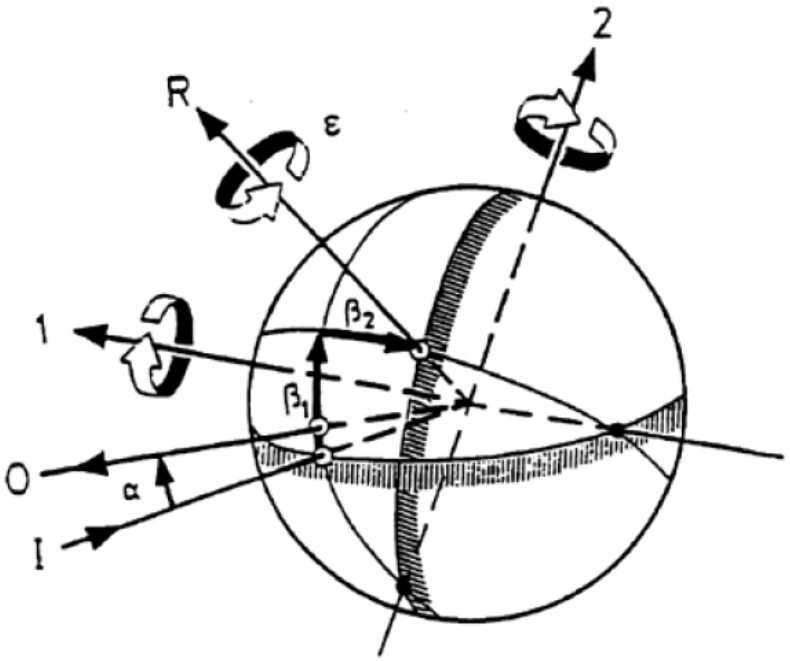
2.1.5. "Colour of the reflected light of the device" The definitions of the colour of the reflected light are given in paragraphs 2.30. of Regulation No. 48.

2.2. Description of Goniometer

A goniometer **as defined in paragraph 2.13. to this Horizontal Reference Document**, which can be used in making retro-reflection measurements in the CIE geometry is illustrated in Annex 1, figure 2. In this illustration, the photometer head (O) is arbitrarily shown to be vertically above the source (I). The first axis is shown to be fixed and horizontal and is situated perpendicular to the observation half-plane. Any arrangement of the components which is equivalent to the one shown can be used.

Figure 1

THE CIE CO-ORDINATE SYSTEM



1: First Axis	I:	Illumination Axis	α:	Observation angle
2: Second Axis	O:	Observation Axis	$ß_1$, $ß_2$:	Entrance angles
	R:	Reference Axis	ε:	Rotation angle

The CIE angular system for specifying and measuring retro-reflective marking materials. The first axis is perpendicular to the plane containing the observation axis and the illumination axis. The second axis is perpendicular both to the first axis and to the reference axis. All axes, angles, and directions of rotation are shown positive.

Notes: (a) The principle fixed axis is the illumination axis.
(b) The first axis is fixed perpendicular to the plane containing the observation and illumination axis.
(c) The reference axis is fixed in the retro-reflective material and moveable with $ß_1$ and $ß_2$.

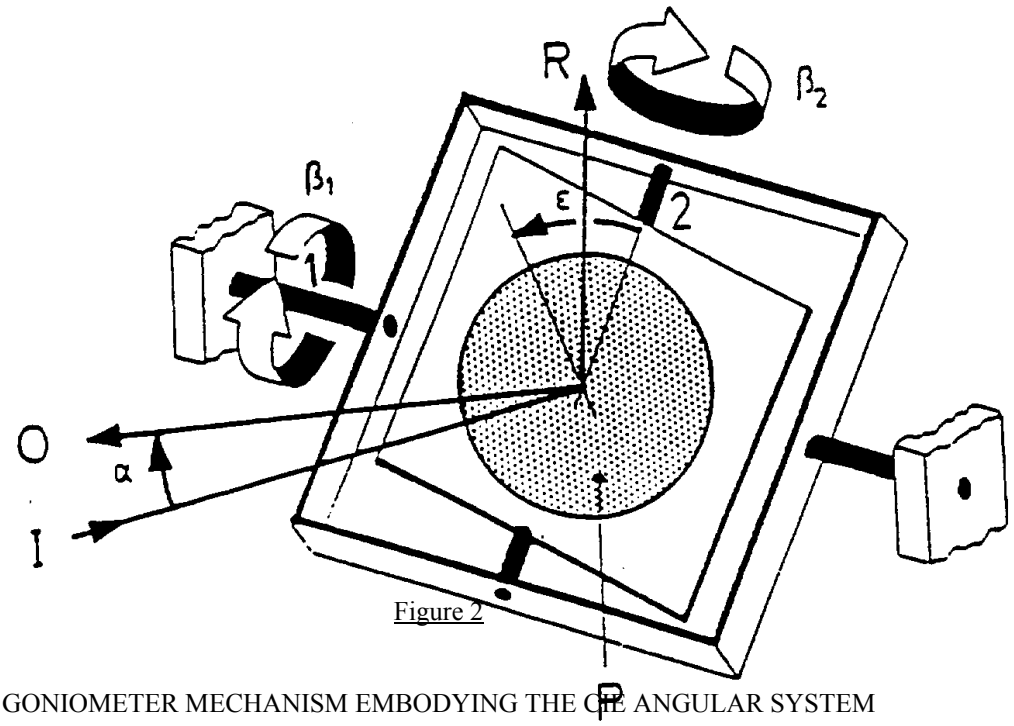


Figure 2

GONIOMETER MECHANISM EMBODYING THE CIE ANGULAR SYSTEM

1:	First Axis	I:	Illumination Axis	α:	Observation angle
2:	Second Axis	O:	Observation Axis	β_1, β_2:	Entrance angles
		R:	Reference Axis	ε:	Rotation angle
		P:	Retro-reflective material		

Representation of a Goniometer mechanism embodying the CIE angular system for specifying and measuring retro-reflective materials. All angles and directions of rotation are shown positive.

Annex 8

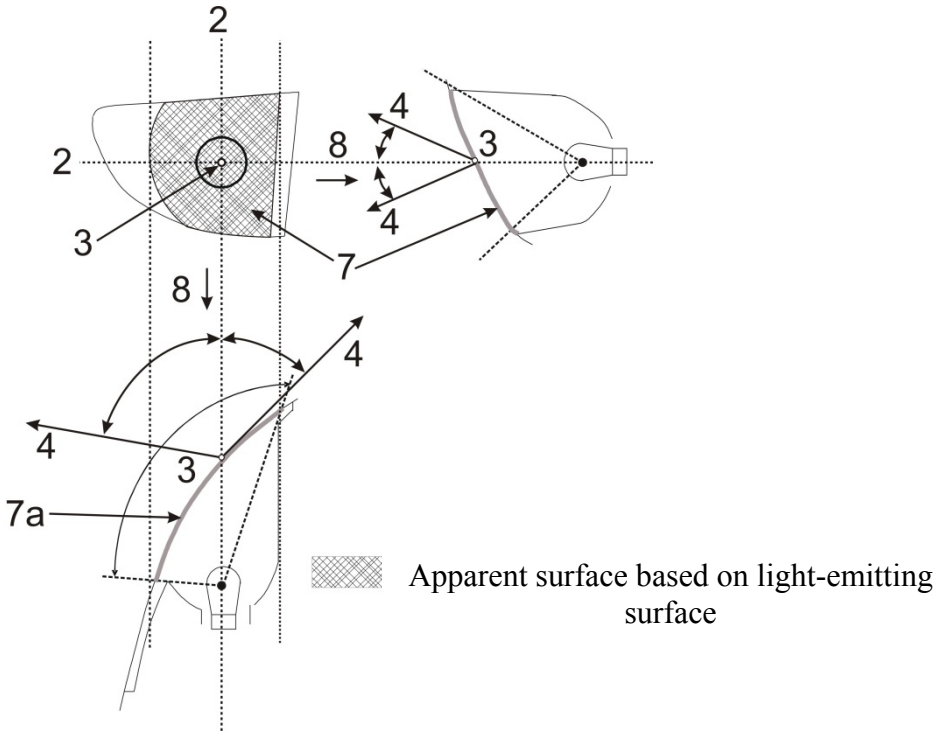
Examples of lamp surfaces, axes, centres of reference, and angles of geometric visibility

These examples show some arrangements to aid the understanding of the provisions and are not intended to be design restrictive.

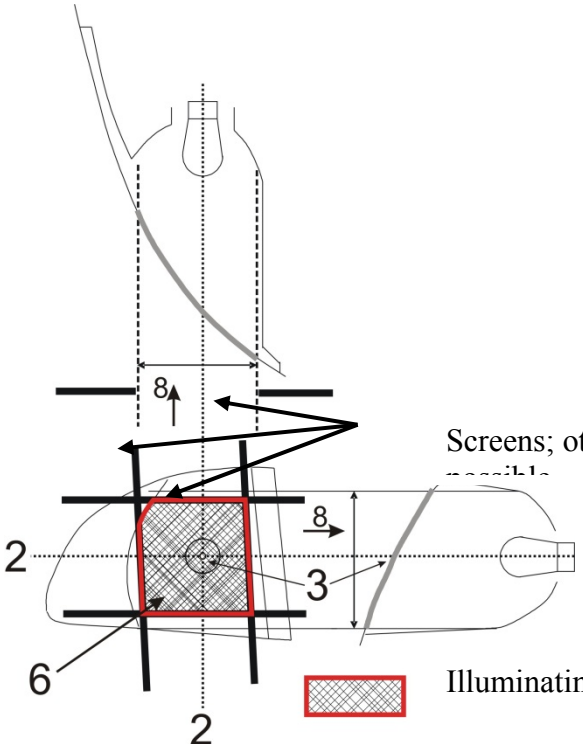
KEY for all examples in this Annex:

1. Illuminating surface	IO Inner optical part
2. Axis of reference	LG Light guide
3. Centre of reference	L Outer lens
4. Angle of geometric visibility	R Reflector
5. Light-emitting surface	S Light source
6. Apparent surface based on the illuminating surface	X Not part of this function
7a. Apparent surface based on the light-emitting surface according to paragraph 2.8. a) (with outer lens)	F1 Function one
7b. Apparent surface based on the light-emitting surface according to paragraph 2.8. b) (without outer lens)	F2 Function two
8. Direction of visibility	

Part 1 – Light emitting surface of a light-signalling device other than a retro-reflector

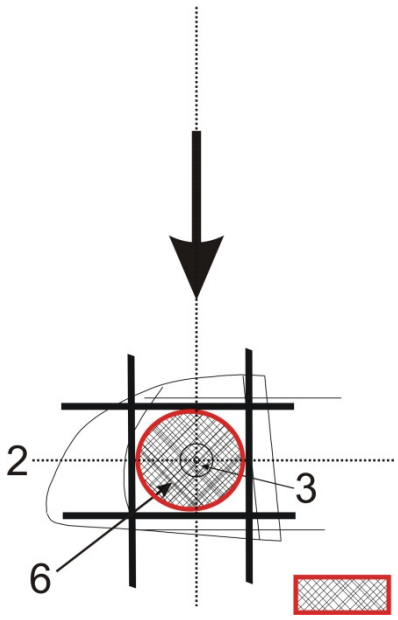


Part 2 – Illuminating surface of a light-signalling device other than a retro-reflector



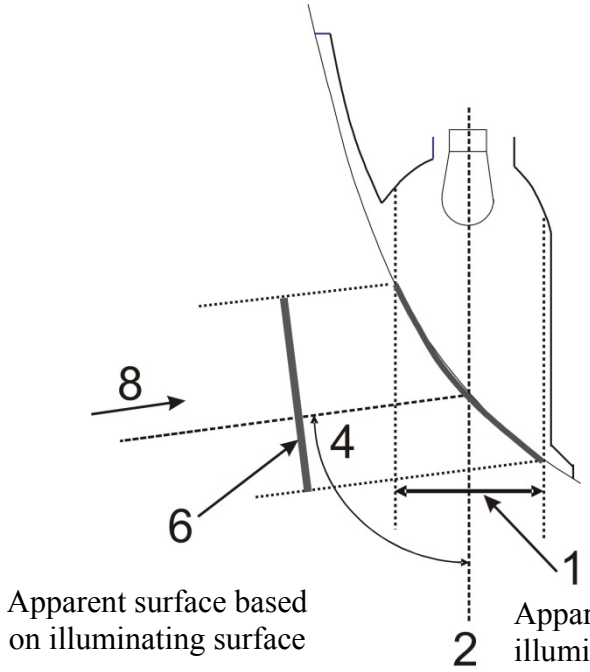
Screens; other positions of the screens are possible

Illuminating surface



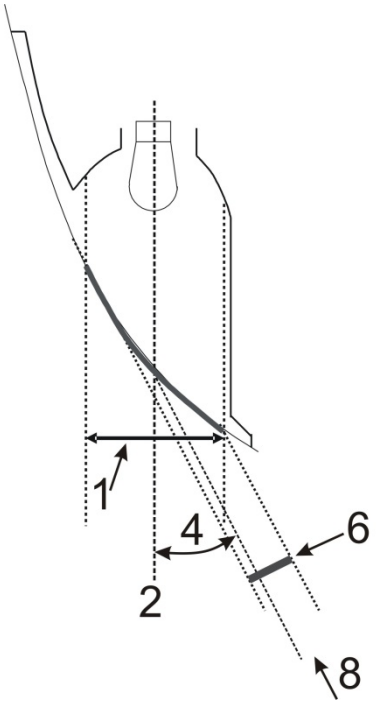
Resulting illuminating surface over all possible screen positions, e.g. for the determination of maximum or minimum area specification.

Part 3 – Examples of apparent surface based on illuminating surface in different directions of geometric visibility



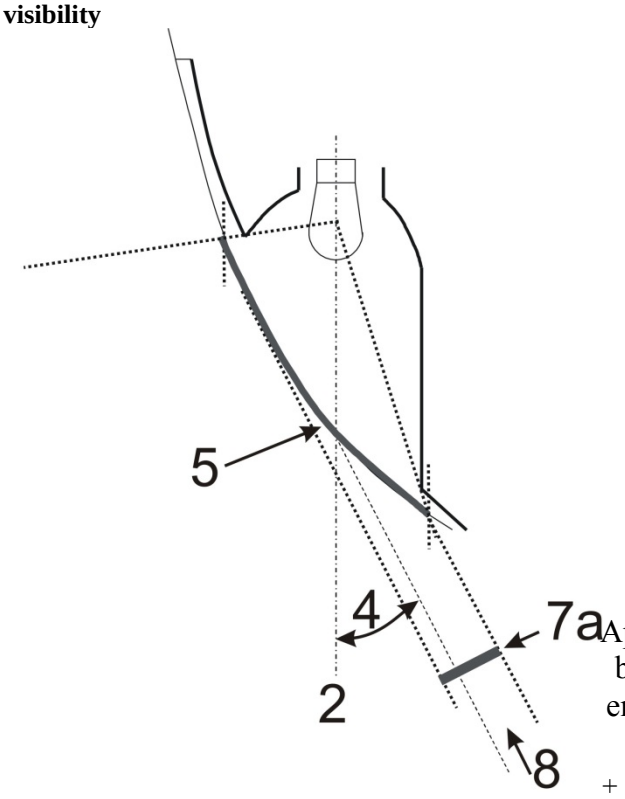
Apparent surface based on illuminating surface

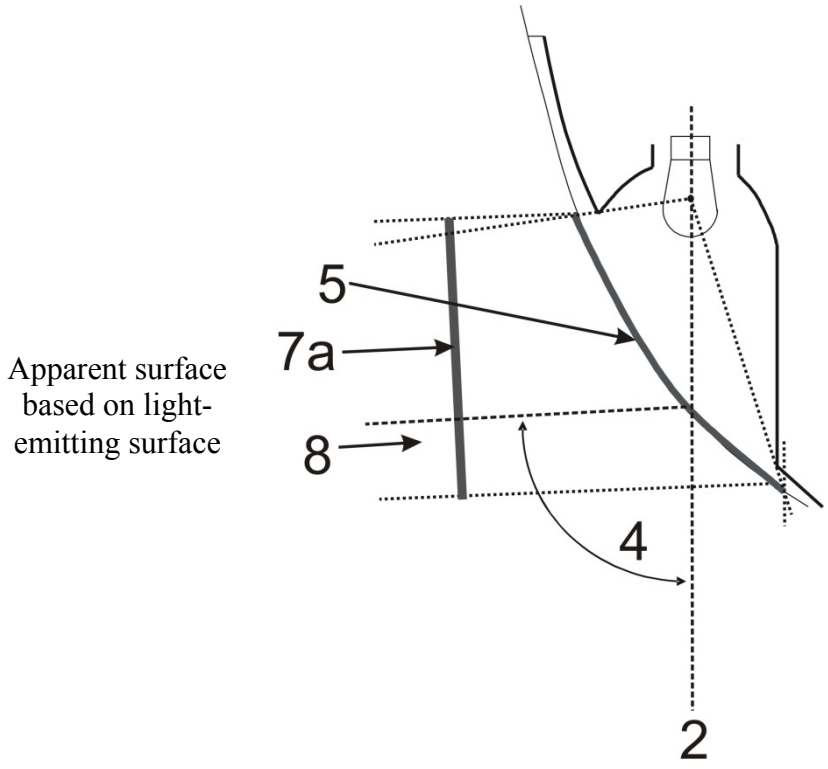
Apparent surface based on illuminating surface



Apparent surface based on illuminating surface

Part 4 – Examples of apparent surface based on light emitting surface in different directions of geometric visibility

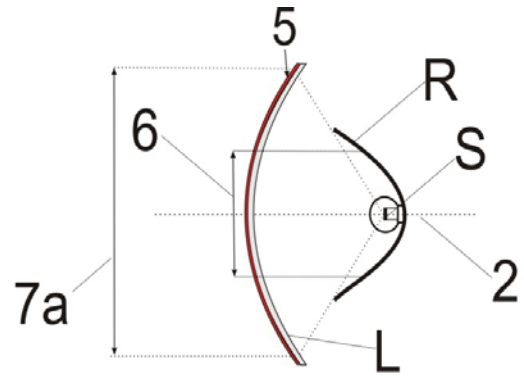




Part 5 – Example of illuminating surface in comparison with light-emitting surface in the case of a "single function lamp" (see paragraphs 2.8. to 2.9. of this Regulation)

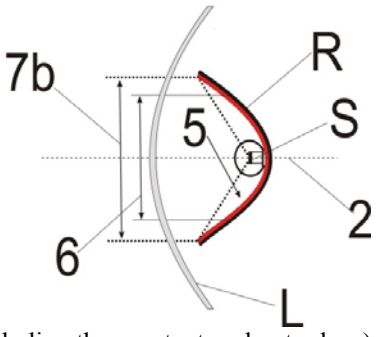
Examples of a light source with a reflector optic behind an outer lens:

Example 1



(Including the outer lens)

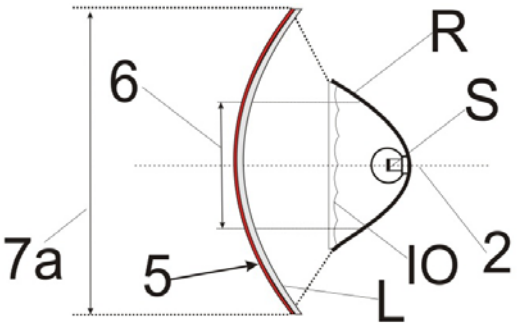
Example 2



(Excluding the non-textured outer lens)

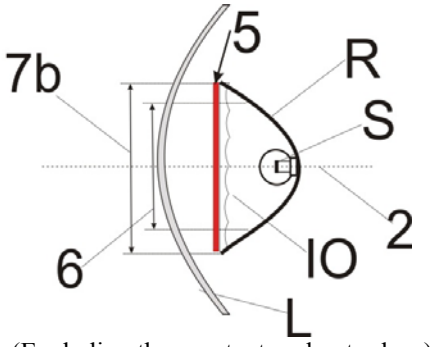
Examples of a light source with a reflector optic with a inner lens behind an outer lens:

Example 3



(Including the outer lens)

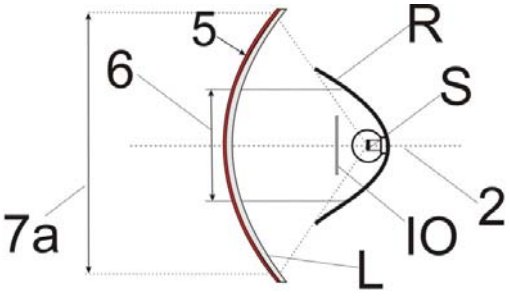
Example 4



(Excluding the non-textured outer lens)

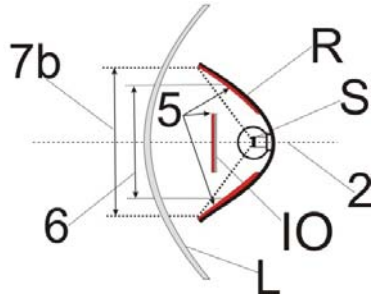
Examples of a light source with a reflector optic with a partial inner lens behind an outer lens:

Example 5



(Including the outer lens)

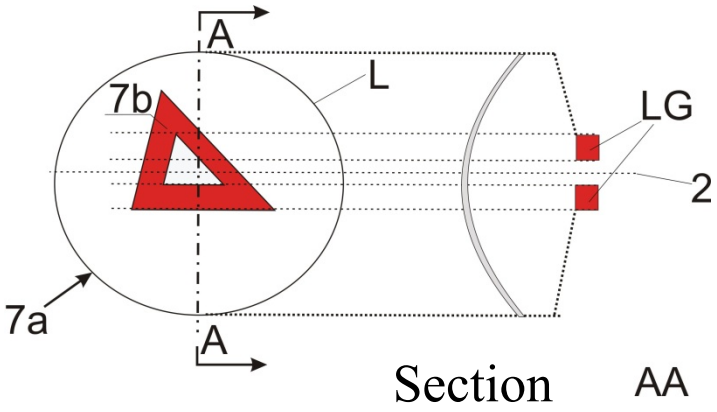
Example 6



(Excluding the non-textured outer lens)

Example of a light guide optic behind an outer lens:

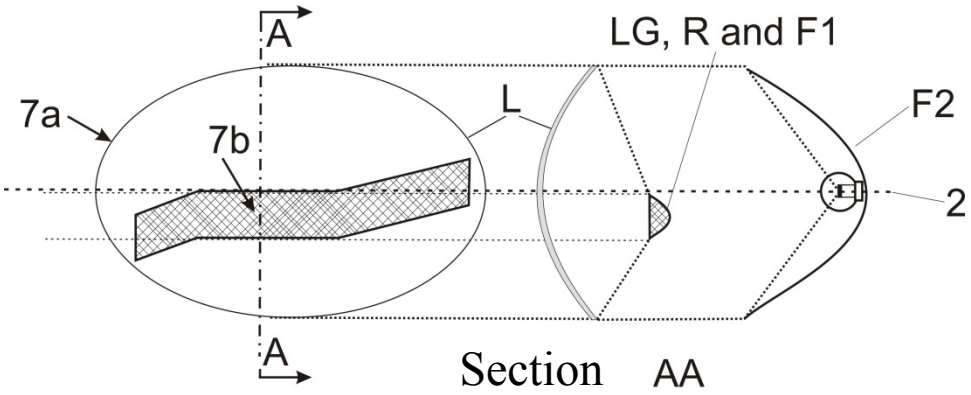
Example 7



In the case where the non-textured outer lens is excluded, "7b" is the apparent surface according to paragraph 2.8. b).

Example of a light guide optic or a reflector optic behind an outer lens:

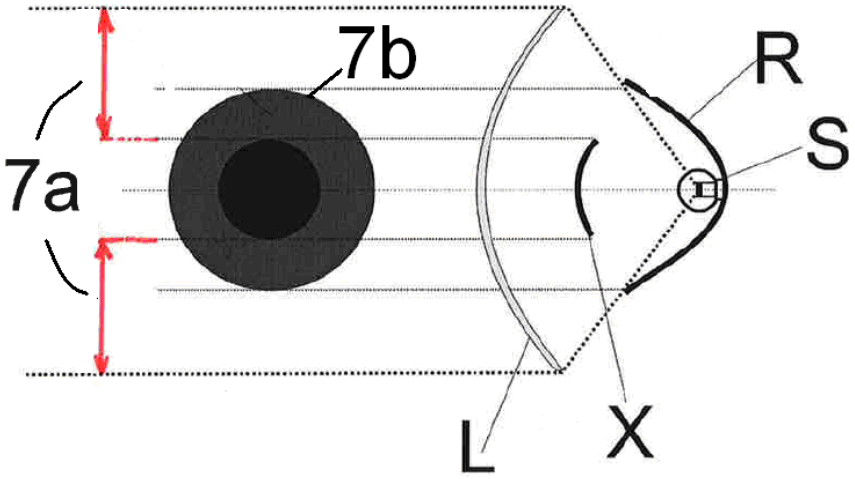
Example 8



In the case where the non textured outer lens is excluded, "7b" is the apparent surface according to paragraph 2.8. b), and F1 shall not transparent to F2

Example of a light source with a reflector optic in combination with an area which is not part of this function, behind an outer lens:

Example 9

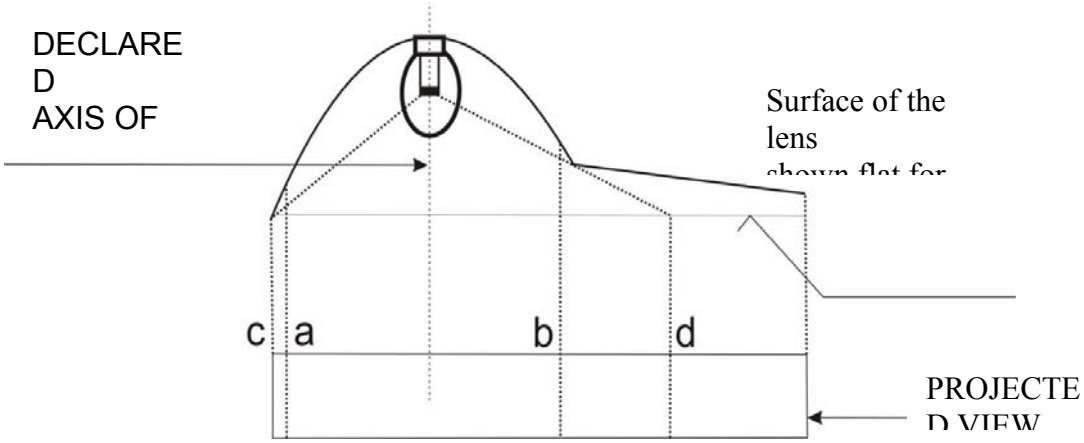


In the case where the non textured outer lens is excluded, "7b" is the apparent surface according to paragraph 2.8. b).

Part 6 – Examples showing the determination of the light-emitting surface in comparison with illuminating surface (See paragraphs 2.8. and 2.9. of this Regulation)

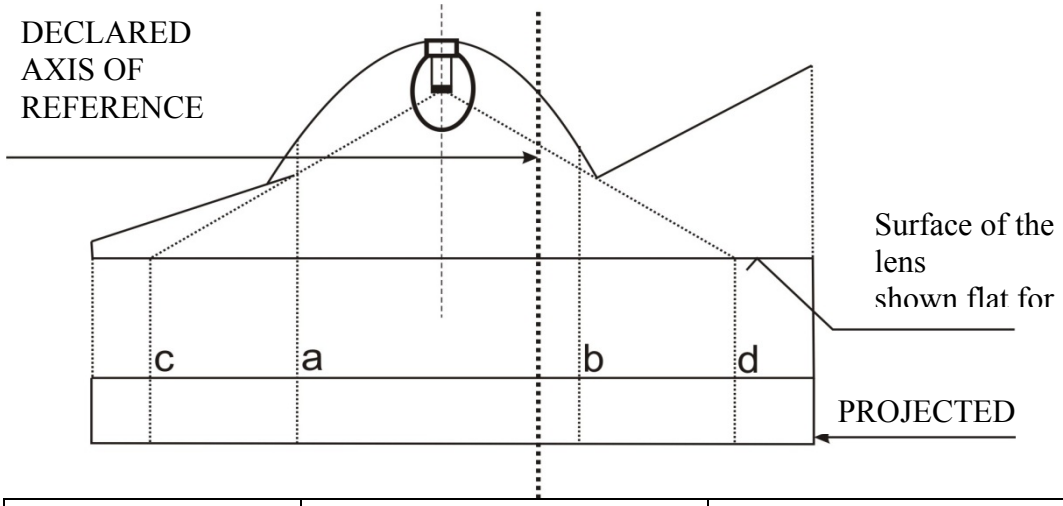
Note: Reflected light could / may contribute to the determination of the light emitting surface

Example A



	Illuminating surface	*Declared light-emitting surface according to 2.8. a)*
Edges are	a and b	c and d

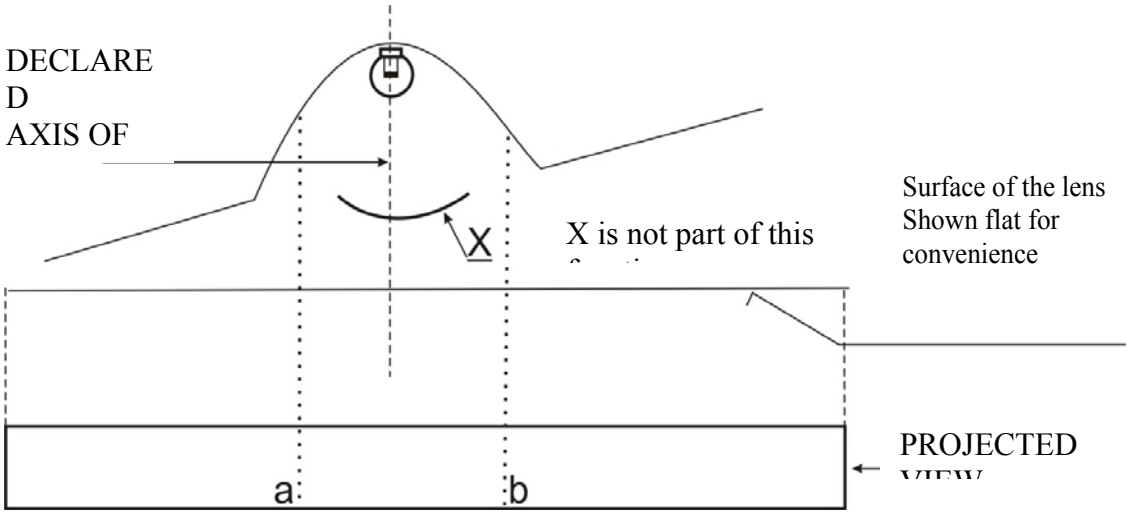
Example B



	Illuminating surface	*Declared Light-emitting surface according to 2.8. a)*
Edges are	a and b	c and d

Example C

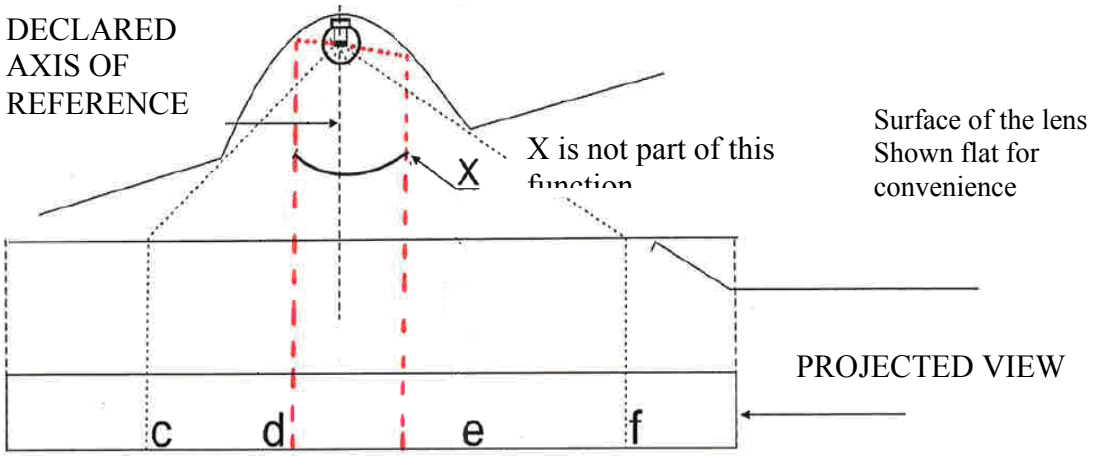
Example to determine the illuminating surface in combination with an area which is not part of the function:



	Illuminating surface
Edges are	a and b

Example D

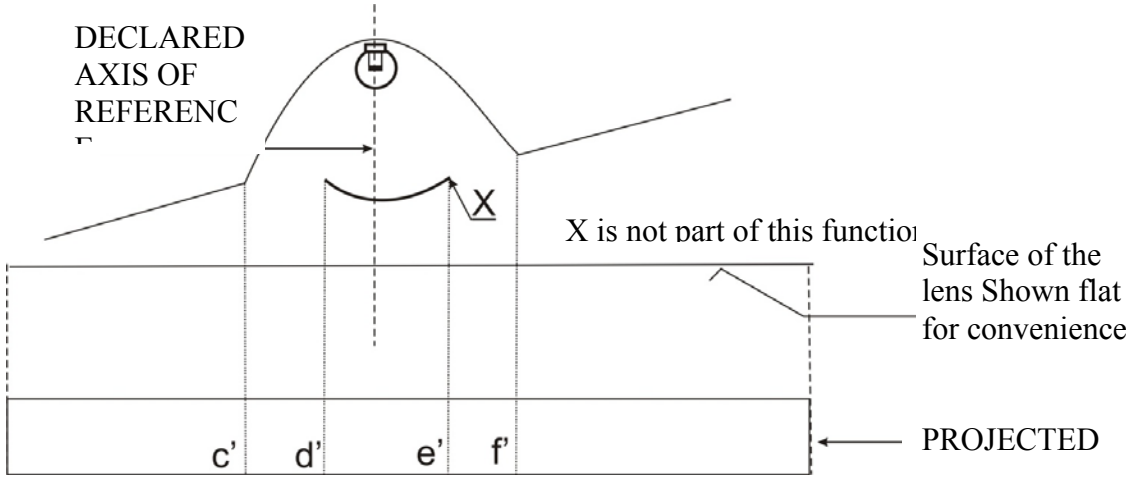
Example to determine a light emitting surface according to 2.8. a) in combination with an area which is not part of the function:



	Declared Light-emitting surface according to 2.8. a)
Edges are	c-d and e-f

Example E

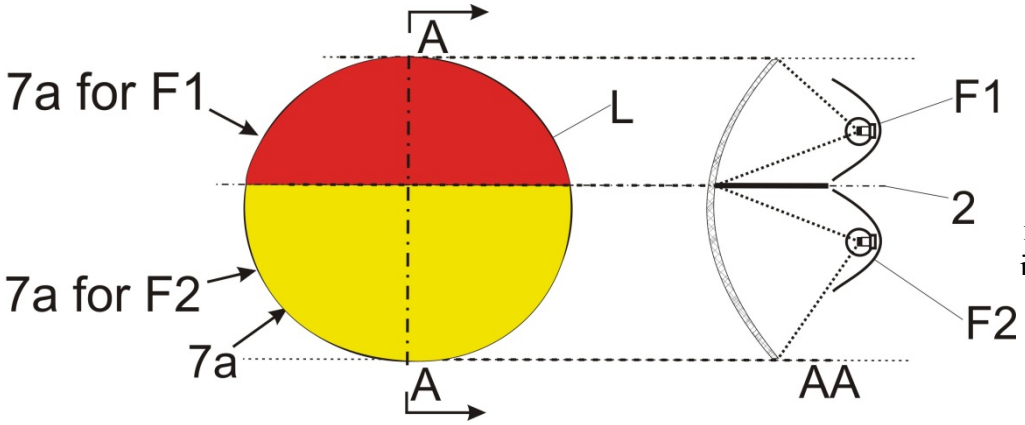
Example to determine the apparent surface in combination with an area which is not part of the function and a non-textured outer lens (according to 2.8. b)):



	Declared Light emitting surface according to 2.8 b) for example
Edges are	c'-d' and e'-f'

Part 7 – Examples to enable a decision regarding the reciprocal incorporation of two functions

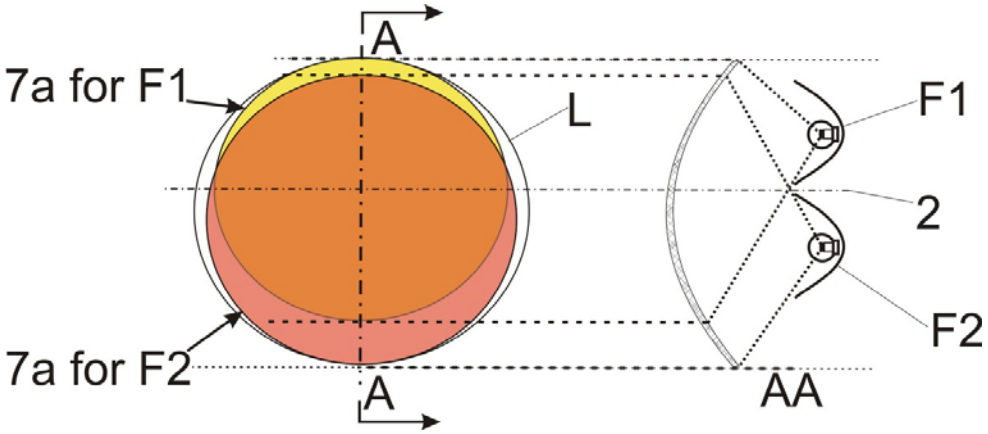
In the case with a textured outer lens and a wall in between:



Not reciprocally incorporated

==========

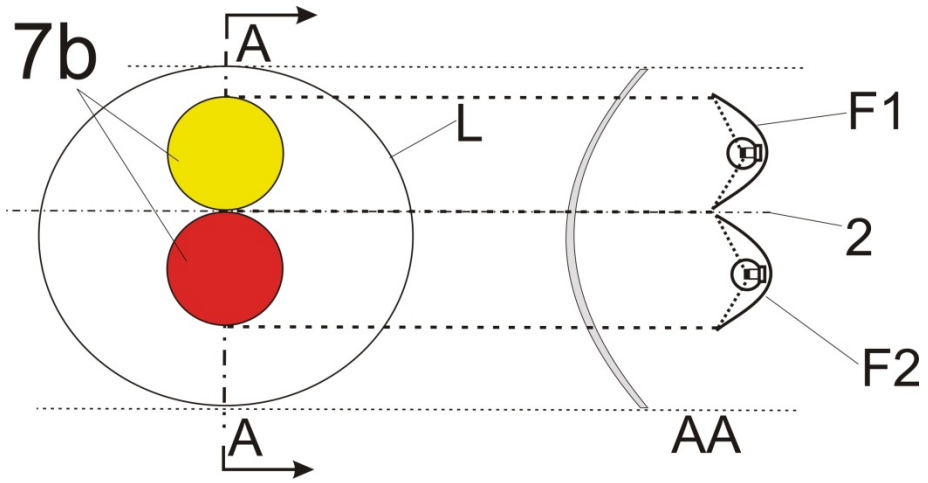
In the case with a textured outer lens:



Reciprocally

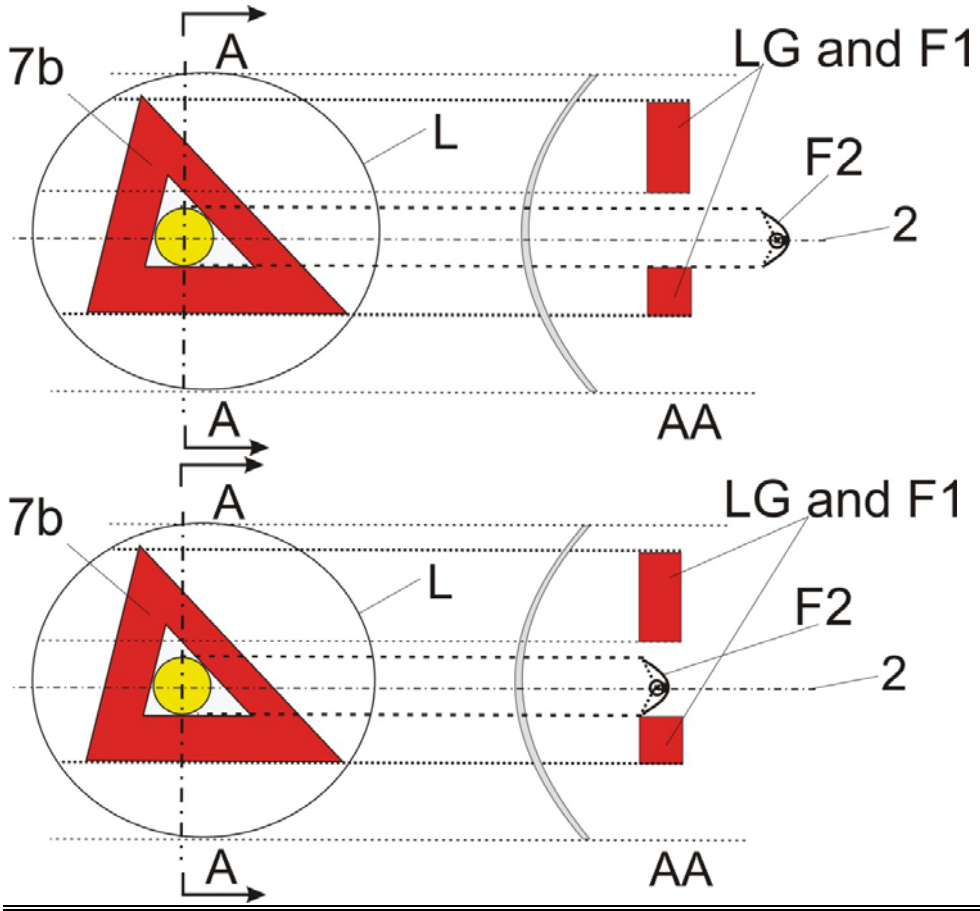
==========

In the case where the non-textured outer lens is excluded:



Not reciprocally incorporated

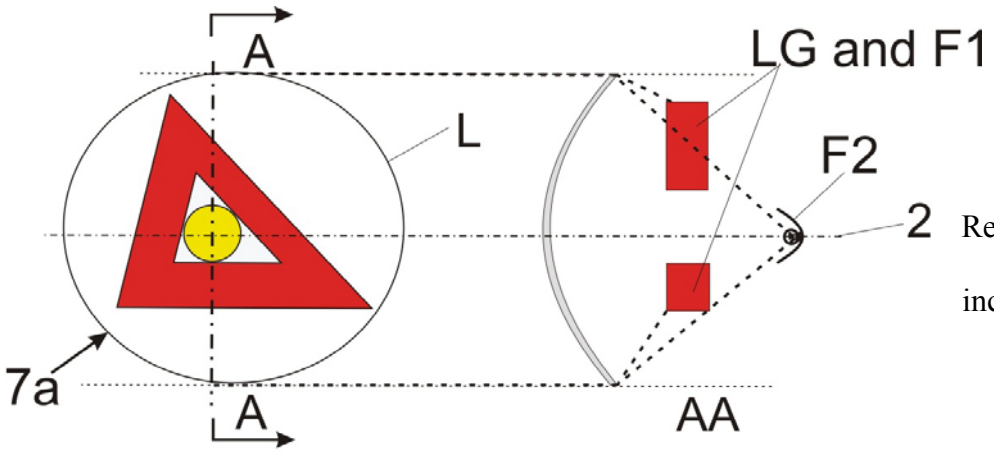
In the case where the non-textured outer lens is excluded:



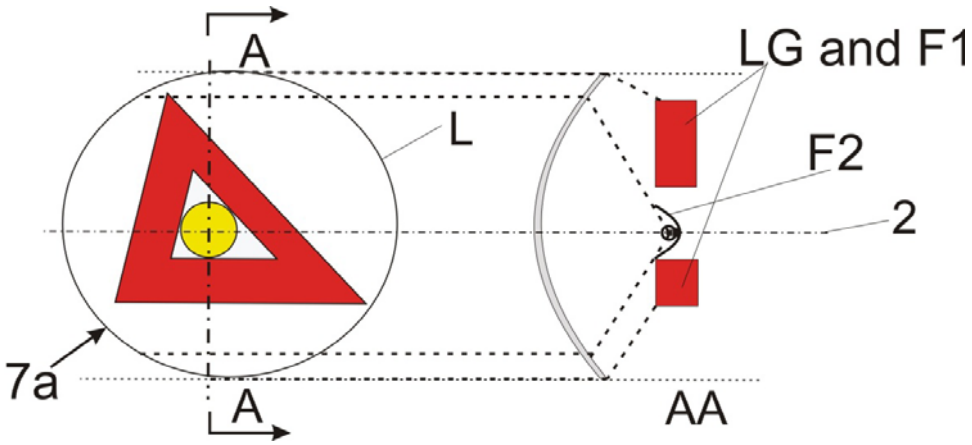
Not reciprocally incorporate

Not reciprocally incorporat

In the case where the outer lens (textured or not) is included:

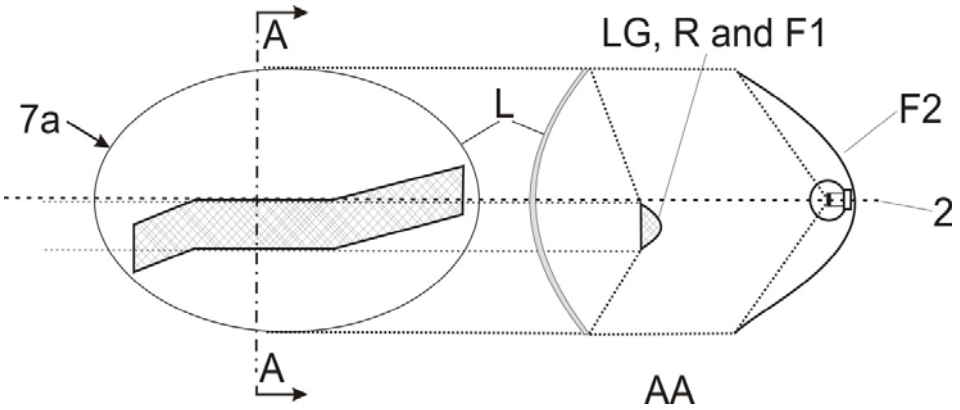


Reciprocally incorporate



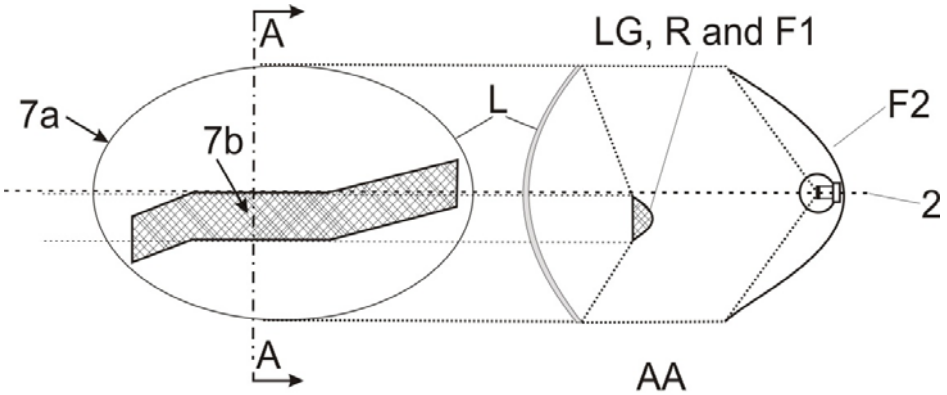
Reciprocally incorporated

In the case where the outer lens (textured or not) is included:



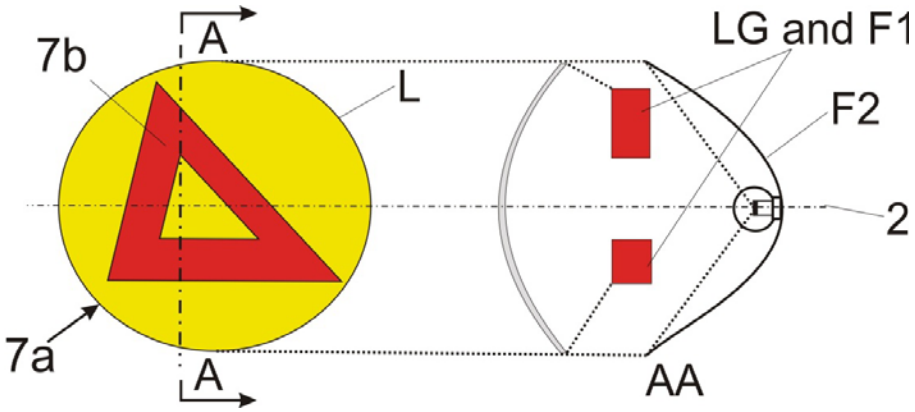
Reciprocally incorporate

In the case where the non-textured outer lens is excluded, "7b" is the apparent surface according to paragraph 2.8. and F1 shall not be transparent to F2:



F1 is not reciprocally incorporate

In the case where the non-textured outer lens is excluded or not:



Reciprocally incorporated

Annex 9

DEFINITION AND SHARPNESS OF THE "CUT-OFF" LINE

Annex 9A

ASYMMETRICAL BEAM PATTERNS

1.0 Provisions concerning passing-beams

1.1. The luminous intensity distribution of the principal passing-beam headlamp shall incorporate a "cut-off" (see Figure 1), which enables the headlamp to be adjusted correctly for the photometric measurements and for the aiming on the vehicle.

The "cut-off" shall provide:

(a) For right hand traffic beams:

(i) A straight "horizontal part" towards the left;

(ii) A raised "elbow – shoulder" part towards the right.

(b) For left hand traffic beams:

(i) A straight "horizontal part" towards the right;

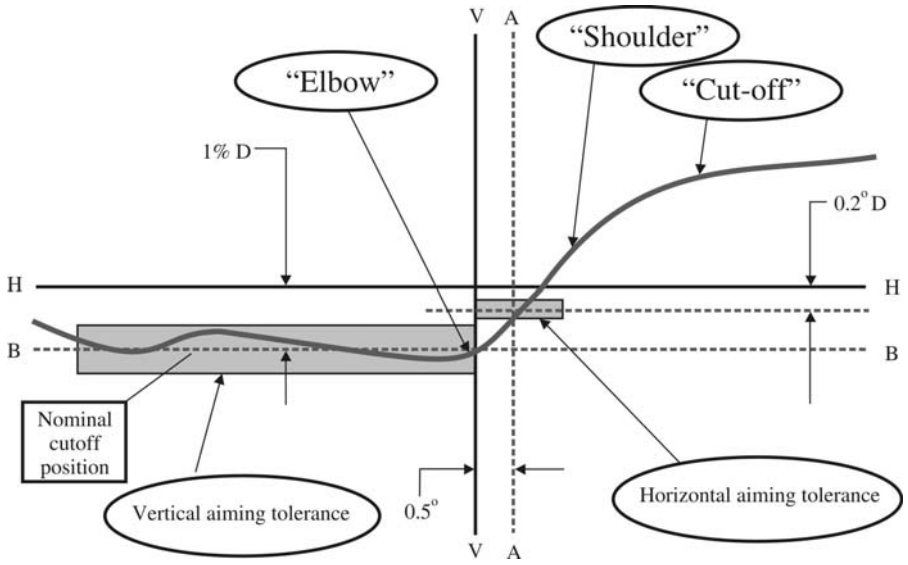
(ii) A raised "elbow - shoulder" part towards the left.

In each case the "elbow-shoulder" part shall have a sharp edge.

1.2. The headlamp shall be visually aimed by means of the "cut-off" (see Figure 1) as follows. The aiming shall be carried out using a flat vertical screen set up at a distance of 10 m or 25 m (as indicated in item 9 of Annex 1) forward of the headlamp and at right angles to the H-V axis as shown in Annex 3 to this Regulation. The screen shall be sufficiently wide to allow examination and adjustment of the "cut-off" of the passing-beam over at least 5° on either side of the V-V line.

1.3. For vertical adjustment: the horizontal part of the "cut-off" is moved upward from below line B and adjusted to its nominal position one per cent (0.57 degrees) below the H-H line;

Figure 1



Note: The scales are different for vertical and horizontal lines.

1.4. For horizontal adjustment: the "elbow – shoulder" part of the "cut-off" shall be moved:

For right hand traffic from right to left and shall be horizontally positioned after its movement so that:

(a) Above the line 0.2° D its "shoulder" shall not exceed the line A to the left;

(b) The line 0.2° D or below its "shoulder" should cross the line A; and

(c) The kink of the "elbow" is basically located within +/-0.5 degrees to the left or right of the V-V line;

or

For left hand traffic from left to right and shall be horizontally positioned after its movement so that:

(a) Above the line 0.2 D its "shoulder" shall not exceed the line A to the right;

(b) On the line 0.2° or below its "shoulder" cross the line A; and

(c) The kink of the "elbow" should be primarily on the V-V line;

1.5. Where a headlamp so aimed does not meet the requirements set out in paragraphs 6.2.4. to 6.2.6. and 6.3., its alignment may be changed, provided that the axis of the beam is not displaced:

Horizontally from line A by more than:

(a) 0.5° to the left or 0.75° to the right, for right hand traffic; or

(b) 0.5° to the right or 0.75° to the left, for left hand traffic; and

Vertically not more than 0.25° up or down from line B.

2.0 Instrumental verification of the "cut-off" for asymmetric passing-beam headlamps

2.1. General

In the case where paragraph 6.2.2.4. of this Regulation applies, the quality of the "cut-off" shall be tested according to the requirements set out in paragraph 2. below and the instrumental vertical and horizontal adjustment of the beam shall be performed according to the requirements set out in paragraph 3. below.

Before carrying out the measurement of the quality of "cut-off" and the instrumental aiming procedure, a visual pre-aim in accordance with paragraphs 6.2.2.1. and 6.2.2.2. of this Regulation is required.

2.2. Measurement of the quality of the "cut-off"

To determine the minimum sharpness, measurements shall be performed by vertically scanning through the horizontal part of the "cut-off" in angular steps of 0.05° at either a measurement distance of:

(a) 10 m with a detector having a diameter of approximately 10 mm or

(b) 25 m with a detector having a diameter of approximately 30 mm.

The measuring distance at which the test was carried out shall be recorded in item 9. of the communication form (see Annex 1 of this Regulation).

To determine the maximum sharpness, measurements shall be performed by vertically scanning through the horizontal part of the "cut-off" in angular steps of 0.05° exclusively at a measurement distance of 25 m and with a detector having a diameter of approximately 30 mm.

The "cut-off" quality shall be considered acceptable if the requirements of paragraphs 2.1. to 2.3. below comply with at least one set of measurements.

2.2.1. Not more than one "cut-off" shall be visible[1].

2.2.2. Sharpness of "cut-off"

The sharpness factor G is determined by scanning vertically through the horizontal part of the "cut-off" at 2.5° from the V-V where:

$G = (\log E_{\beta} - \log E_{(\beta + 0.1°)})$ where β = the vertical position in degrees.

The value of G shall not be less than 0.13 (minimum sharpness) and not greater than 0.40 (maximum sharpness).

2.2.3. Linearity

The part of the horizontal "cut-off" that serves for vertical adjustment shall be horizontal between 1.5° and 3.5° from the V-V line (see Figure 1).

The inflection points of the "cut-off" gradient at the vertical lines at 1.5°, 2.5° and 3.5° shall be determined by the equation:

The maximum vertical distance between the inflection points determined shall not exceed 0.2°.

[1] This paragraph should be amended when an objective test method is available.

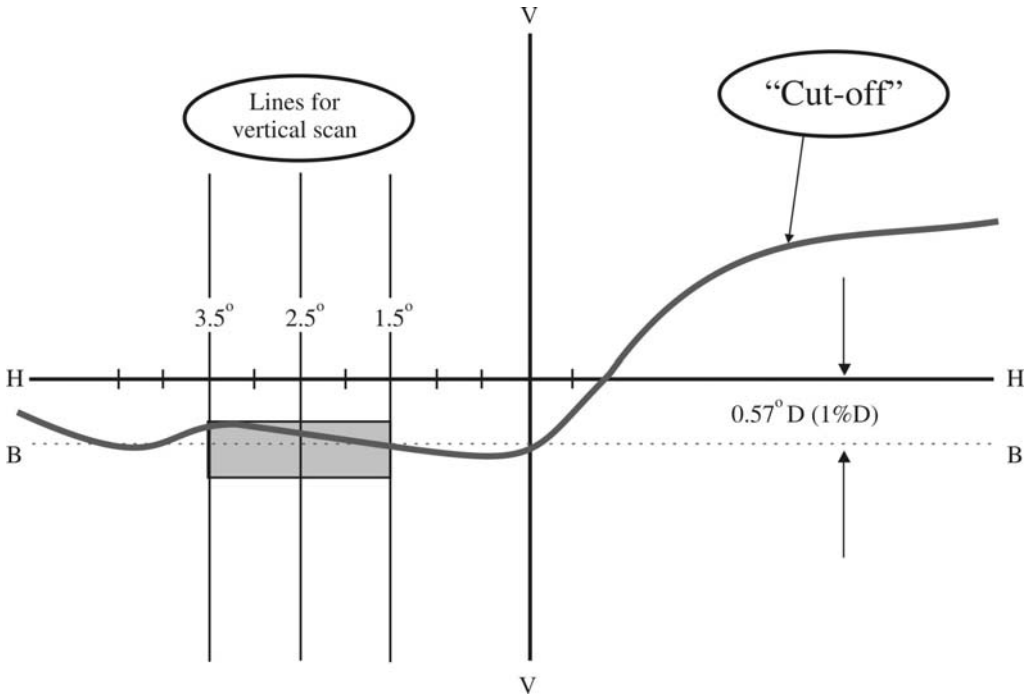
(d^2 (log E) / $d\beta^2$ = 0).

2.3. Vertical and horizontal adjustment

If the "cut-off" complies with the quality requirements of paragraph 2. of this annex, the beam adjustment may be performed instrumentally.

FIGURE 1

MEASUREMENT OF "CUT-OFF" QUALITY



Note: The scales are different for vertical and horizontal lines.

2.3.1. Vertical adjustment

Moving upward from below the line B (see Figure 2 below), a vertical scan is carried out through the horizontal part of the "cut-off" at 2.5° from V-V. The inflection point (where d^2 (log E) / dv^2 = 0) is determined and positioned on the line B situated one per cent below H-H.

2.3.2. Horizontal adjustment

The applicant shall specify one of the following horizontal aim methods:

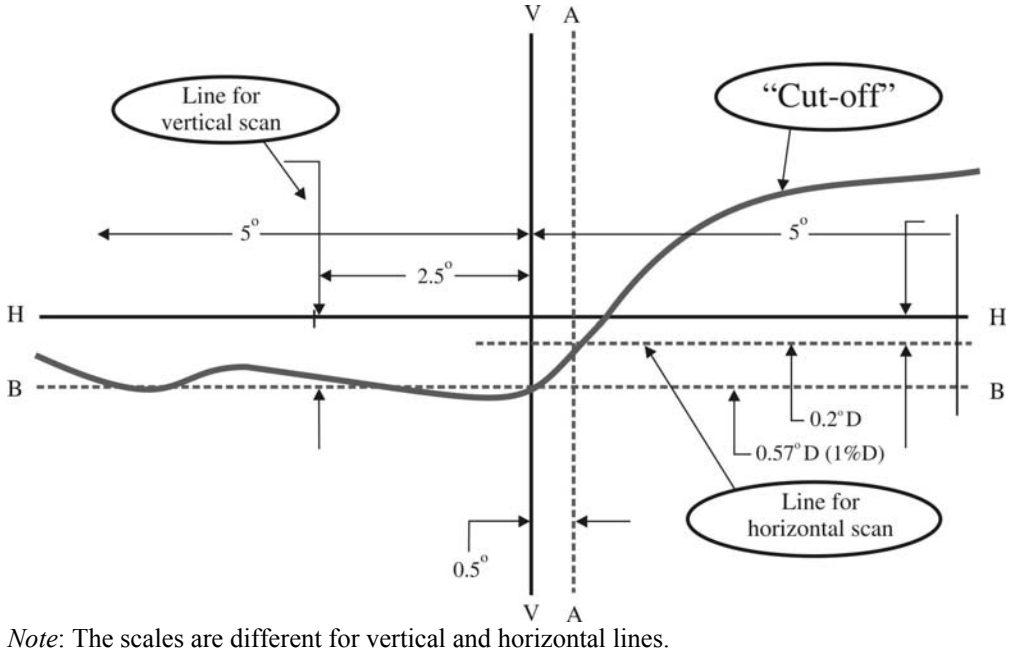
(a) The "0.2 D line" method (see Figure 2 below).

A single horizontal line at 0.2° D shall be scanned from 5° left to 5° right after the lamp has been aimed vertically. The maximum gradient "G" determined using the formula G = (log E_β - log $E_{(\beta + 0.1°)}$) where β is the horizontal position in degrees, shall not be less than 0.08.

The inflection point found on the 0.2 D line shall be positioned on the line A.

FIGURE 2

INSTRUMENTAL VERTICAL AND HORIZONTAL ADJUSTMENT - HORIZONTAL LINE SCAN METHOD



Note: The scales are different for vertical and horizontal lines.

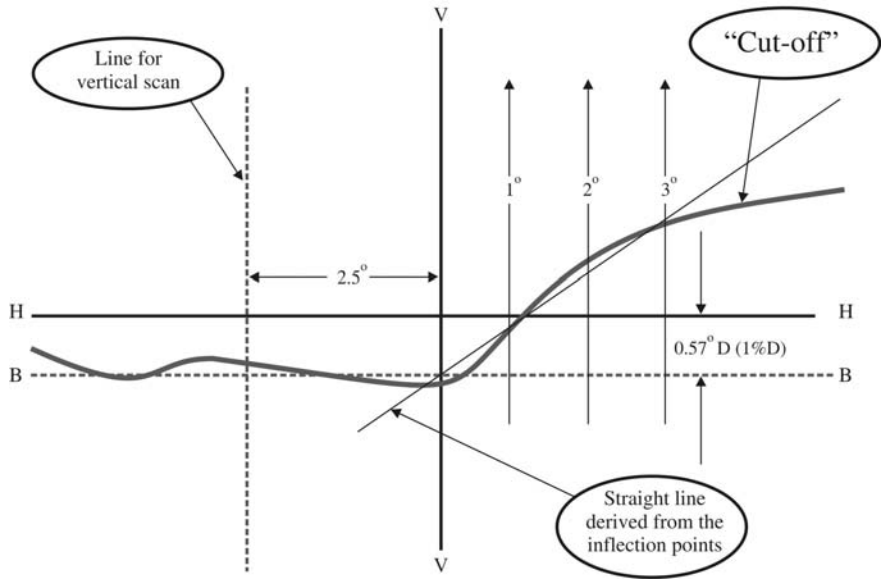
(b) The "3 line" method (see Figure 3)

Three vertical lines shall be scanned from 2° D to 2° U at 1°R, 2°R, and 3°R after the lamp has been aimed vertically. The respective maximum gradients "G" determined using the formula:

$$G = (\log E_{\beta} - \log E_{(\beta + 0.1°)})$$

where β is the vertical position in degrees, shall not be less than 0.08. The inflection points found on the three lines shall be used to derive a straight line. The intersection of this line and the line B found while performing vertical aim shall be placed on the V line.

Figure 3
INSTRUMENTAL VERTICAL AND HORIZONTAL ADJUSTMENT - THREE LINE SCAN METHOD



Note: The scales are different for vertical and horizontal lines.

Annex 9 B

DEFINITION AND SHARPNESS OF THE "CUT-OFF" LINE

FOR SYMMETRICAL PASSING BEAM HEADLAMPS

AND AIMING PROCEDURE

BY MEANS OF THIS "CUT-OFF" LINE

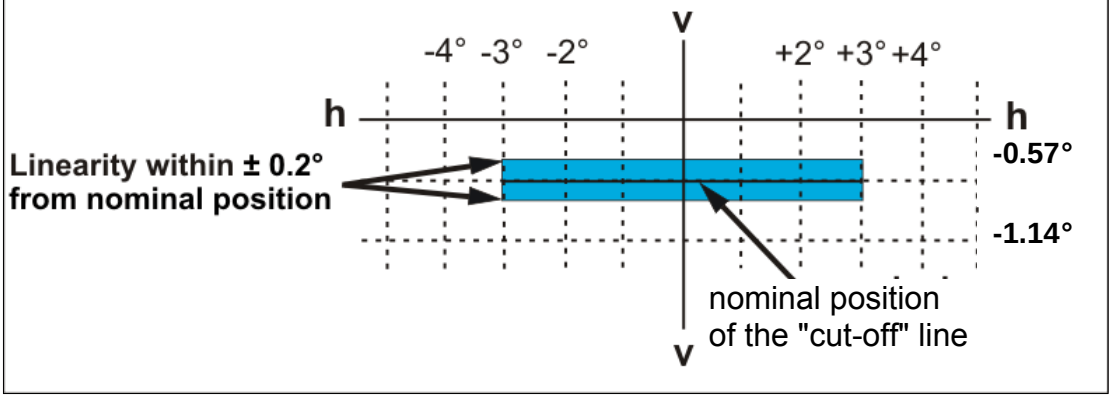
1. General

1.1. The luminous intensity distribution of the symmetrical passing-beam headlamps shall incorporate a "cut-off" line which enables the symmetrical passing-beam headlamp to be adjusted correctly for the photometric measurements and for the aiming on the vehicle. The characteristics of the "cut-off" line shall comply with the requirements set out in paragraphs 2. to 4. below:

2. Shape of the "cut-off" line

2.1. For visual adjustment of the symmetrical passing-beam headlamp the "cut-off" line shall provide a horizontal line for vertical adjustment of the symmetrical passing-beam headlamp extending to either side of the V-V line (see Figure 1) as specified in paragraph 6.2.1. of this Regulation.

Figure 1: Shape and position of the "cut-off" line



3. Adjustment of the symmetrical passing-beam headlamp

3.1. Horizontal adjustment: the beam with the "cut-off" line shall be so positioned that the projected beam pattern appears approximately symmetrical to the V-V line.

3.2. Vertical adjustment: after horizontal adjustment of the symmetrical passing-beam headlamp according to paragraph 3.1. above, the vertical adjustment shall be performed in such a way that the beam with its "cut-off" line is moved upwards from the lower position until the "cut-off" line is situated at nominal vertical position. For nominal vertical adjustment the "cut-off" line is positioned on the V-V line at 1 per cent below the h-h line.

If the horizontal part is not straight but slightly curved or inclined, the "cut-off" line shall not exceed the vertical range formed by two horizontal lines which are situated from 3° left to 3° right of the V-V line at 0.2° for Class B and 0.3° for Classes A, C**,** D and E headlamps above and below the nominal position of the "cut-off" (see Figure 1).

3.3. When the vertical adjustments of three different individuals differs by more than 0.2° for Class B and 0.3° for Classes A, C, D and E head lamps, the horizontal part of the "cut-off" line is assumed not to provide sufficient linearity or sharpness for performing visual adjustment. In this case the quality of "cut-off" shall be tested instrumentally for compliance with requirements as follows.

4. Measurement of the quality of "cut-off"

4.1. Measurements shall be performed by vertically scanning through the horizontal part of the "cut-off" line in angular steps not exceeding 0.05°:

(a) At either a measurement distance of 10 m and a detector with a diameter of approximately 10 mm;

(b) Or at a measurement distance of 25 m and a detector with a diameter of approximately 30 mm.

The measurement of the "cut-off" quality shall be considered acceptable if the requirements of the paragraph 4.1.2. of this annex shall comply with at least one measurement at 10 m or 25 m.

The measuring distance at which the test was determined shall be noted down in paragraph 9., Annex 1 "Communication form" of this Regulation.

The scanning is performed from its lower position upwards through the "cut-off" line along the vertical lines at −3° to −1.5° and +1.5° to +3° from the V-V line. When so measured, the quality of the "cut-off" line shall meet the following requirements:

4.1.1. Not more than one "cut-off" line shall be visible[1].

4.1.2. Sharpness of "cut-off": if scanned vertically through the horizontal part of the "cut-off" line along the ±2.5 -lines, the maximum value measured for:

$$G = (\log E_V - \log E_{(V + 0.1°)})$$

is called the sharpness factor G of the "cut-off" line. The value of G shall not be less than 0.13 for Class B and 0.08 for Classes A, C, D and E.

4.1.3. Linearity: the part of the "cut-off" line which serves for vertical adjustment shall be horizontal from 3°L to 3°R of the V-V line. This requirement is deemed to be met if the vertical positions of the inflection points according to paragraph 3.2. above at 3° left and right of the V-V line do not differ by more than 0.2° for Class B and 0.3° for Classes A, C, D and E headlamps from the nominal position at the V-V line.

5. Instrumental vertical adjustment

[1] This paragraph will be amended, if an objective test method is available.

If the "cut-off" line complies with the above quality requirements, the vertical beam adjustment can be performed instrumentally. For this purpose the inflection point where d^2 (log E) / $dv^2 = 0$ is positioned on the V-V line in its nominal position below the h-h-line. The movement for measuring and adjusting the "cut-off" line shall be upwards from below the nominal position.

Annex 10

TESTS FOR STABILITY OF PHOTOMETRIC PERFORMANCE OF

SIGNALLING LAMPS AND HEAD LAMPS IN OPERATION

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

11.1. 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 °C ± 5 °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 lamps and other), the test shall be made with the light sources present in the lamp, in accordance with **Annex 5 of this HRD.**

11.2. 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 (filament lamps and other) the test conditions set in **Annex 5 of this HRD** shall be applied.

11.3. 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 according to **the specific paragraph " Intensity of Light" in the relevant Regulation** shall be measured. At that measurement the values shall reach at least 90 per cent of the values obtained before the heat resistance test on the same device.

B Heat resistance test for head lamps and front fog lamps

Tests on complete headlamps

Once the photometric values have been measured according to the prescriptions of this Regulation, in the point for I_{max} for driving-beam and in

points HV, 50 R, B 50 L for passing-beam (or HV, 50 L, B 50 R for headlamps designed for left-hand traffic) a complete headlamp sample shall be tested for stability of photometric performance in operation. "Complete headlamp" shall be understood to mean the complete lamp itself including those surrounding body parts and lamps which could influence its thermal dissipation.

The tests shall be carried out:

(a) In a dry and still atmosphere at an ambient temperature of 23 °C ± 5 °C, the test sample being mounted on a base representing the correct installation on the vehicle;

(b) In case of replaceable light sources: using mass production filament light sources, which have been aged for at least one hour, or mass production gas-discharge light sources, which have been aged for at least 15 hours or mass production LED modules which have been aged for at least 48 hours and cooled down to ambient temperature before starting the tests as specified in this Regulation. The LED modules supplied by the applicant shall be used.

The measuring equipment shall be equivalent to that used during headlamp type approval tests.

The test sample shall be operated without being dismounted from or readjusted in relation to its test fixture. The light source used shall be a light source of the category specified for that headlamp.

1. Test for stability of photometric performance

1.1. Clean headlamp

The headlamp shall be operated for 12 hours as described in paragraph 1.1.1. and checked as prescribed in paragraph 1.1.2.

1.1.1. Test procedure[2]

The headlamp shall be operated for a period according to the specified time, so that:

[2] For the test schedule see Annex 8 to this Regulation.

1.1.1.1. (a) In the case where only one lighting function (driving or passing-beam or front fog lamp) is to be approved, the corresponding filament and/or LED module(s) is (are) lit for the prescribed time[3];

(b) In the case of a headlamp with a passing-beam and one or more driving-beams or in the case of a headlamp with a passing-beam and a front fog lamp:

(i) The headlamp shall be subjected to the following cycle until the time specified is reached:

15 minutes, principal passing-beam filament or principal passing-beam LED module(s) lit;

5 minutes, all filaments and/or LED module(s) lit.

(ii) If the applicant declares that the headlamp is to be used with only the passing-beam lit or only the driving-beam(s) lit[4] at a time, the test shall be carried out in accordance with this condition, activating[2] successively the passing-beam half of the time and the driving-beam(s) (simultaneously) for half the time specified in paragraph 1.1. above.

(c) In the case of a headlamp with a front fog lamp and one or more driving-beams:

(i) The headlamp shall be subjected to the following cycle until the time specified is reached:

15 minutes, front fog lamp lit;

5 minutes, all filaments and/or all LED modules lit.

(ii) If the applicant declares that the headlamp is to be used with only the front fog lamp lit or only the driving-beam(s) lit[3] at a time, the test shall be carried out in accordance with this condition, activating[2] successively the front fog lamp half of the time and the driving-beam(s) (simultaneously) for half the time specified in paragraph 1.1. above.

(d) In the case of a headlamp with a passing-beam, one or more driving-beams and a front fog lamp:

(i) The headlamp shall be subjected to the following cycle until the time specified is reached:

15 minutes, principal passing-beam filament or principal passing-beam LED module(s) lit;

5 minutes, all filaments and/or all LED modules lit.

[3] When the tested headlamp includes signalling lamps, the latter shall be lit for the duration of the test, except for a daytime running lamp. In the case of a direction indicator lamp, it shall be lit in flashing mode with an on/ off time of approximately one to one.

[4] Should two or more lamp filaments and/or LED module(s) be simultaneously lit when headlamp flashing is used, this shall not be considered as being normal use of the filaments and/or LED module(s).

(ii) If the applicant declares that the headlamp is to be used with only the passing-beam lit or only the driving-beam(s)[3] lit at a time, the test shall be carried out in accordance with this condition, activating[2] successively the principal passing-beam half of the time and the driving-beam(s) for half the time specified in paragraph 1.1. above, while the front fog lamp is subjected to a cycle of 15 minutes off and 5 minutes lit for half of the time and during the operation of the driving-beam;

(iii) If the applicant declares that the headlamp is to be used with only the passing-beam lit or only the front fog lamp[3] lit at a time, the test shall be carried out in accordance with this condition, activating[2] successively the principal passing-beam half of the time and the front fog lamp for half of the time specified in paragraph 1.1. above, while the driving-beam(s) is(are) subjected to a cycle of 15 minutes off and 5 minutes lit for half of the time and during the operation of the principal passing-beam;

(iv) If the applicant declares that the headlamp is to be used with only the passing-beam lit or only the driving-beam(s)[3] lit or only the front fog lamp[3] lit at a time, the test shall be carried out in accordance with this condition, activating[2] successively the principal passing-beam one third of the time, the driving-beam(s) one third of the time and the front fog lamp for one third of the time specified in paragraph 1.1. above.

(e) In the case of a passing-beam designed to provide bend lighting with the addition of a filament light source and/or one or more LED module(s), this light source and/or LED module(s) shall be switched on for one minute, and switched off for nine minutes during the activation of the passing-beam only (see Annex 4 – Appendix 1).

1.1.1.2. Test voltage

The voltage shall be applied to the terminals of the test sample as follows:

(a) In case of replaceable filament light source(s) operated directly under vehicle voltage system conditions:

The test shall be performed at 6.3 V, 13.2 V or 28.0 V as applicable except if the applicant specifies that the test sample may be used at a different voltage. In this case, the test shall be carried out with the filament light source operated at the highest voltage that can be used.

(b) In case of replaceable gas discharge light source(s): The test voltage for the electronic light source control-gear is 13.2 ± 0.1 volts for 12 V vehicle voltage system, or otherwise specified in the application for approval.

(c) In the case of non-replaceable light source operated directly under vehicle voltage system conditions: All measurements on lighting units equipped with non-replaceable light sources (filament light sources and/ or others) shall be made at 6.3 V, 13.2 V or 28.0 V or at other voltages according to the vehicle voltage system as specified by the applicant respectively.

(d) In the case of light sources, replaceable or non-replaceable, being operated independently from vehicle supply voltage and fully controlled by the system, or, in the case of light sources supplied by a supply and operating device, the test voltages as specified above shall be applied to the input terminals of that device. The test laboratory may require from the manufacturer the supply and operating device or a special power supply needed to supply the light source(s).

(e) LED module(s) shall be measured at 6.75 V, 13.2 V or 28.0 V respectively, if not otherwise specified within this Regulation. LED module(s) operated by an electronic light source control gear, shall be measured as specified by the applicant.

(f) Where signalling lamps are grouped, combined or reciprocally incorporated into the test sample and operating at voltages other than the nominal rated voltages of 6 V, 12 V or 24 V respectively, the voltage shall be adjusted as declared by the manufacturer for the correct photometric functioning of that lamp.

1.1.2. Test results

1.1.2.1. Visual inspection

Once the headlamp has been stabilized to the ambient temperature, the headlamp lens and the external lens, if any, shall be cleaned with a clean, damp cotton cloth. It shall then be inspected visually; no distortion, deformation, cracking or change in colour of either the headlamp lens or the external lens, if any, shall be noticeable.

1.1.2.2. Photometric test

To comply with the requirements of this Regulation, the photometric values shall be verified in the following points:

In the case of a head lamp with an asymmetrical beam pattern:

Passing-beam:

50 R - B 50 L – **25L** for headlamps designed for right-hand traffic,

50 L - B 50 R – **25R** for headlamps designed for left-hand traffic.

Driving-beam:

Point I_{max}

In the case of a head lamp with a symmetrical beam pattern:

For Class B headlamp:

Passing beam: 50R - 50L - 0.50U/1.5L and 0.50U/1.5R.

Driving beam: Point of I max

For Classes C, D and E headlamp:

Passing beam: 0.86D/3.5R - 0.86D/3.5L - 0.50U/1.5L and 1.5R.

Driving beam: Point of Imax
In the case of a front fog lamps:

In case of Class "B" front fog lamps: at point HV and the point of Imax in zone D.

In case of Class"F3" front fog lamps: on line 5 at point h = 0 and the point of Imax in zone D.

Another aiming may be carried out to allow for any deformation of the headlamp base due to heat (the change of the position of the cut-off line is covered in paragraph 2. of this annex).

In the case of a head lamp with an asymmetrical beam pattern or front fog lamps:

A 10 per cent discrepancy between the photometric characteristics and the values measured prior to the test is permissible including the tolerances of the photometric procedure.

In the case of a head lamp with a symmetrical beam pattern:

Except for points 0.50U/1.5L and 0.50U/1.5R, a 10 per cent discrepancy between the photometric characteristics and the values measured prior to the test is permissible including the tolerances of the photometric procedure. The value measured at points 0.50U/1.5L and 0.50U/1.5R shall not exceed the photometric value measured prior to the test by more than 255cd.

1.2. Dirty headlamp

After being tested as specified in paragraph 1.1. above, the headlamp shall be operated for one hour as described in paragraph 1.1.1., after being prepared as prescribed in paragraph 1.2.1., and checked as prescribed in paragraph 1.1.2.

1.2.1. Preparations of the headlamp

1.2.1.1. Test mixture

See Appendix 2 to this Annex

1.2.1.2. Application of the test mixture to the headlamp

The test mixture shall be uniformly applied to the entire light-emitting surface of the headlamp and then left to dry. This procedure shall be repeated until the illumination value has dropped to 15-20 per cent of the values measured for each following point under the conditions described in this annex:

In the case of a head lamp with an asymmetrical beam pattern:

Point of E_{max} in passing-beam/driving-beam and in driving-beam only,

50 R and 50 V[5] for a headlamp producing only a passing-beam, designed for right-hand traffic,

[5]Point 50 V is situated 375 mm below HV on the vertical line v-v on the screen at 25 m distance.

50 L and 50 V[6] for a headlamp producing only a passing-beam, designed for left-hand traffic.

In the case of a head lamp with a symmetrical beam pattern:

For Class B headlamp:
Passing beam/driving beam and driving beam only: Point of Emax
Passing beam only: B 50 and 50 V
For Class C, D and E headlamp:
Passing beam/driving beam and driving beam only: Point of Emax
Passing beam only: 0.50U/1.5L and 1.5R and 0.86D/V

In the case of a front fog lamps:

point of Emax in zone D for a front fog lamp;

2. Test for change in vertical position of the cut-off line under the influence of heat

This test consists of verifying that the vertical drift of the cut-off line under the influence of heat does not exceed a specified value for an operating headlamp producing a passing-beam.

The headlamp tested in accordance with paragraph 1., shall be subjected to the test described in paragraph 2.1., without being removed from or readjusted in relation to its test fixture.

2.1. Test

The test shall be carried out in a dry and still atmosphere at an ambient temperature of 23 °C ± 5 °C.

Using a mass production filament lamp or the LED module(s) as submitted with the headlamp, which has (have) been aged for at least one hour, the headlamp shall be operated on the principal passing-beam without being dismounted from or readjusted in relation to its test fixture. (For the purpose of this test, the voltage shall be adjusted as specified in paragraph 1.1.1.2.). The position of the cut-off line in its horizontal part (between vv and the vertical line passing through point B 50 L for right-hand traffic or B 50 R for left-hand traffic) shall be verified 3 minutes (r_3) and 60 minutes (r_{60}) respectively after operation.

The measurement of the variation in the cut-off line position as described above shall be carried out by any method giving acceptable accuracy and reproducible results.

2.2. Test results

2.2.1. The result expressed in milliradians (mrad) shall be considered as acceptable for a passing-beam headlamp when the absolute value $\Delta r_1 = \left| r_3 - r_{60} \right|$ recorded on the headlamp is not more than 1.0 mrad ($\Delta r_1 \leq 1.0$ mrad) upward and not more than 2.0 mrad ($\Delta r_1 \leq 2.0$ mrad) downwards.

2.2.2. However, if this value is:

Movement	
upward	more than 1.0 mrad but not more than 1.5 mrad ($1.0 \text{ mrad} < \Delta r_I \leq 1.5 \text{ mrad}$)

downward	more than 2.0 mrad but not more than 3.0 mrad ($2.0 \text{ mrad} < \Delta r_I \leq 3.0 \text{ mrad}$)

a further sample of a headlamp shall be tested as described in paragraph 2.1. after being subjected three consecutive times to the cycle as described below, in order to stabilize the position of mechanical parts of the headlamp on a base representative of the correct installation on the vehicle:

Operation of the passing-beam for one hour, (the voltage shall be adjusted as specified in paragraph 1.1.1.2.),

After this period of one hour, the headlamp type shall be considered as acceptable if the absolute value Δr measured on this sample meets the requirements in paragraph 2.2.1. above.

Annex 10 - Appendix 1

Overview of operational periods concerning test for stability of photometric performance

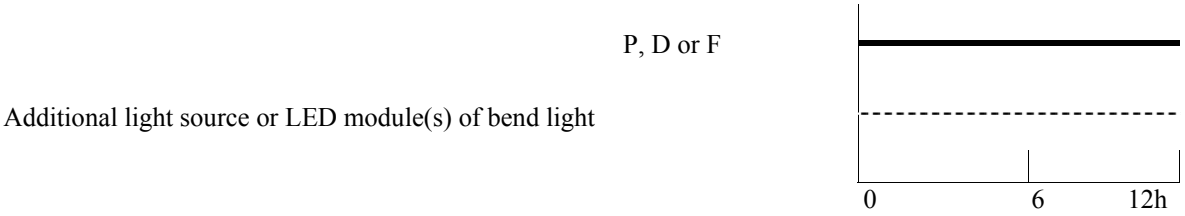
Abbreviations:
- P: passing-beam lamp
- D: driving-beam lamp (D_1 + D_2 means two driving-beams)
- F: front fog lamp

means a cycle of 15 minutes off and 5 minutes lit

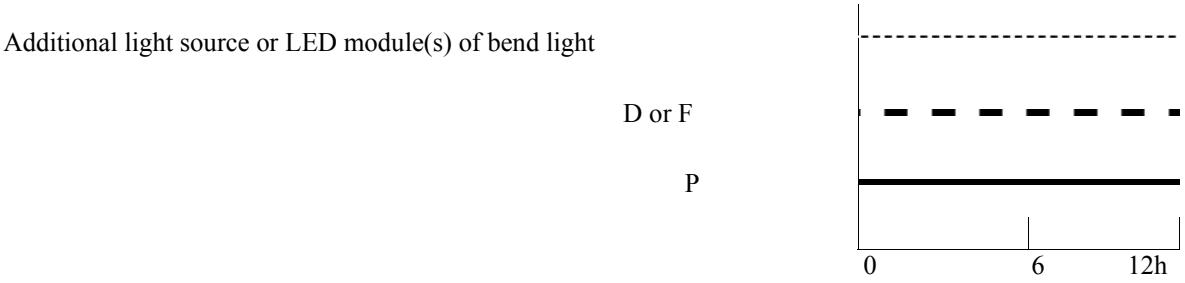
means a cycle of 9 minutes off and 1 minute lit

All following grouped headlamps and front fog lamps together with the added marking symbols are given as examples and are not exhaustive.

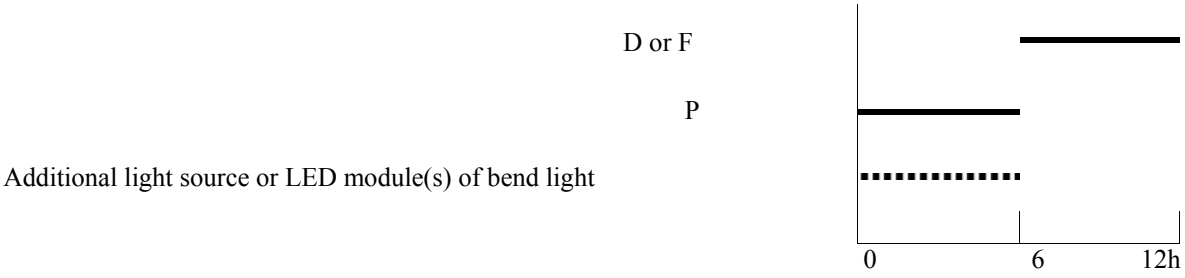
1. P or D or F (HC or HR or B)



2. P+F (HC B) or P+D (HCR)



3. P+F (HC/B) or HC/B or P+D (HC/R)



Annex 10 Appendix 2

TEST MIXTURE

1. Test mixture

1.1. For headlamp with the outside lens in glass:

The mixture of water and a polluting agent to be applied to the headlamp shall be composed of:

9 parts by weight of silica sand with a particle size of 0-100 µm,

1 part by weight of vegetal carbon dust **produced from** ~~(~~beech wood~~)~~ with a particle size of 0-100 µm,

0.2 parts by weight of NaCMC[1], and

5 parts by weight of sodium chloride (pure at 99 per cent),

an appropriate quantity of distilled water, with a conductivity of ≤ 1 mS/m.

The mixture must not be more than 14 days old.

1.2. For headlamp with outside lens in plastic material:

The mixture of water and polluting agent to be applied to the headlamp shall be composed of:

9 parts by weight of silica sand with a particle size of 0-100 µm,

1 part by weight of vegetal carbon dust **produced from** ~~(~~beech wood~~)~~ with a particle size of 0-100 µm,

0.2 parts by weight of NaCMC[1], and

5 parts by weight of sodium chloride (pure at 99 per cent),

13 parts by weight of distilled water with a conductivity of ≤ 1 mS/m, and

2 ± 1 parts by weight of surface-actant[4].

The mixture must not be more than 14 days old."

[1] NaCMC represents the sodium salt of carboxymethylcellulose, customarily referred to as CMC. The NaCMC used in the dirt mixture shall have a degree of substitution (DS) of 0.6-0.7 and a viscosity of 200-300 cP for a 2 per cent solution at 20° C.

Annex 11

REQUIREMENTS FOR LAMPS INCORPORATING LENSES

OF PLASTIC MATERIAL

– TESTING OF LENS OR MATERIAL SAMPLES

0. General administrative specifications:

0.1. **A test report shall be prepared on the base of this HRD, covering the test and test results as described below , which will be added to the test report and the documentation to a specific head lamp or front fog lamp for approval.**

0.2. For the test of plastic material of which the lenses are made:

0.2.1. Fourteen lenses;

0.2.1.1. Ten of these lenses may be replaced by ten samples of material at least 60 x 80 mm in size, having a flat or convex outer surface and a substantially flat area (radius of curvature not less than 300 mm) in the middle measuring at least 15 x 15 mm;

0.2.1.2. Every such lens or sample of material shall be produced by the method to be used in mass production;

0.2.2. A reflector to which the lenses can be fitted in accordance with the manufacturer's instructions.

0.2.3. For testing the ultraviolet (UV)-resistance of light transmitting components made of plastic material against UV radiation of LED modules inside the headlamp:

0.2.3.1. One sample of each of the relevant material as being used in the headlamp or one headlamp sample containing these. Each material sample shall have the same appearance and surface treatment, if any, as intended for use in the headlamp to be approved;

0.2.3.2. The UV-resistance testing of internal materials to light source radiation is not necessary if no LED modules other than low-UV-types as specified in Annex 10 of this Regulation are being applied or if provisions are taken, to shield the relevant headlamp components from UV radiation, e.g. by glass filters.

1. General specifications

1.1. The samples supplied pursuant to paragraph 2.2.4. of this Regulation shall satisfy the specifications indicated in paragraphs 2.1. to 2.5. below.

1.2. The two samples of complete lamps supplied pursuant to paragraph 2.2.3. of this Regulation and incorporating lenses of plastic material shall, with regard to the lens material, satisfy the specifications indicated in paragraph 2.6. below.

1.3. The samples of lenses of plastic material or samples of material shall be subjected, with the reflector to which they are intended to be fitted (where applicable), to approval tests in the chronological order indicated in Table A reproduced in Appendix 1 to this annex.

1.4. However, if the lamp manufacturer can prove that the product has already passed the tests prescribed in paragraphs 2.1. to 2.5. below, or the equivalent tests pursuant to another regulation, those tests need not be repeated; only the tests prescribed in Appendix 1, Table B, shall be mandatory.

2. Tests

2.1. Resistance to temperature changes

2.1.1. Tests

Three new samples (lenses) shall be subjected to five cycles of temperature and humidity (RH = relative humidity) change in accordance with the following programme:

3 hours at 40 °C ± 2 °C and 85-95 per cent RH;

1 hour at 23 °C ± 5 °C and 60-75 per cent RH;

15 hours at -30 °C ± 2 °C;

1 hour at 23 °C ± 5 °C and 60-75 per cent RH;

3 hours at 80 °C ± 2 °C;

1 hour at 23 °C ± 5°C and 60-75 per cent RH;

Before this test, the samples shall be kept at 23 °C ± 5 °C and 60-75 per cent RH for at least four hours.

Note: The periods of one hour at 23 °C ± 5 °C shall include the periods of transition from one temperature to another which are needed in order to avoid thermal shock effects.

2.1.2. Photometric measurements

2.1.2.1. Method

Photometric measurements shall be carried out on the samples before and after the test.

These measurements shall be made using a standard (étalon) lamp and/or LED module(s), **or if applicable with a standard gas-discharge light source**, as present in the headlamp, at the following points:

In the case of a head lamp with an asymmetrical beam pattern:

B 50 L and 50 R for the passing-beam (B 50 R and 50 L in the case of headlamps intended for left-hand traffic);

I_{max} for the driving-beam.

In the case of a head lamp with a symmetrical beam pattern:

B 50, 50L and 50R for Class B headlamp, 0.86D/3.5R, 0.86D/3.5L, 0.50U/1.5L and 1.5R for Class C, D and E headlamp for the passing beam or a passing/driving lamp; Imax for the driving beam of a driving lamp or a passing/driving lamp;

In the case of a front fog lamps:

In the case of Class "B" front fog lamps:
(a) at point HV and
(b) point h = 0, v = 2° D in zone D.
In the case of Class "F3" front fog lamps:
(a) intersection VV line with line 6 and
(b) intersection VV line with line 4.

The head lamp or front fog lamp used for this test shall be noted in the test report.

2.1.2.2. Results

The variation between the photometric values measured on each sample before and after the test shall not exceed 10 per cent including the tolerances of the photometric procedure.

2.2. Resistance to atmospheric and chemical agents

2.2.1. Resistance to atmospheric agents

Three new samples (lenses or samples of material) shall be exposed to radiation from a source having a spectral energy distribution similar to that of a black body at a temperature between 5,500 K and 6,000 K. Appropriate filters shall be placed between the source and the samples so as to reduce as far as possible radiations with wave lengths smaller than 295 nm and greater than 2,500 nm. The samples shall be exposed to an energetic illumination of 1,200 W/m^2 ± 200 W/m^2 for a period such that the luminous energy that they receive is equal to 4,500 MJ/m^2 ± 200 MJ/m^2. Within the enclosure, the temperature measured on the black panel placed on a level with the samples shall be 50 °C ± 5 °C. In order to ensure a regular exposure, the samples shall revolve around the source of radiation at a speed between 1 and 5 1/min.

The samples shall be sprayed with distilled water of conductivity lower than 1 mS/m at a temperature of 23 °C ± 5 °C, in accordance with the following cycle:

spraying: 5 minutes; drying: 25 minutes.

2.2.2. Resistance to chemical agents

After the test described in paragraph 2.2.1. above and the measurement described in paragraph 2.2.3.1. below have been carried out, the outer face of the said three samples shall be treated as described in paragraph 2.2.2.2. with the mixture defined in paragraph 2.2.2.1. below.

2.2.2.1. Test mixture

The test mixture shall be composed of 61.5 per cent n-heptane, 12.5 per cent toluene, 7.5 per cent ethyl tetrachloride, 12.5 per cent trichloroethylene and 6 per cent xylene (volume per cent).

2.2.2.2. Application of the test mixture

Soak a piece of cotton cloth (as per ISO 105) until saturation with the mixture defined in paragraph 2.2.2.1. above and, within 10 seconds, apply it for

10 minutes to the outer face of the sample at a pressure of 50 N/cm^2, corresponding to an effort of 100 N applied on a test surface of 14 x 14 mm.

During this 10-minute period, the cloth pad shall be soaked again with the mixture so that the composition of the liquid applied is continuously identical with that of the test mixture prescribed.

During the period of application, it is permissible to compensate the pressure applied to the sample in order to prevent it from causing cracks.

2.2.2.3. Cleaning

At the end of the application of the test mixture, the samples shall be dried in the open air and then washed with the solution described in paragraph 2.3.1. (Resistance to detergents)

23 °C ± 5 °C.

Afterwards the samples shall be carefully rinsed with distilled water containing not more than 0.2 per cent impurities at 23 °C ± 5 °C and then wiped off with a soft cloth.

2.2.3. Results

2.2.3.1. After the test of resistance to atmospheric agents, the outer face of the samples shall be free from cracks, scratches, chipping and deformation, and the mean variation in transmission $\Delta t = \frac{T_2 - T_3}{T_2}$, measured on the three samples according to the procedure described in Appendix 2 to this annex shall not exceed 0.020 ($\Delta t_m \leq 0.020$).

2.2.3.2. After the test of resistance to chemical agents, the samples shall not bear any traces of chemical staining likely to cause a variation of flux diffusion, whose mean variation $\Delta d = \frac{T_5 - T_4}{T_2}$, measured on the three samples according to the procedure described in Appendix 2 to this annex shall not exceed 0.020 ($\Delta d_m \leq 0.020$).

2.2.4. Resistance to light source radiations

The following test shall be done:

Flat samples of each light transmitting plastic component of the headlamp are exposed to the light of the LED module(s). The parameters such as angles and distances of these samples shall be the same as in the headlamp. These samples shall have the same colour and surface treatment, if any, as the parts of the headlamp.

After 1,500 hours of continuous operation, the colorimetric specifications of the transmitted light must be met, and the surfaces of the samples shall be free of cracks, scratches, scalings or deformation.

2.3. Resistance to detergents and hydrocarbons

2.3.1. Resistance to detergents

The outer face of three samples (lenses or samples of material) shall be heated to 50 °C ± 5 °C and then immersed for five minutes in a mixture

maintained at 23 °C ± 5 °C and composed of 99 parts distilled water containing not more than 0.02 per cent impurities and one part alkylaryl sulphonate.

At the end of the test, the samples shall be dried at 50 °C ± 5 °C. The surface of the samples shall be cleaned with a moist cloth.

2.3.2. Resistance to hydrocarbons

The outer face of these three samples shall then be lightly rubbed for one minute with a cotton cloth soaked in a mixture composed of 70 per cent n-heptane and 30 per cent toluene (volume per cent), and shall then be dried in the open air.

2.3.3. Results

After the above two tests have been performed successively, the mean value of the variation in transmission $\Delta t = \frac{T_2 - T_3}{T_2}$, measured on the three samples according to

The procedure described in Appendix 2 to this annex shall not exceed 0.010 ($\Delta t_m \leq 0.010$).

2.4. Resistance to mechanical deterioration

2.4.1. Mechanical deterioration method

The outer face of the three new samples (lenses) shall be subjected to the uniform mechanical deterioration test by the method described in Appendix 3 to this annex.

2.4.2. Results

After this test, the variations:

in transmission: $\Delta t = \frac{T_2 - T_3}{T_2}$,

and in diffusion: $\Delta t = \frac{T_5 - T_4}{T_2}$,

shall be measured according to the procedure described in Appendix 2 in the area specified in paragraph 2.2.4.1.1. of this Regulation. The mean value of the three samples shall be such that:

$$\Delta t_m \leq 0.100;$$

$$\Delta d_m \leq 0.050.$$

2.5. Test of adherence of coatings, if any

2.5.1. Preparation of the sample

A surface of 20 mm x 20 mm in area of the coating of a lens shall be cut with a razor blade or a needle into a grid of squares approximately 2 mm x 2 mm. The pressure on the blade or needle shall be sufficient to cut at least the coating.

2.5.2. Description of the test

Use an adhesive tape with a force adhesion of 2 N/(cm of width) ±20 per cent measured under the standardized conditions specified in Appendix 4 to this annex. This adhesive tape, which shall be at least 25 mm wide, shall be pressed for at least five minutes to the surface prepared as prescribed in paragraph 2.5.1. above.

Then the end of the adhesive tape shall be loaded in such a way that the force of adhesion to the surface considered is balanced by a force perpendicular to that surface. At this stage, the tape shall be torn off at a constant speed of 1.5 m/s ± 0.2 m/s.

2.5.3. Results

There shall be no appreciable impairment of the gridded area. Impairments at the intersections between squares or at the edges of the cuts shall be permitted, provided that the impaired area does not exceed 15 per cent of the gridded surface.

2.6. Tests of the complete headlamp incorporating a lens of plastic material

2.6.1. Resistance to mechanical deterioration of the lens surface

2.6.1.1. Tests

The lens of lamp sample No. 1 shall be subjected to the test described in paragraph 2.4.1. above.

2.6.1.2. Results

After the test, the results of photometric measurements carried out on the headlamp in accordance with this Regulation shall not exceed by more than 30 per cent the maximum values prescribed at points B 50 L and HV and not be more than 10 per cent below the minimum values prescribed at point 75 R (in the case of headlamps intended for left-hand traffic, the points to be considered are B 50 R, HV and 75 L).

2.6.2. Test of adherence of coatings, if any

The lens of lamp sample No. 2 shall be subjected to the test described in paragraph 2.5. above.

3. Verification of the conformity of production

3.1. With regard to the materials used for the manufacture of lenses, the lamps of a series shall be recognized as complying with this Regulation if:

3.1.1. After the test for resistance to chemical agents and the test for resistance to detergents and hydrocarbons, the outer face of the samples exhibits no cracks, chipping or deformation visible to the naked eye (see paras. 2.2.2., 2.3.1. and 2.3.2. above);

3.1.2. After the test described in paragraph 2.6.1.1. above, the photometric values at the points of measurement considered in paragraph 2.6.1.2. above are within the limits prescribed for conformity of production by this Regulation.

3.2. If the test results fail to satisfy the requirements, the tests shall be repeated on another sample of headlamps selected at random.

Annex 11 - Appendix 1

Chronological order of ~~approval~~ material tests

A. Tests on plastic materials (lenses or samples of material supplied pursuant to paragraph 2.2.4. of this Regulation).

Samples	*Lenses or samples of material*										*Lenses*			
Tests	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.1. Limited photometry (A.6, para. 2.1.2.)											X	X	X	
1.1.1. Temperature change (A.6, para. 2.1.1.)											X	X	X	
1.2. Limited photometry (A.6, para. 2.1.2.)											X	X	X	
1.2.1. Transmission measurement	X	X	X	X	X	X	X	X	X					
1.2.2. Diffusion measurement	X	X	X				X	X	X					
1.3. Atmospheric agents (A.6, para. 2.2.1.)	X	X	X											
1.3.1. Transmission measurement	X	X	X											
1.4. Chemical agents (A.6, para.2.2.2.)	X	X	X											
1.4.1. Diffusion measurements	X	X	X											
1.5. Detergents (A.6, para. 2.3.1.)				X	X	X								
1.6. Hydrocarbons (A.6, para. 2.3.2.)				X	X	X								
1.6.1. Transmission measurement				X	X	X								
1.7. Deterioration (A.6, para. 2.4.1.)							X	X	X					
1.7.1. Transmission measurement							X	X	X					
1.7.2. Diffusion measurement							X	X	X					
1.8. Adherence (A.6, para. 2.5.)														X
1.9 Resistance to light source radiations (A.6, para. 2.2.4.)										X				

Annex 10

Annex 12

Colour fastness to artificial light Xenon-arc lamp test

1. Scope

This annex specifies a method intended for determining the resistance of the colour of test samples of all kinds and in all forms to the action of an artificial light source representative of natural daylight (D65).

2. Principle

A specimen of the test samples to be tested is exposed to artificial light under prescribed conditions, along with a blue wool reference as specified.

3. Reference materials

The colour fastness ratings mentioned in this annex are obtained by comparison unexposed with exposed specified blue wool references for verification of the radiation dose as a required maximum contrast in this Regulation.

3.1. Blue wool references developed and produced in Europe are identified by the numerical designation 1 to 8. These references are blue wool cloths dyed with the dyes listed in table 1. For the test procedure of this Regulation described by this annex only the blue wool references 5 and 7 will be applied as described in Table 1 below.

TABLE 1

DYES FOR BLUE WOOL REFERENCES 5 AND 7

Reference	*Dye (Colour Index designation)* [1]
5	Cl Acid Blue 47
7	Cl Solubilised Vat Blue 5

[1] The Colour Index (third edition) is published by The Society of Dyers and Colourists, P.O. Box 244, Perkin House, 82 Grattan Road, Bradford BD1 2JB, UK, and by The American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709-2215, USA.

4. Grey scale

The grey scale for determining changes in colour of test samples in colour fastness tests. A precise colorimetric specification of the scale is given in Appendix 1 to this annex.

4.1. The use of the scale is described in paragraph 2 of Appendix 1 to this annex.

5. Xenon-arc lamp apparatus

The apparatus shall be either an air-cooled or water-cooled Xenon-arc weathering device capable of exposing samples in accordance with EN ISO 4892-2.

5.1. The exposure conditions shall comply with the specifications in the Table 2 below.

TABLE 2

ARTIFICIAL WEATHERING TEST PARAMETERS

Exposure parameters	*Air–cooled lamp*	*Water–cooled lamp*
Light/dark/water spray cycle	Continuous light without water spray	Continuous light without water spray
Black standard temperature during light only periods	(47 ± 3) °C using a black standard thermometer	(47 ± 3) °C using a black standard thermometer
Relative humidity	Approximately 40 %	Approximately 40 %
Filters	Window glass filters Specifications see paragraph 5.2. below	Window glass filters Specifications see paragraph 5.2. below
		Irradiance (W/m²) controlled at:
Over 300nm to 400nm range	42±2	42±2
Over 300nm to 800nm range	550	630

Note 1: Water used for the specimen spray should contain no more than 1 ppm silica. Higher levels of silica can produce spotting on samples and variability in results. Water of the required purity can be obtained by distillation or by a combination of deionization and reverse osmosis.

Note 2: While irradiance levels should be set at the above levels, variations in filter ages and transmissivity, and in calibration variations, will generally mean that irradiance error will be in the order of ± 10 per cent.

5.2 Light source

The light source shall consist of a xenon arc lamp of correlated colour temperature 5500 K to 6500 K, the size of which will depend on the type of apparatus used. The xenon-arc lamp shall use filters that provide a reasonable simulation of solar radiation filtered by typical window glass. Table 3 gives the relative spectral irradiance requirements for the filtered xenon-arc. It is the responsibility of the supplier of the exposure device to provide necessary certification that the filters that they supply for use in the exposure tests described in this standard meets the requirements of Table 3.

Annex 10

TABLE 3

Relative spectral irradiance requirements for window glass filters [a, b, c, d, e] used for the Xenon-arc devices used in this standard.

Spectral Bandpass Wavelength λ in nm	*Minimum % [c]*	*CIE No.85, Table 4 plus window glass % [d, e]*	*Maximum %[c]*
l < 300			0.29
300 ≤ λ ≤ 320	0.1	≤1	2.8
320 < λ ≤ 360	23.8	33.1	35.5
360 < λ ≤400	62.4	66.0	76.2

[a] Data in Table 3 is the irradiance in the given bandpass expressed as a percentage of the total irradiance from 290 nm to 400 nm. To determine whether a specific filter or set of filters for a xenon-arc meets the requirements of Table 3, the spectral irradiance from 250 nm to 400 nm must be measured. The total irradiance in each wavelength bandpass is then summed and divided by the total irradiance from 290 nm to 400 nm.

[b] The minimum and maximum data in Table 3 are based on more than 30 spectral irradiance measurements for water and air cooled xenon-arcs with window glass filters of various lots and ages. Spectral irradiance data is for filters and xenon-burners within the ageing recommendations of the device manufacturer. As more spectral irradiance data become available, minor changes in the limits are possible. The minimum and maximum data are at least the three sigma limits from the mean for all measurements.

[c] The minimum and maximum columns will not necessarily sum to 100 per cent because they represent the minimum and maximum for the data used. For any individual spectral irradiance, the calculated percentage for the bandpasses in Table 3 will sum to 100 per cent. For any individual xenon-arc lamp with window glass filters, the calculated percentage in each bandpass must fall within the minimum and maximum limits of Table 2. Test results can be expected to differ between exposures using xenon-arc devices in which the spectral irradiance differ by as much as that allowed by the tolerances. Contact the manufacturer of the xenon-arc devices for specific spectral irradiance data for the xenon-arc and filters used.

[d] The data from Table 4 in CIE No. 85 [1] plus window glass was determined by multiplying the CIE No. 85, Table 4 data by the spectral transmittance of 3 mm thick window glass (see ISO 11341 [2]). These data are target values for xenon-arc with window glass filters.

[e] For the CIE 85 Table 4 plus window glass, the UV irradiance from 300 nm to 400 nm is typically about 9 per cent and the visible irradiance (400 nm to 800 nm) is typically about 91 per cent when expressed as a percentage of the total irradiance from 300 nm to 800 nm. The percentages of UV and visible irradiances on samples exposed in xenon arc devices may vary due to the number and reflectance properties of specimens being exposed.

5.3. Light exposure equivalents for blue wool light fastness references for exposure by a Xenon-arc lamp

TABLE 4

BLUE WOOL REFERENCE

Blue wool reference		*420nm*	*300 nm–400 nm*
No.		kj/m²	kj/m²
5	L6	340	13824
7	L8	1360	55296
For colour change of step 4 on the grey scale			

6. Procedure (blue wool references)

6.1 Place the test samples mounted on the holders in the apparatus and expose them continuously to weathering following the method described below.

6.2 At the same time expose the blue wool references mounted on card-board, cover one-third of each.

6.3 Only one side of the test samples shall be exposed to weathering and light.

6.4 While the specimens are drying, the air in the test chamber shall not be moistened.

Note: The actual conditions of the weathering test depend on the kind of test apparatus used.

6.5. Before mounting the tested specimens for assessment, dry them in air at a temperature not exceeding 60°C.

6.6. Trim and mount the exposed blue wool reference so that they measure at least 15 mm x 30 mm, one on each side of a portion of the original which has been trimmed to the same size and shape as the specimens.

6.7. Unexposed samples of original fabric identical to those being tested are required as references for comparison with the specimens during weathering.

Annex 12 - Appendix 1

Definition of the Grey Scale

This section describes the grey scale for determining changes in colour of test samples in colour fastness tests, and its use. A precise colorimetric specification of the scale is given as a permanent record against which newly prepared working standards and standards that may have changed can be compared.

1. The essential, or 5-step, scale consists of five pairs of non-glossy grey colour chips (or swatches of grey cloth), which illustrate the perceived colour differences corresponding to fastness ratings 5, 4, 3, 2 and 1. This essential scale may be augmented by the provision of similar chips or swatches illustrating the perceived colour differences corresponding to the half-step

fastness ratings 4-5, 3-4, 2-3 and 1-2, such scales being termed 9-step scales. The first member of each pair is neutral grey in colour and the second member of the pair illustrating fastness rating 5 is identical with the first member. The second members of the remaining pairs are increasingly lighter in colour so that each pair illustrates increasing contrasts or perceived colour differences which are defined colorimetrically. The full colorimetric specification is given below:

1.1. The chips or swatches shall be neutral grey in colour and shall be measured with a spectrophotometer with the specular component included. The colorimetric data shall be calculated using CIE standard colorimetric system for Illuminant D65;

1.2. The Y tristimulus value of the first member of each pair shall be 12 ± 1;

1.3. The second member of each pair shall be such that the colour difference between it and the adjacent first member is as follows.

TABLE 1

CIELAB DIFFERENCE IN RELATION TO THE FASTNESS GRADE

Fastness grade	*CIELab difference*	*Tolerance*
5	0	0.2
(4-5)	0.8	±0.2
4	1.7	±0.3
(3-4)	2.5	± 0.35
3	3,4	±0.4
(2-3)	4.8	±0.5
2	6.8	±0.6
(1-2)	9.6	±0.7
1	13.6	±1.0

Fastness grade	*CIELab difference*	*Tolerance*

Note 1: Bracketed values apply only to the 9-step scale.

Note 2: Use of the scale:

Place a piece of the original blue reference and the exposed specimen of it side by side in the same plane and oriented in the same direction. Place the grey scale nearby in the same plane. The surrounding field should be neutral grey colour approximately midway between that illustrating grade 1 and that illustrating grade 2 of the grey scale for assessing change in colour (this is approximately Munsell N5). Illuminate the surfaces with north sky light in the Northern hemisphere, south sky light in the Southern hemisphere, or an equivalent source with an illumination of 600 lx or more. The light should be incident upon the surfaces at approximately 45°, and the direction of viewing approximately perpendicular to the plane of the surfaces. Compare the visual difference between original and exposed blue standard with the differences represented by the grey scale.

If the 5-step scale is used, the fairness rating of the specimen is that number of the grey scale which has a perceived colour difference equal in magnitude to the perceived colour difference between the original and the treated specimens; if the latter is judged to be nearer the imaginary contrast lying midway between two adjacent pairs than it is to either, the specimen is given an intermediate assessment, for example 4-5 or 2-3. A rating of 5 is given only when there is no perceived difference between the tested specimen and the original material.

If the 9-step scale is used, the fastness rating of the specimen is that number of the grey scale which has a perceived colour difference nearest in magnitude to the perceived colour difference between the original and the tested specimens. A rating of 5 is given only when there is no perceived difference between the tested specimen and the original material.

Insert a new Annex 10, to read:

"**Annex 12 - Appendix 2**

Description of the measurement geometry for measurement of the colour and the luminance factor of fluorescent retro-reflective materials

Micro-prismatic materials show the phenomenon of 'flares' or 'sparkles' (Note 1), which might influence the measured results unless special precautions are taken. A reference method, using the wider apertures of the CIE 45°a:0° (or 0°:45°a) geometry is introduced in paragraph 12. of Annex 5 to this regulation.

Ideally, the measurements shall be made using the CIE 45°a:0° (or 0°:45°a), called the forty-five annular / normal geometry (or the normal/ forty-five annular geometry) defined in CIE 15 (see paragraph 12. of Annex 5.) The measurement area shall be minimum 4.0 cm².

For this geometry CIE 15 recommends that:

(a) The sampling aperture be irradiated uniformly from all directions between two circular cones with their axes normal to the sampling aperture and apices at the centre of the sampling aperture, the smaller of the cones having a half angle of 40° and the larger of 50;°

(b) The receiver uniformly collects and evaluates all radiation reflected within a cone with its axis on the normal to the sampling aperture, apex at the centre of the sampling aperture, and a half angle of 5°.

The annular geometry can be approximated by the use of a number of light sources in a ring or a number of fibre bundles illuminated by a single source and terminated in a ring to obtain the CIE 45°c:0° (circumferential / normal geometry) (Note 2, Note 3).

An alternative manner of approximation is to use a single light source, but rotate the sample during measurement with a rotational speed that ensures that a number of revolutions takes place during the exposure time interval for a measurement so that all wavelengths are given equal weight (Note 2, Note 3).

In addition, the apertures of the light source and the receiver shall have sufficient dimensions in proportion to distances to ensure a reasonable compliance with the above-mentioned recommendations.

Note 1 'Flares' or 'sparkles' are caused by characteristic paths of rays that enter and leave the sheeting surface at different angles. A characteristic path will dominate by raising the luminance factor value significantly and possibly distorting the chromaticity co-ordinates if it is included within narrow beams of illumination and measurement. However, the average contribution to the daylight reflection is normally small.

Note 2 In practice the recommendations can be approximated only. The important issue is that the annular principle is applied and that illumination and collection occur in directions forming fairly large solid angles, as this will reduce the influence of the above-mentioned ‘sparkles’ of micro-prismatic materials and of other variations with the precise geometry shown by some of these materials.

Note 3 In spite of such precautions, the practical difficulties of establishing the annular geometry in accordance with the recommendations introduce uncertainty of measurement."

Annex 13

Reserved

Annex 14

Requirements for LED modules and headlamps including LED modules

1. General specifications

1.1. Each LED module sample submitted shall conform to the relevant specifications of this Regulation when tested with the supplied electronic light source control-gear(s), if any.

1.2. LED module(s) 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. A LED module shall be considered to have failed if any one of its LEDs has failed.

1.3. LED module(s) shall be tamperproof.

1.4. The design of removable LED module(s) shall be such that:

1.4.1. When the LED module is removed and replaced by another module provided by the applicant and bearing the same light source module identification code, the photometric specifications of the headlamp shall be met;

1.4.2. LED modules with different light source module identification codes within the same lamp housing, shall not be interchangeable.

2. Manufacture

2.1. The LED(s) on the LED module shall be equipped with suitable fixation elements.

2.2. The fixation elements shall be strong and firmly secured to the LED(s) and the LED module.

3. Test conditions

3.1. Application

3.1.1. All samples shall be tested as specified in paragraph 4. below.

3.1.2. The kind of light sources on a LED module shall be light-emitting diodes (LED) as defined in Regulation No. 48 paragraph 2.7.1. in particular with regard to the element of visible radiation. Other kinds of light sources are not permitted.

3.2. Operating conditions

3.2.1. LED module operating conditions

All samples shall be tested under the conditions as specified in paragraphs 6.1.4. and 6.1.5. of this Regulation. If not specified differently in this annex LED modules shall be tested inside the headlamp as submitted by the manufacturer.

3.2.2. Ambient temperature

For the measurement of electrical and photometric characteristics, the headlamp shall be operated in a dry and still atmosphere at an ambient temperature of 23 °C ± 5 °C.

3.3. Ageing

Upon the request of the applicant the LED module shall be operated for 15 h and cooled down to ambient temperature before starting the tests as specified in this Regulation.

4. Specific requirements and tests

4.1. Colour rendering

4.1.1. Red content

In addition to measurements as described in paragraph 7. of this Regulation:

The minimum red content of the light of a LED module or headlamp incorporating LED module(s) tested at 50 V shall be such that:

$$k_{red} = \frac{\int_{\lambda=610\,nm}^{780\,nm} E_e(\lambda)\,V(\lambda)\,d\lambda}{\int_{\lambda=380\,nm}^{780\,nm} E_e(\lambda)\,V(\lambda)\,d\lambda} \geq 0.05$$

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.

4.2. UV-radiation

The UV-radiation of a low-UV-type LED module shall be such that:

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

where:

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

k_m = 683 lm/W is the maximum value of the luminous efficacy of radiation.

(For definitions of the other symbols see paragraph 4.1.1. 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 UV below:

TABLE UV

VALUES ACCORDING TO "IRPA/INIRC GUIDELINES ON LIMITS OF EXPOSURE TO ULTRAVIOLET RADIATION". WAVELENGTHS (IN NANOMETRES) CHOSEN ARE REPRESENTATIVE; OTHER VALUES SHOULD BE INTERPOLATED.

λ	$S(\lambda)$	λ	$S(\lambda)$	λ	$S(\lambda)$
250	0.430	305	0.060	355	0.000 16
255	0.520	310	0.015	360	0.000 13
260	0.650	315	0.003	365	0.000 11
265	0.810	320	0.001	370	0.000 09
270	1.000	325	0.000 50	375	0.000 077
275	0.960	330	0.000 41	380	0.000 064
280	0.880	335	0.000 34	385	0.000 053
285	0.770	340	0.000 28	390	0.000 044
290	0.640	345	0.000 24	395	0.000 036
295	0.540	350	0.000 20	400	0.000 030
300	0.300				

4.3. Temperature stability

4.3.1. Illuminance

4.3.1.1. A photometric measurement of the headlamp shall be made after 1 minute of operation for the specific function at the test point specified below. For these measurements, the aim can be approximate but must be maintained for before and after ratio measurements.

Test points to be measured:

Passing-beam 50 V

Driving-beam H – V

4.3.1.2. The lamp shall continue operation until photometric stability has occurred. The moment at which the photometry is stable is defined as the point in time at which the variation of the photometric value is less than 3 per cent within any 15 minutes period. After stability has occurred, aim for complete photometry shall be performed in accordance with the requirements of the specific device. Photometer the lamp at all test points required for the specific device.

4.3.1.3. Calculate the ratio between the photometric test point value determined in paragraph 4.3.1.1. above and the point value determined in paragraph 4.3.1.2. above.

4.3.1.4. Once stability of photometry has been achieved, apply the ratio calculated above to each of the remainder of the test points to create a new photometric table that describes the complete photometry based on one minute of operation.

4.3.1.5. The luminous intensity values, measured after one minute and after photometric stability has occurred, shall comply with the minimum and maximum requirements.

4.3.2. Colour

The colour of the light emitted measured after one minute and measured after photometric stability has been obtained, as described in paragraph 4.3.1.2. of this annex, shall both be within the required colour boundaries.

5. The measurement of the objective luminous flux of LED module(s) producing the principal passing-beam shall be carried out as follows:

5.1. The LED module(s) shall be in the configuration as described in the technical specification as defined in paragraph 2.2.2. of this Regulation. Optical elements (secondary optics) shall be removed by the Technical Service at the request of the applicant by the use of tools. This procedure and the conditions during the measurements as described below shall be described in the test report.

5.2. Three LED modules of each type shall be submitted by the applicant with the light source control gear, if applicable, and sufficient instructions.

Suitable thermal management (e.g. heat sink) may be provided, to simulate similar thermal conditions as in the corresponding headlamp application.

Before the test each LED module shall be aged at least for seventy-two hours under the same conditions as in the corresponding headlamp application.

In the case of use of an integrating sphere, the sphere shall have a minimum diameter of one meter, and at least ten times the maximum dimension of the LED module, whichever is the largest. The flux measurements can also be performed by integration using a goniophotometer. The prescriptions in CIE - Publication 84 - 1989, regarding the room temperature, positioning, etc., shall be taken into consideration.

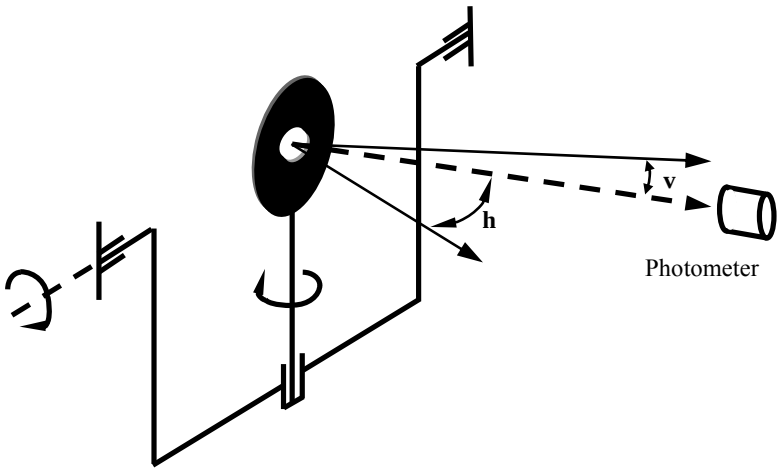
The LED module shall be burned in for approximately one hour in the closed sphere or goniophotometer.

The flux shall be measured after stability has occurred, as explained in paragraph 4.3.1.2. of this annex to this Regulation.

The average of the measurements of the three samples of each type of LED module shall be deemed to be its objective luminous flux.

"**Annex 15**

Gonio(photo)meter system used for the photometric measurements as defined in paragraph 2.13. of this Horizontal Reference Document



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