SLR-64-08/Rev.1

New technology and EPLLA

(Effective Projected Luminous Lens Area
in absence of a lens involved in optical design, it could be also called
Effective Projected Luminous Lamp Area)

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Sketches of various representations of EPLLA were provided by Larry Rice and Monty Foust and were used in presentation by
Richard L. Van Iderstine - Chairman, SAE Measuring Luminous Area Task Force - Scottsdale, AZ, Spring 2008

Some material was paraphrased form a presentation to UN-GRE-SLR by Michael Larsen - SAE Chair for SAE J2999™ EPLLA

What is EPLLA for?

Original intent of the regulation

830638

History of Lighting Test Development

George E. Meese
In Cooperation with the SAE Lighting Committee

Glare considerations at various times in the past have also prompted consideration of minimum effective lens areas to keep intrinsic brightness within reason.

- Lit Area (EPLLA) was put in place in the early 1970s to control glare complaints
  - The theory being that diluting the lens luminance over a larger area to fulfill a lamp function will result in less perceived glare

FMVSS 108 (TSD 108)

From FMVSS 108 Definitions:

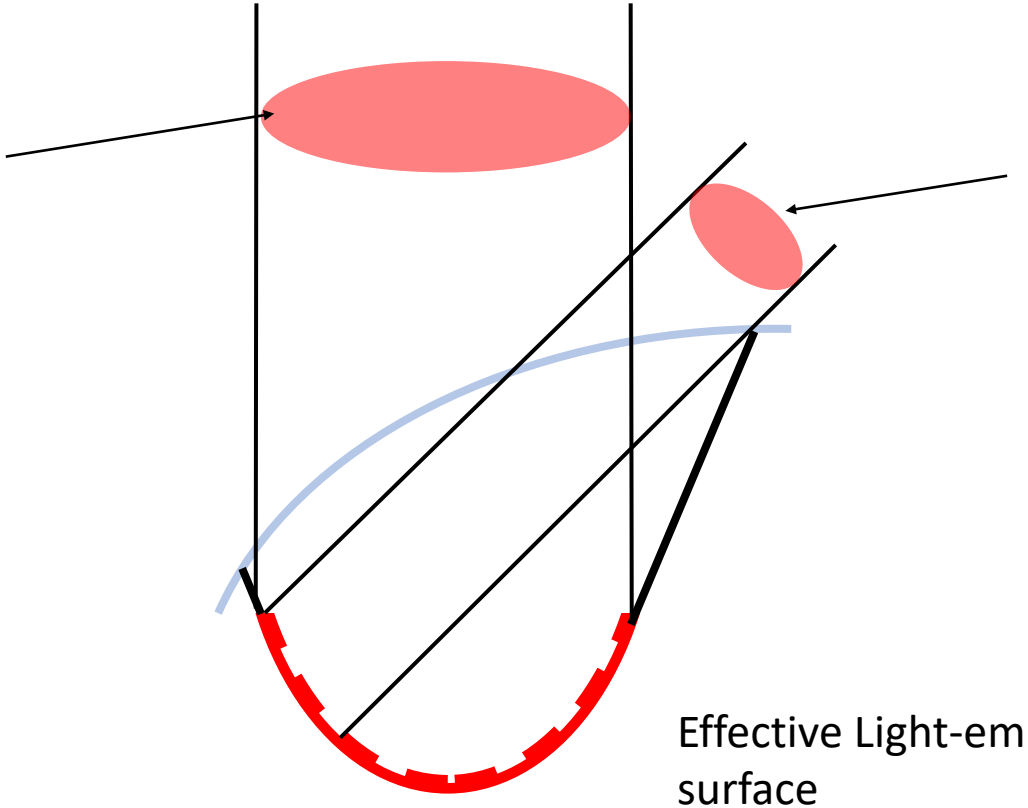
Effective light-emitting surface means that portion of a lamp that directs light to the photometric test pattern, and does not include transparent lenses, mounting hole bosses, reflex reflector area, beads or rims that may glow or produce small areas of increased intensity as a result of uncontrolled light from an area of ½° radius around a test point.

Effective projected luminous lens area (EPLLA) means the area of the orthogonal projection of the **effective light-emitting surface** of a lamp on a plane perpendicular to a defined direction relative to the axis of reference. Unless otherwise specified, the direction is coincident with the axis of reference.

Reflector Optics

Unobstructed
Effective Projected Luminous
Lens Area

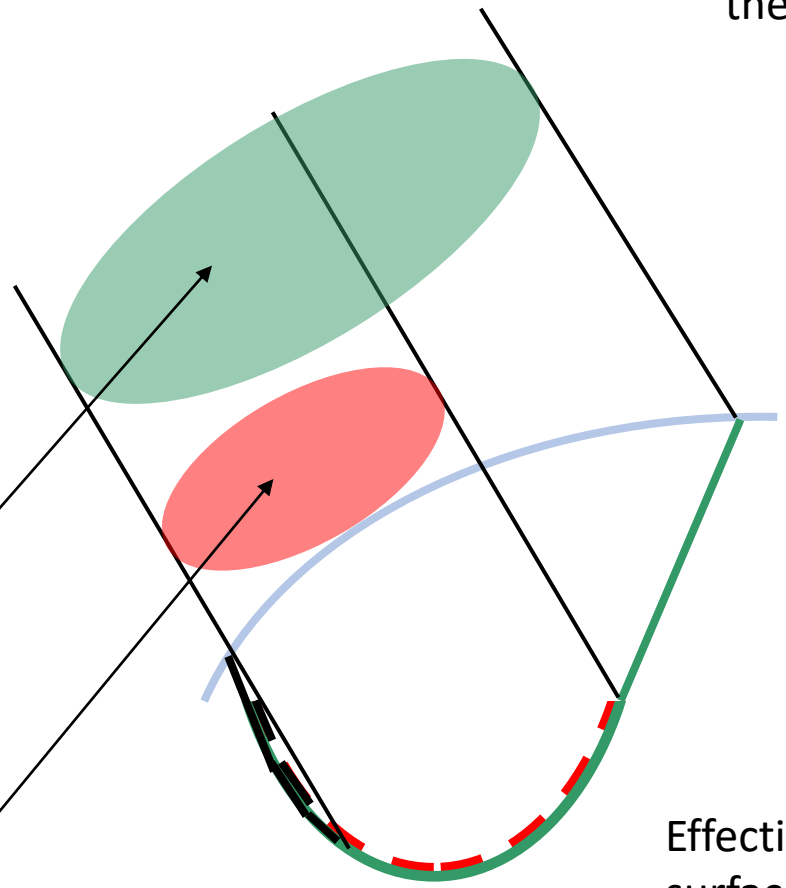
Orthogonally projected in
the **HV direction**



Orthogonally projected in
the **defined direction**

Effective Light-emitting
surface

Reflector Optics



Orthogonally projected in the defined direction

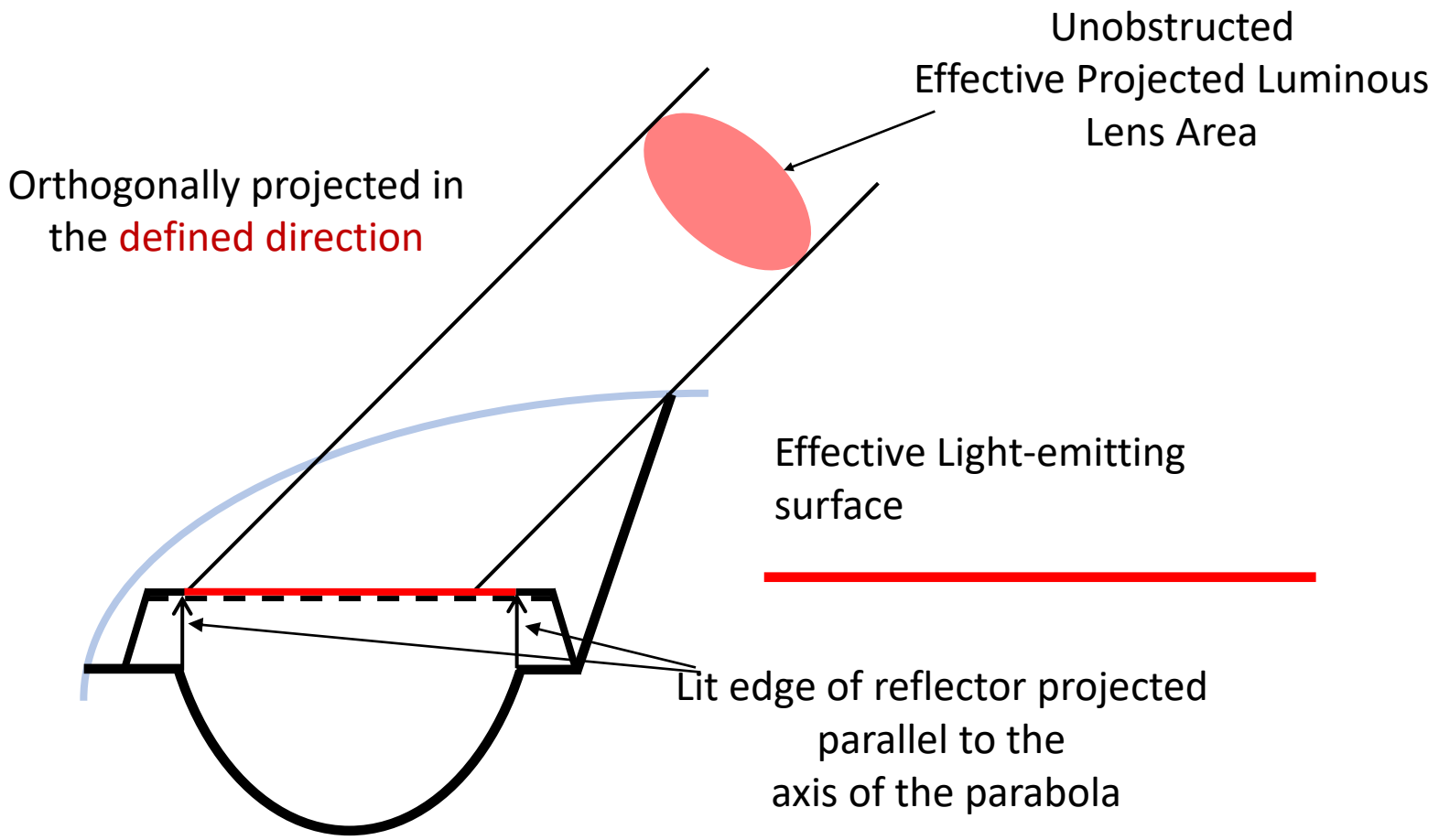
Unobstructed Effective Projected Luminous Lens Area

Maybe if far wall directs light to the photometric test pattern.

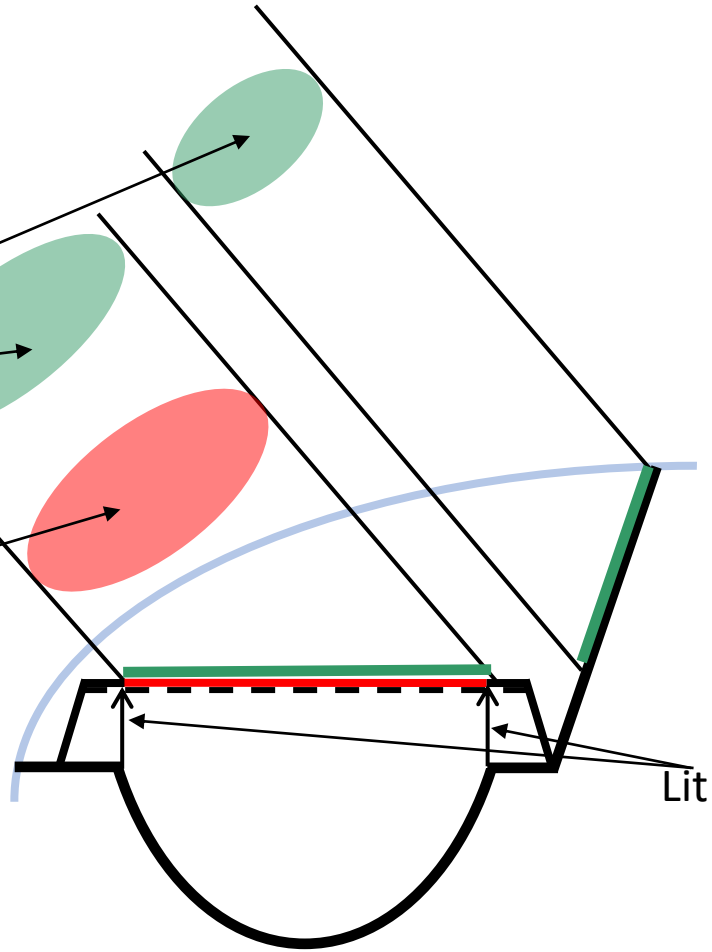
Maybe if far wall is not reflective.

Effective Light-emitting surface

Inner Lens Optics



Inner Lens Optics



Unobstructed Effective Projected Luminous Lens Area:

- if far wall directs light to the photometric test pattern.

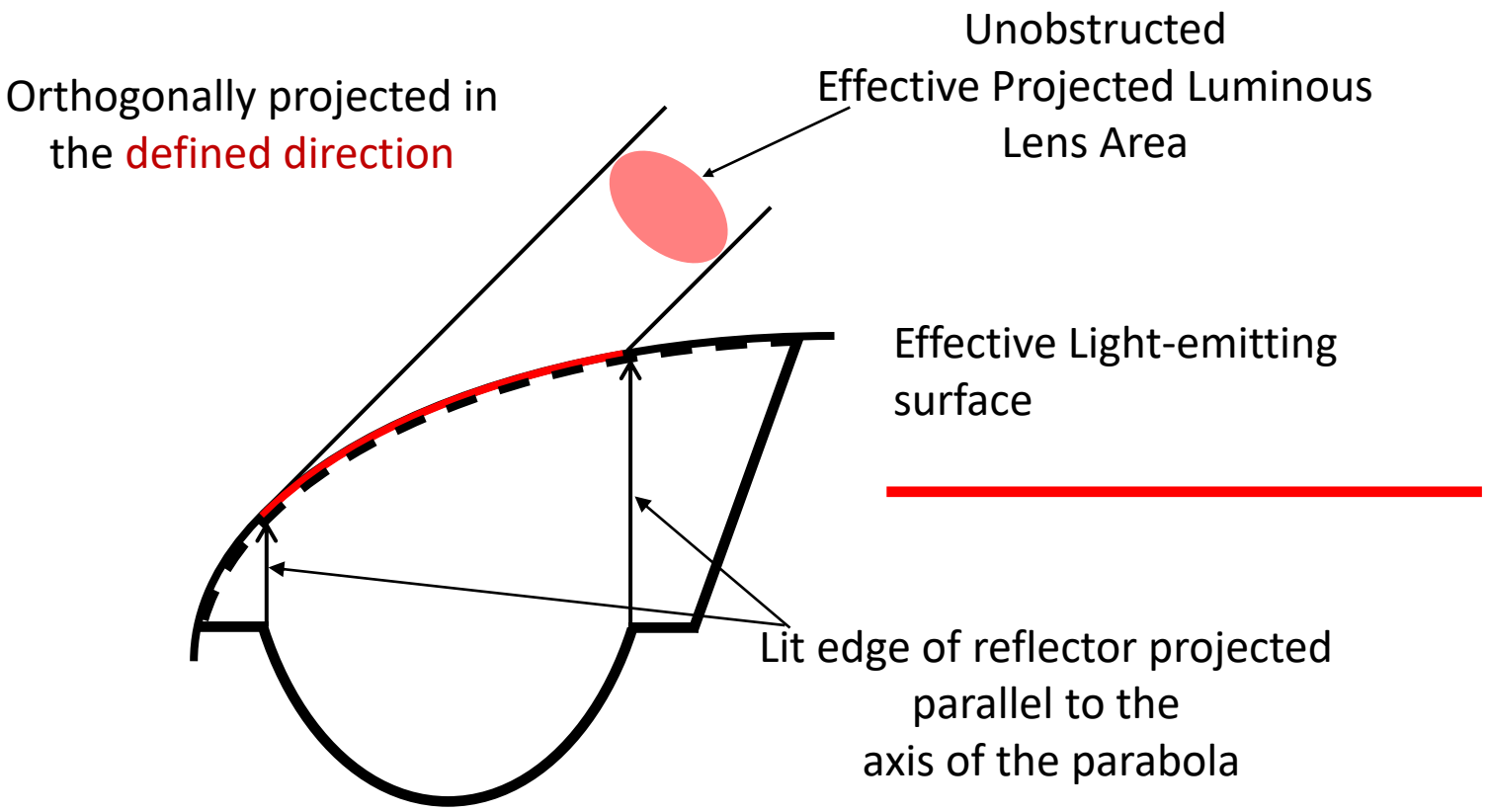
- if far wall is not reflective.

Orthogonally projected in the defined direction

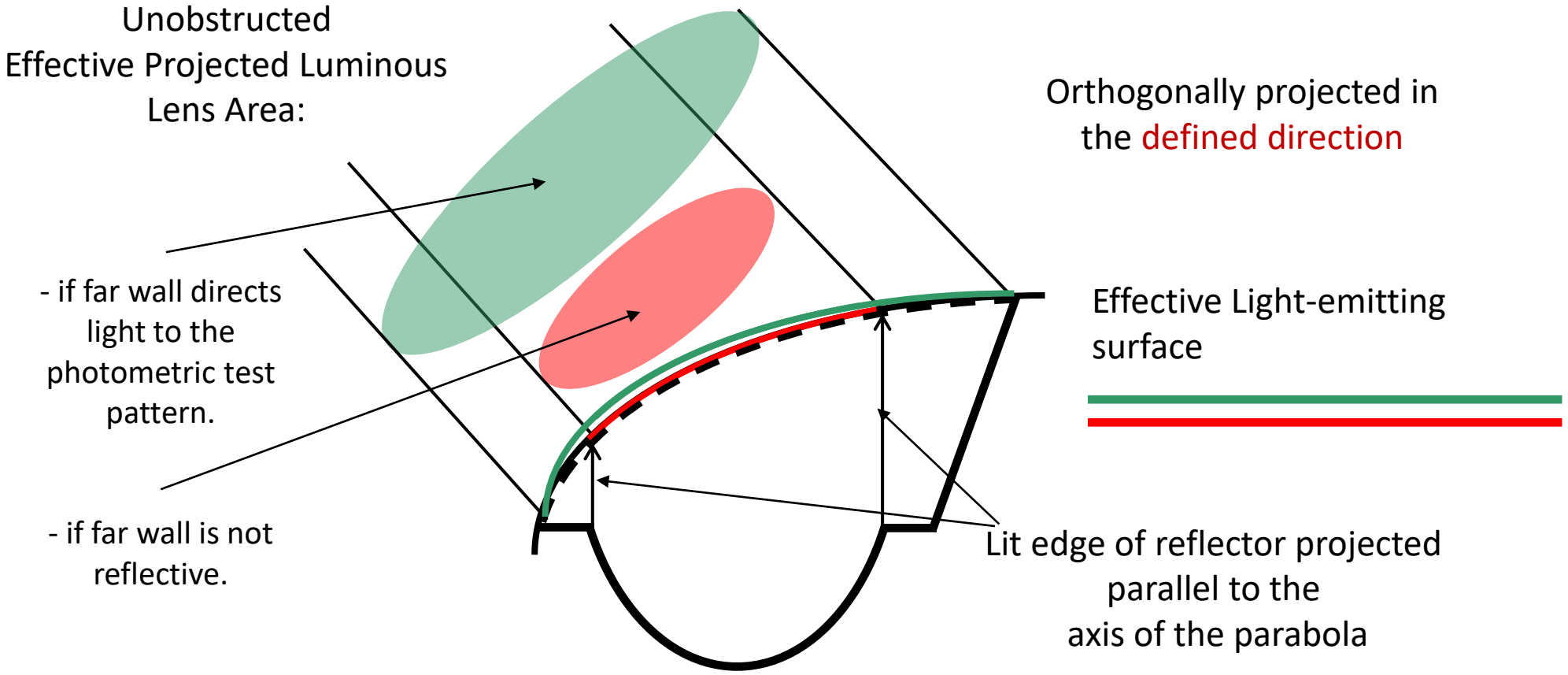
Effective Light-emitting surface

Lit edge of reflector projected down the axis of the parabola

Outer Lens Optics



Outer Lens Optics



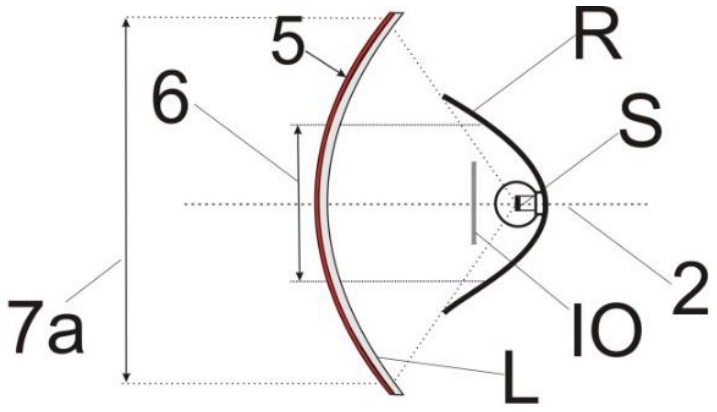
How to measure EPLLA (USA and Canada)

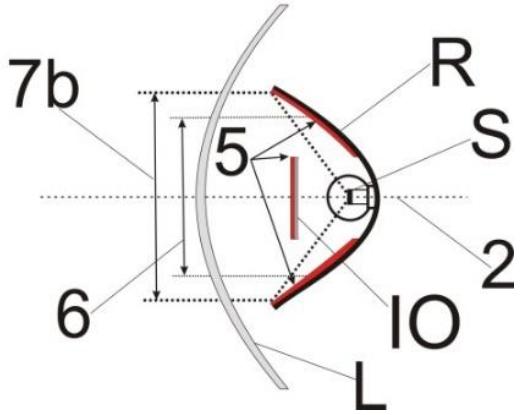
- New technologies enable lamp configurations not foreseen back in 1970 when EPLLA was defined (*LEDs, LED control, OLEDs, light pipes, light guides, …*)
  - Imaginative interpretations for how EPLLA is measured in new designs are causing concerns for - industry - SAE, GTB and governments - NHTSA / Transport Canada / and recently @ UN-ECE
- SAE attempted to develop a Recommended Practice to measure EPLLA
- SAE J2999™ "Determination of Effective Projected Luminous Lens Area (EPLLA) by Design Analysis" - published in 2013 to guide how EPLLA is determined
  - EPLLA is determined similarly to apparent surface in UN R48
  - During the development of J2999™, there was very little disagreement between automakers for what elements should and should not be counted towards lit area
  - J2999™ method enables manufacturers to measure EPLLA prior to production tooling
- SAE J3333 "Determination of the Effective Projected Luminous Lens Area (EPLLA) by Measurement" - attempt failed
  - Industry concerned about the ability to predict production lamp's measured luminance

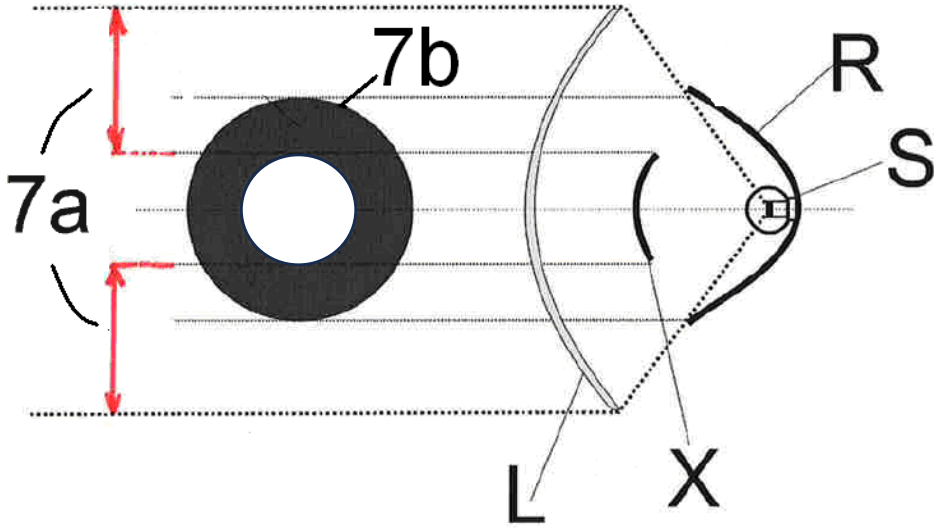
UN Regulation 48

1. Illuminating surface
2. Axis of reference
3. Centre of reference
4. Angle of geometric visibility
5. **Light-emitting surface**
6. Apparent surface based on the illuminating surface
7. **Apparent surface based on the light-emitting surface according to paragraph 2.10.2. (a) (with outer lens)**
8. **Apparent surface based on the light-emitting surface according to paragraph 2.10.2. (b) (without outer lens)**
9. Direction of visibility

IO	Inner optical part
LG	Light guide
L	Outer lens
R	Reflector
S	Light source
X	Not part of this function
F1	Function one
F2	Function two

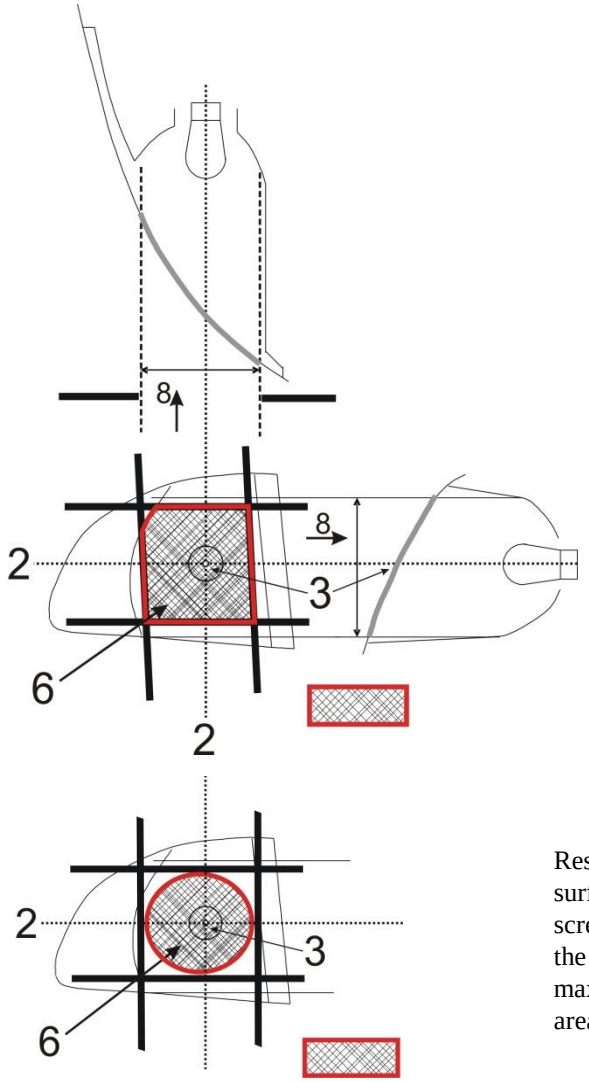






Drawings from Annex 3

UN Regulation 48



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

Drawings from Annex 3

1. Illuminating surface
2. Axis of reference
3. Centre of reference
4. Angle of geometric visibility
5. Light-emitting surface
6. **Apparent surface based on the illuminating surface**

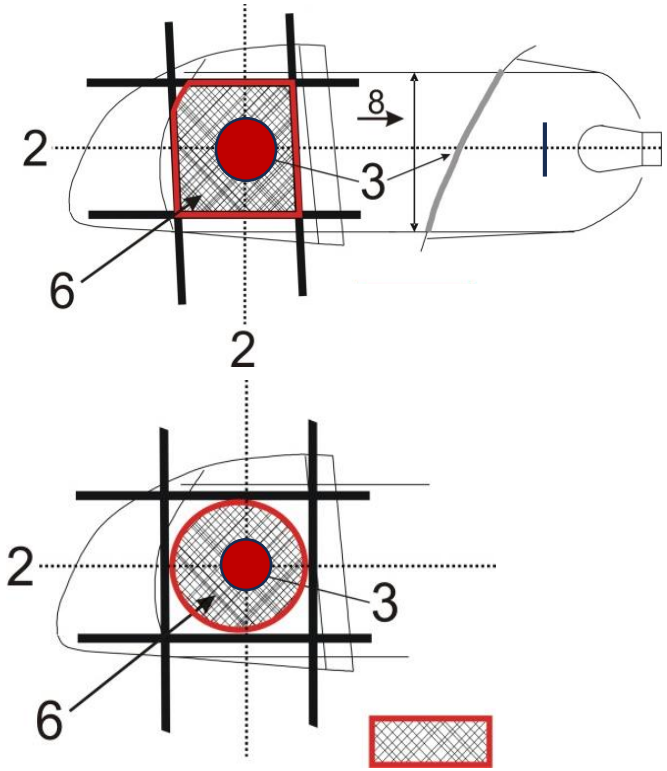
7a. Apparent surface based on the light-emitting surface according to paragraph 2.10.2. (a) (with outer lens)

7b. Apparent surface based on the light-emitting surface according to paragraph 2.10.2. (b) (without outer lens)

8. Direction of visibility

IO	Inner optical part
LG	Light guide
L	Outer lens
R	Reflector
S	Light source
X	Not part of this function
F1	Function one
F2	Function two

?



Observations:

- UN R48 **apparent surface** based on light emitting surface per para. 2.10.2
  - Equivalent to the FMVSS 108 **effective projected luminous lens (*lamp*) area (EPLLA)**
  - SAE J2999 could be used to determine the **apparent surface** based on light emitting surface
  - Apparent surface/EPLLA may be determined at lamp design stage

- UN R48 **apparent surface** based on illuminating surface
  - **Apparent surface** may be defined only for an existing (manufactured) lamp
  - If finished, SAE J3333 could be useful to determine **apparent surface** based on illuminating surface
  - Not very useful method for lamp manufacturers

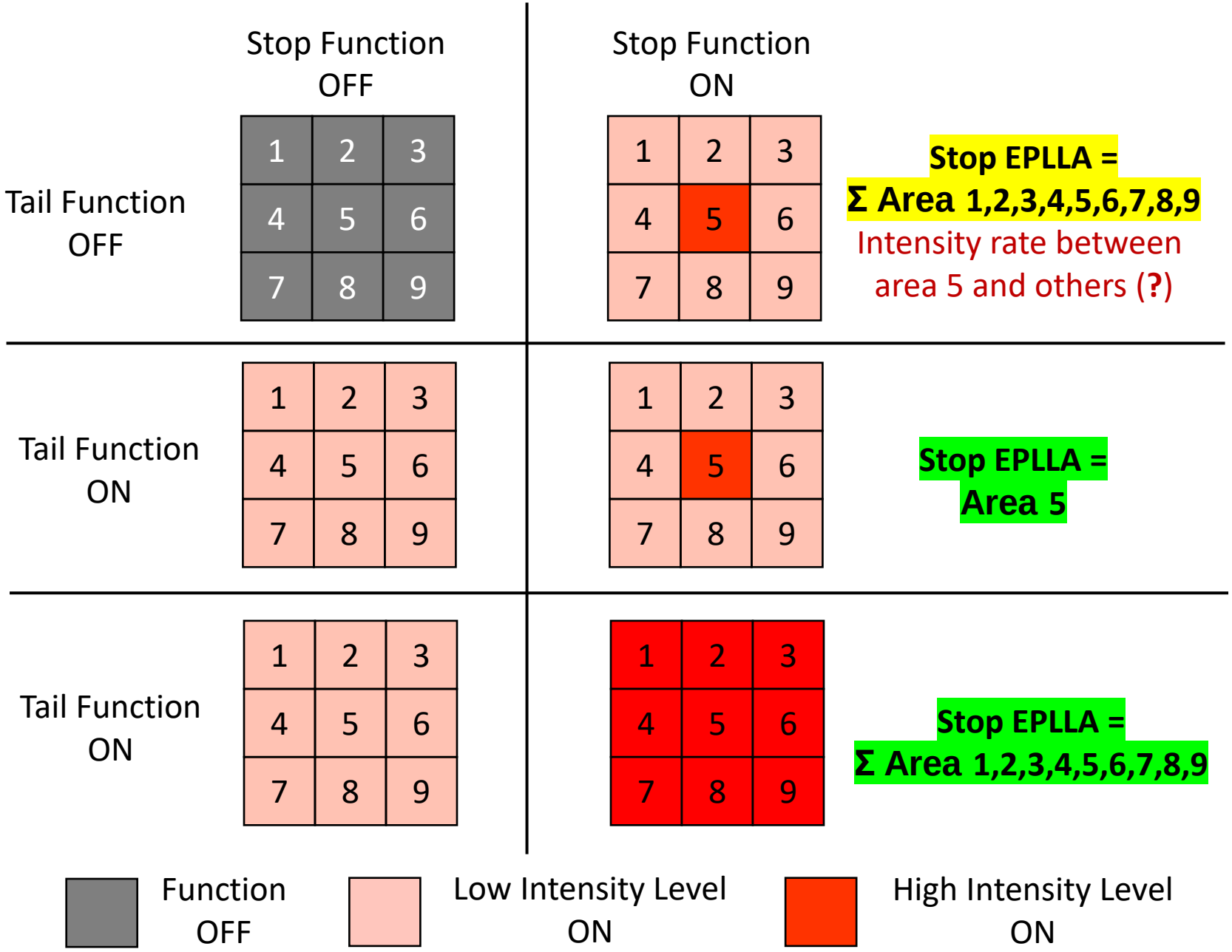
Suggestion:

- Establish a clear definition of **light-emitting-surface/luminous-area** providing a **light function**
- It is imperative that this surface/area can be determined at the **light function's** design stage

EPLLA CHALLENGE

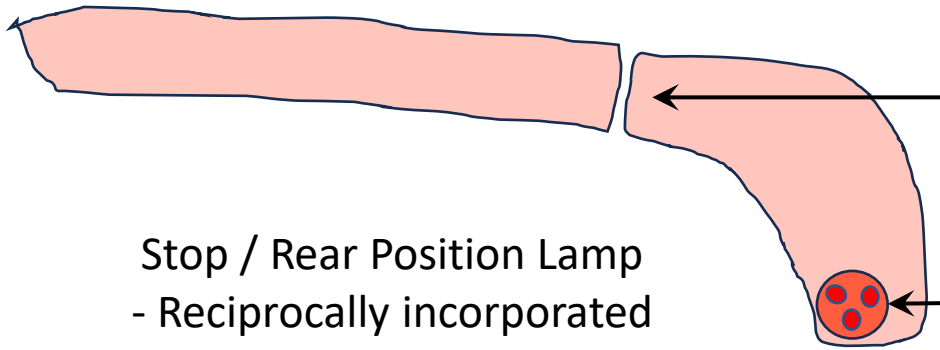
created by modern technology

(glare, understanding of the signal or both)


Stop Function OFF
Stop Function ON
Tail Function OFF
Tail Function ON
Tail Function ON
1 2 3
4 5 6
7 8 9
Stop EPLLA = Σ Area 1,2,3,4,5,6,7,8,9
Intensity rate between area 5 and others (?)
Stop EPLLA = Area 5
Stop EPLLA = Σ Area 1,2,3,4,5,6,7,8,9
Function OFF
Low Intensity Level ON
High Intensity Level ON

What is possible (and done) today …
… and what EPLLA was intended to prevent

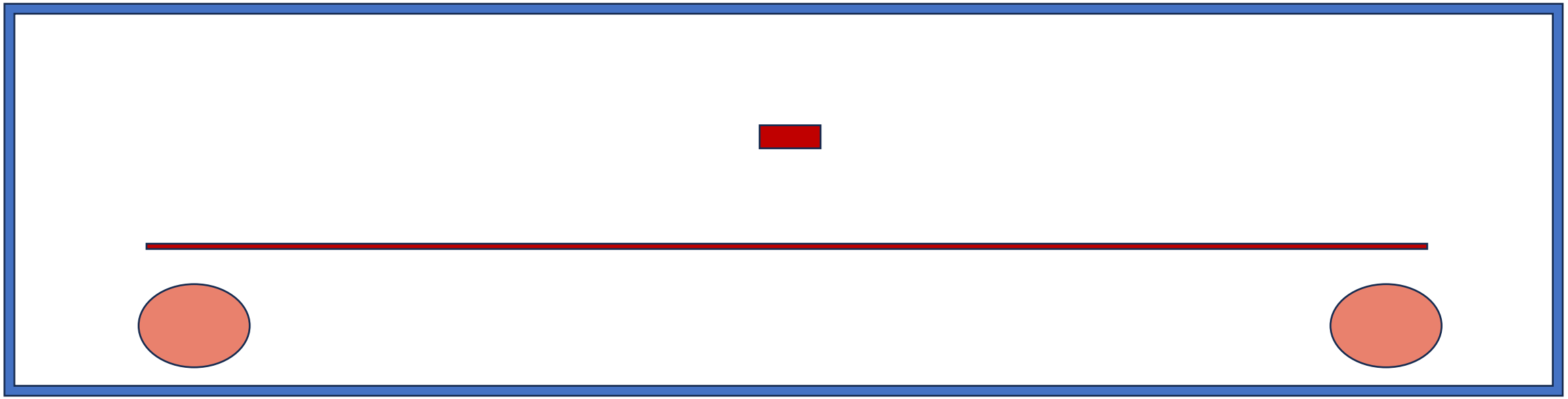
Luminous area size



UN R48 – a solution to contemplate

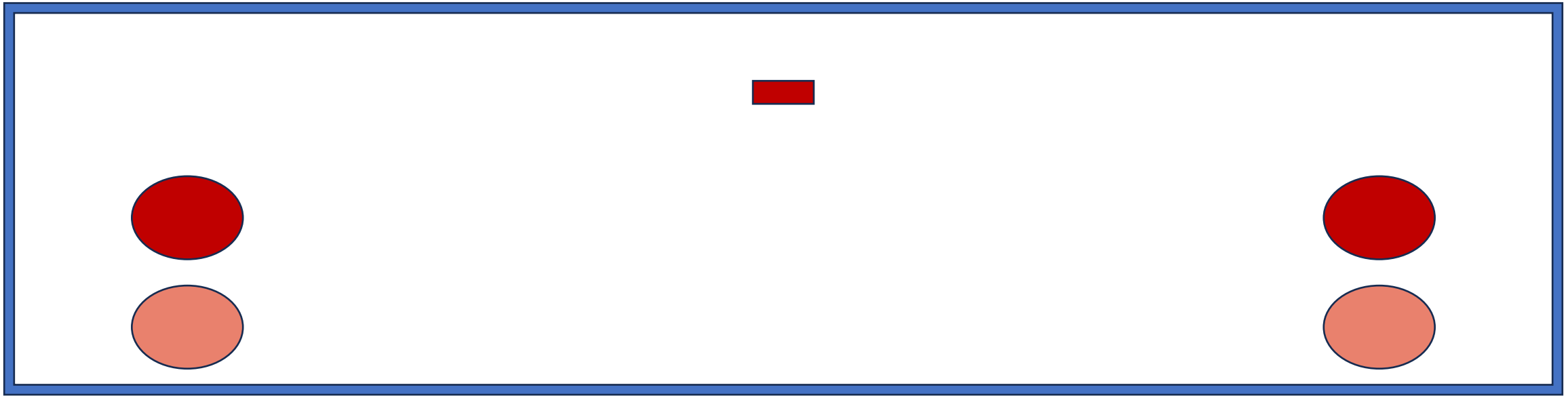
5.x.y.z. The light signalling device shall be designed in such a way that the luminous area(s) producing a light function is uniformly lit (illuminated). This requirement is deemed satisfied if the difference (ratio) between the brightest and darkest area (pixel) of [5cm^2] is not more than [25%].

Where the illumination of the apparent surface is clearly uniform the exact ratios need not be determined.



Stop signal

Luminous area shape



Thank you for your attention

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FMVSS 108 (TSD 108)

Table IV-a—Effective Projected Luminous Lens Area Requirements

Lighting device	Passenger cars, multipurpose passenger vehicles, trucks, trailers, and buses of less than 2032 mm in overall width minimum effective projected luminous lens area (sq mm)			Multipurpose passenger vehicles, trucks, trailers, and buses 2032 mm or more in overall width minimum effective projected luminous lens area each lamp (sq mm)	Motorcycles minimum effective projected luminous lens area (sq mm)	
	Single compartment lamp	Multiple compartment lamp or multiple lamps			Multiple compartment lamp or multiple lamps	
		Each compartment or lamp	Combined compartments or lamps		Each compartment or lamp	Single or combined compartments or lamps
Front turn signal lamp	2200		2200	7500	2200	2258
Rear turn signal lamp	5000	2200	5000	7500	2200	2258
Stop lamp	5000	2200	5000	7500	2200	[1]5000

Table IV-b—Effective Projected Luminous Lens Area Requirements

Lighting device	Passenger cars, multipurpose passenger vehicles, trucks, and buses of less than 2032 mm in overall width and with a GVWR of 10,000 lbs or less using a single lamp minimum effective projected luminous lens area (sq mm)	Multipurpose passenger vehicles, trucks, and buses of less than 2032 mm in overall width and with a GVWR of 10,000 lbs or less using dual lamps of identical size and shape minimum effective projected luminous lens area each lamp (sq mm)
High-mounted stop lamp	2903	1452

Table IV-c—Effective Projected Luminous Lens Area Requirements

Lighting device	School bus minimum effective projected luminous lens area each lamp (sq mm)
School bus signal lamp	12,258

UN Regulation 48

2.10.2. "*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 3 (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 3 (see e.g. Part 5).

UN Regulation 48

2.10.3.2."*Illuminating surface of a light-signalling device other than a retro-reflector*" (paragraphs 2.5.3. to 2.5.7., 2.6.1., 2.5.11. and 2.5.13. to 2.5.16.) 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 3, Parts 2, 3, 5 and 6).

UN Regulation 48

2.10.4 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 2.9.3. 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 3 to this Regulation.