GRE TF S/R – 17th meeting

Summary of demonstration in laboratory

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Aachen, 15-June 2023

Introduction and Overview

- This laboratory demo was intended to support the discussion in TF S/R
- Context: relation between light source details and low-beam reflector
- STEP 1: Basic principles of headlamps
  Standard reflector → pin hole → filament image on screen → correlation between different reflector segments and the light distribution
- STEP 2a: Type-approved headlamps with type-approved light sources
  Compare different H7 filament light source types in same R112 headlamp
- STEP 2b: Type-approved headlamps with type-approved light sources
  Compare same H7 filament light source in different R112 headlamp types
- STEP 2c: Type-approved headlamps with type-approved light sources
  Compare R112 headlamp type with H7 filament and R112 headlamp type with non-repl. OEM-LED
- STEP 3: 2-sided LEDr designs
  Compare – in different headlamp types – H7 filament with nationally approved LEDr (“2-sided design”)

STEP 1
STEP 2a
2b
2c
STEP 3

STEP 1

STEP 2a

2b

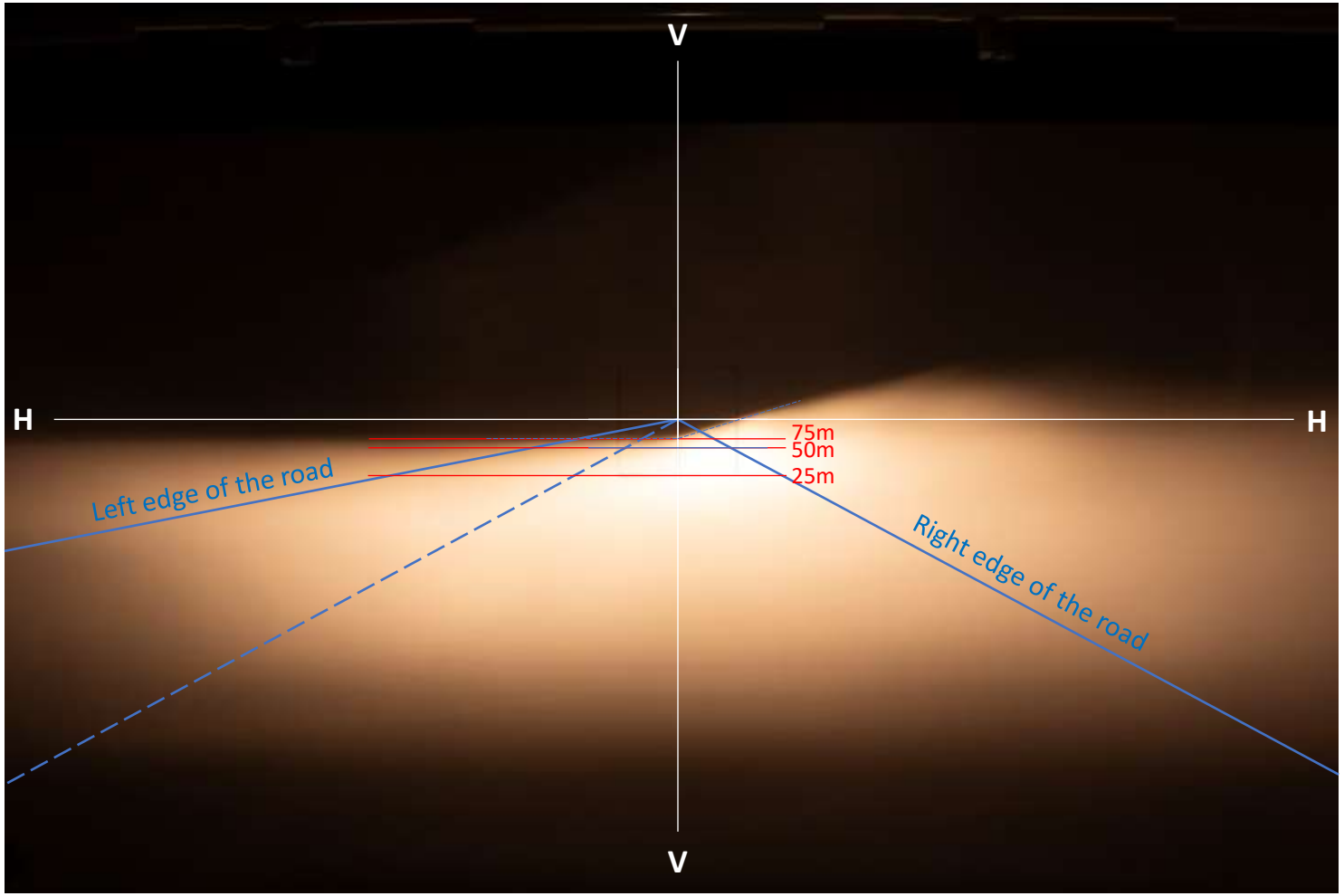
2c

STEP 3

Basic principles of headlamps

Basic principles *(1/7)*

Headlamp A, H7 halogen



Beam on wall at 10 m distance ("Goniometer view")

- HV coordinate system
- Perspective view of road
- Corresponding distances

STEP 1

STEP 2a

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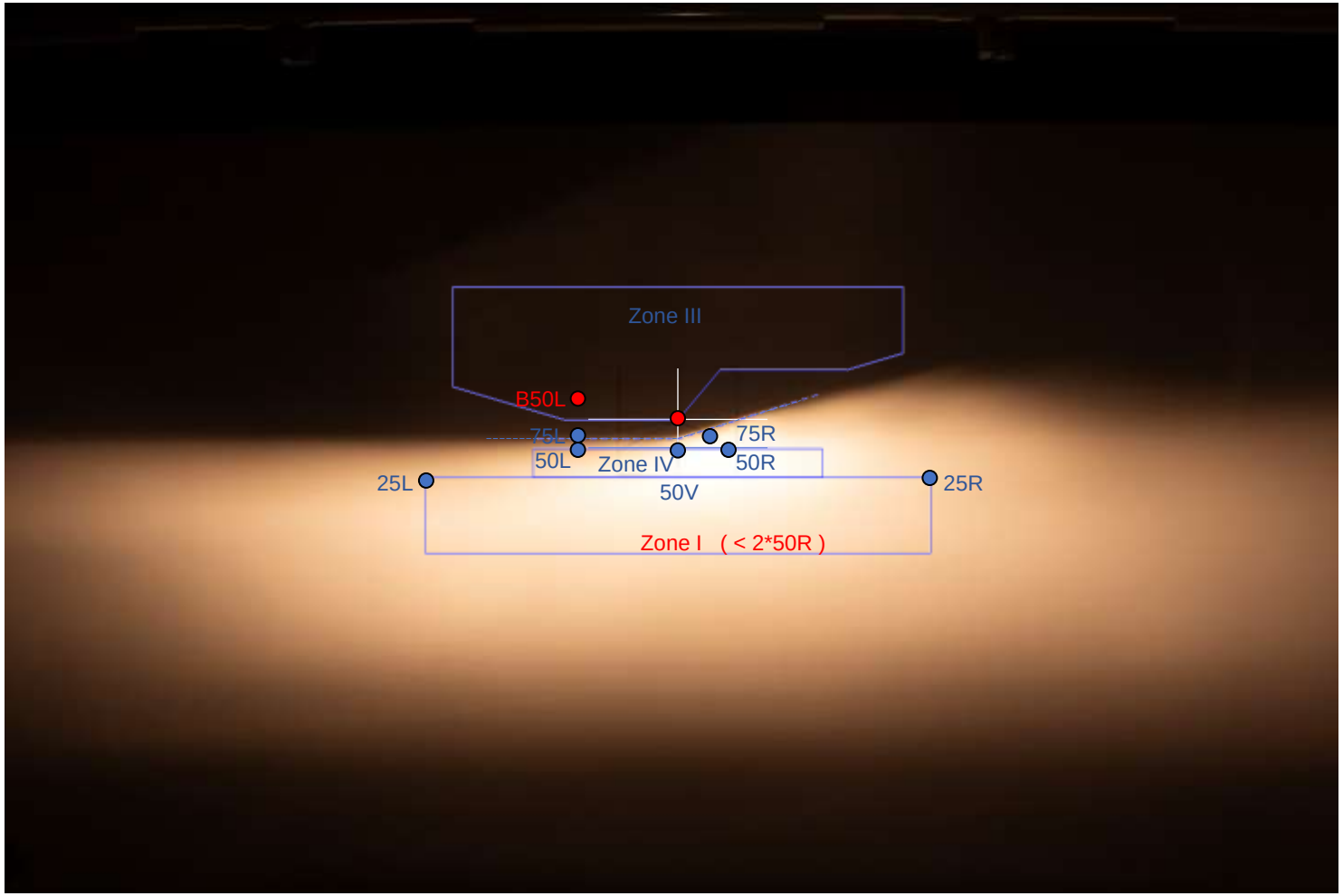
STEP 3

Basic principles *(2/7)*

Headlamp A, H7 halogen



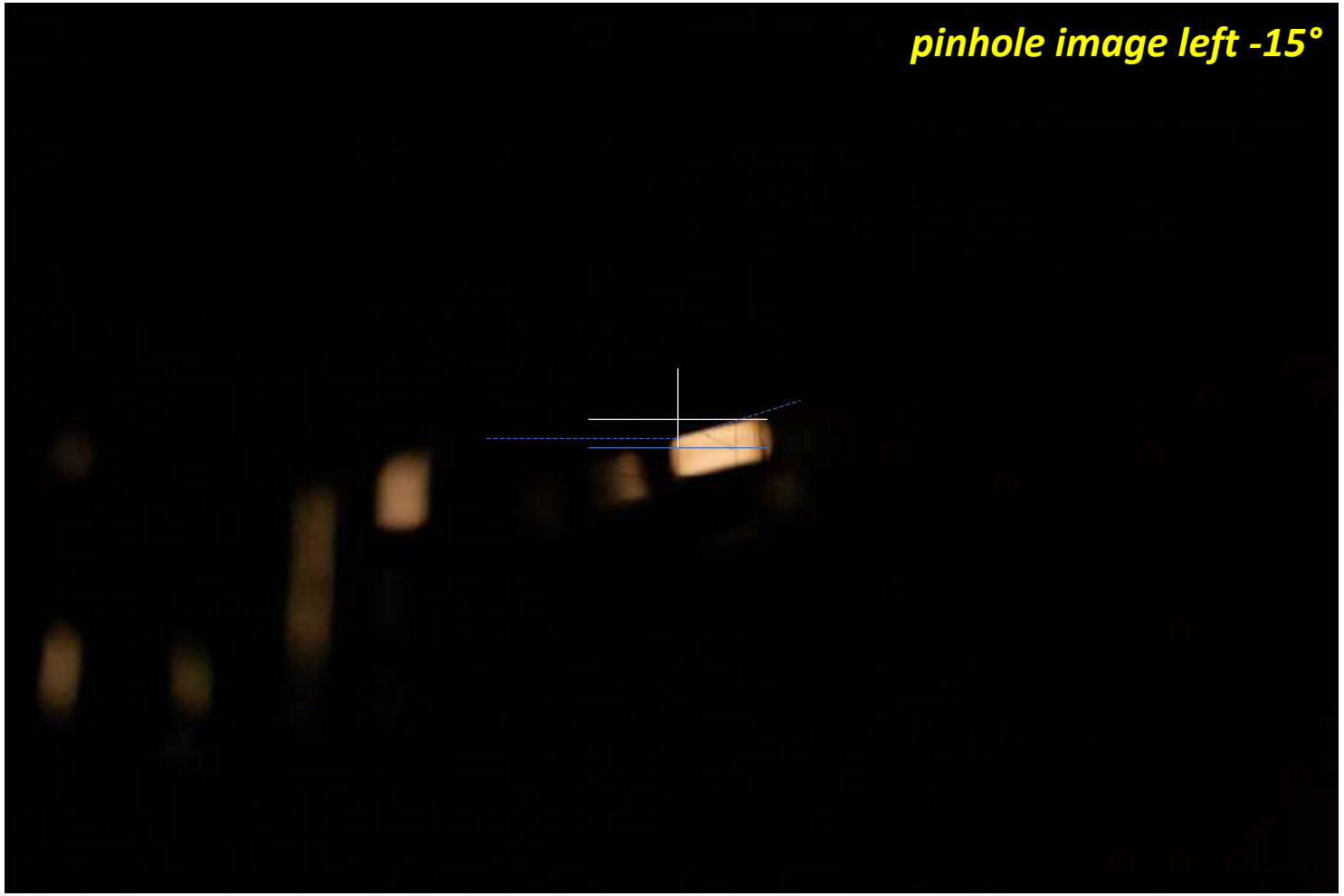
Legal test points and zone, R112 class B

- At 75m: 75R (min), 75 L (max)
- At 50m: 50R (min), 50V (min), 50L (max)
- At 25m: 25R (min), 25L (min)
- Zone I: no min., max. dep. on 50R value
- Zone III: max. to limit glare
- Zone IV: min. to enable min. homogeneity

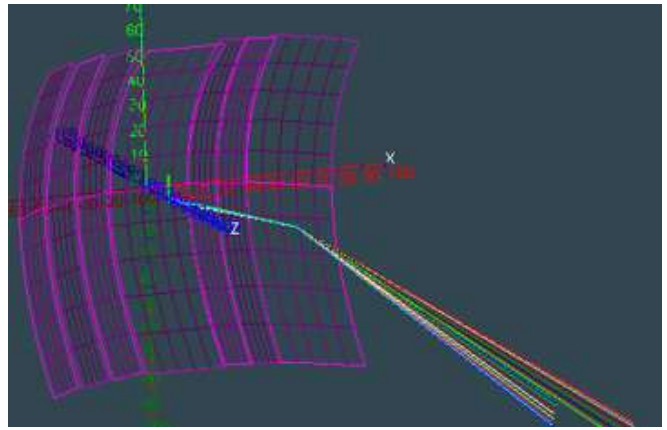
→ There is no minimum intensity required at a distance closer than 25m to the vehicle!

Basic principles *(3/7)*

Headlamp A, H7 halogen



reflector and pin hole position creating filament image on the wall (10 m)



model reflector in headlamp simulation software with
rays hitting single point on reflector (like pin hole)

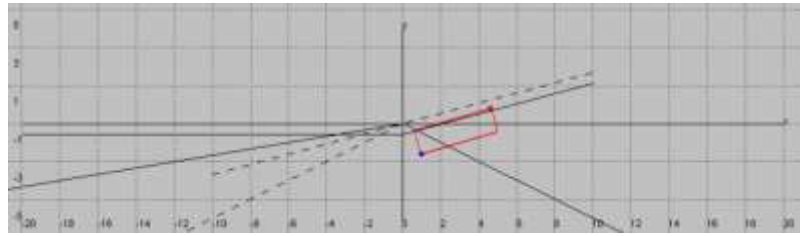


image of filament created by above
rays hitting single point on reflector (like pin hole)

STEP 1

STEP 2a

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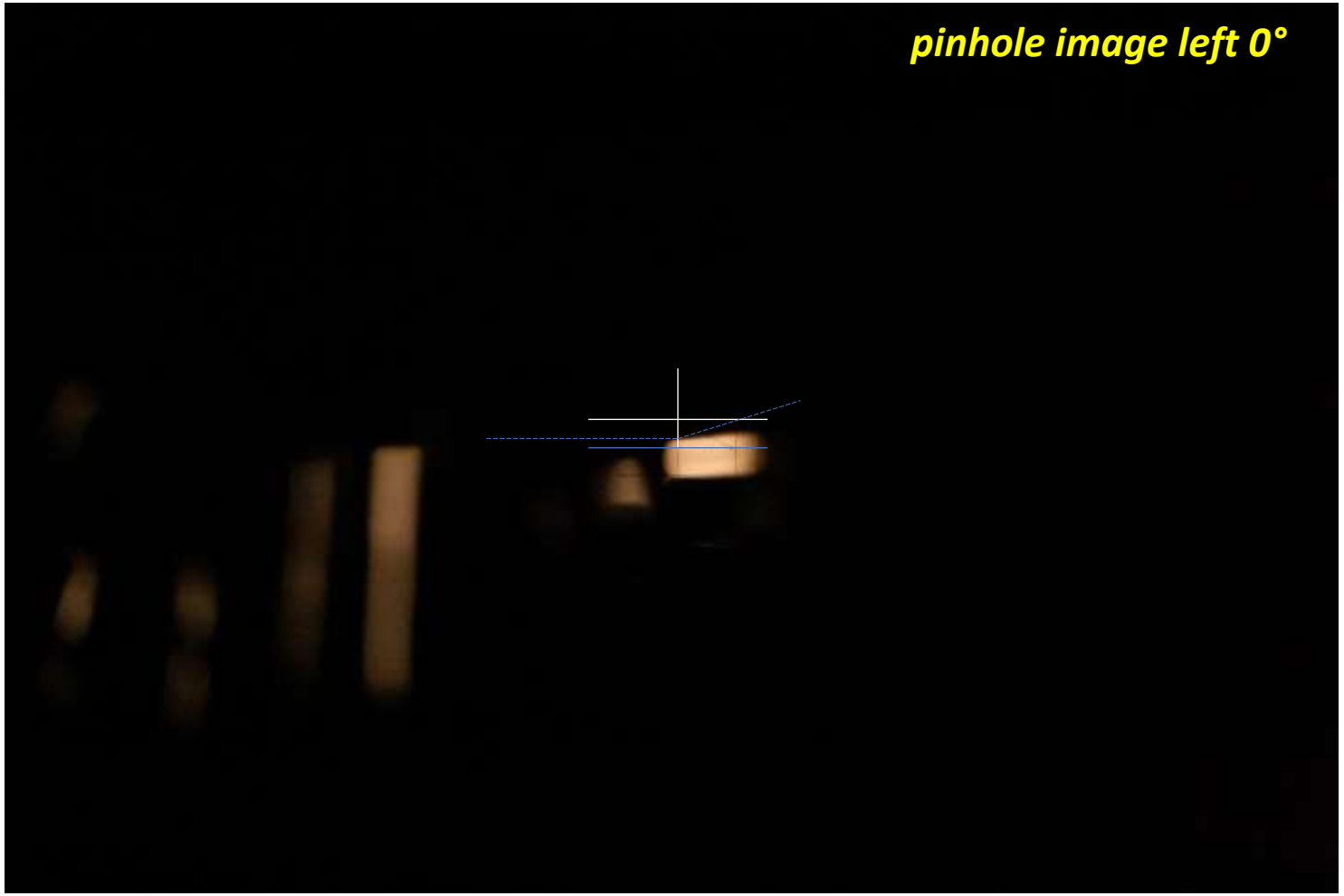
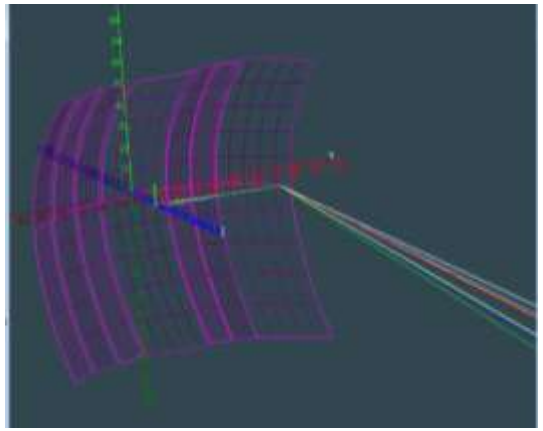
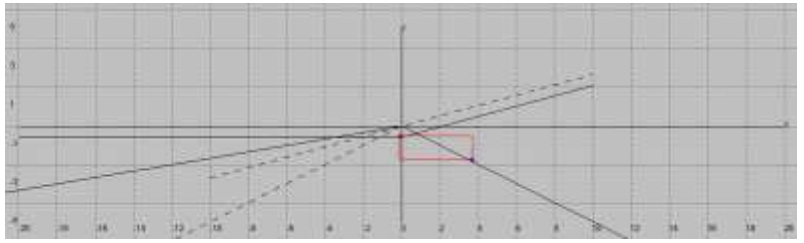
STEP 3

Basic principles *(4/7)*

Headlamp A, H7 halogen







STEP 1

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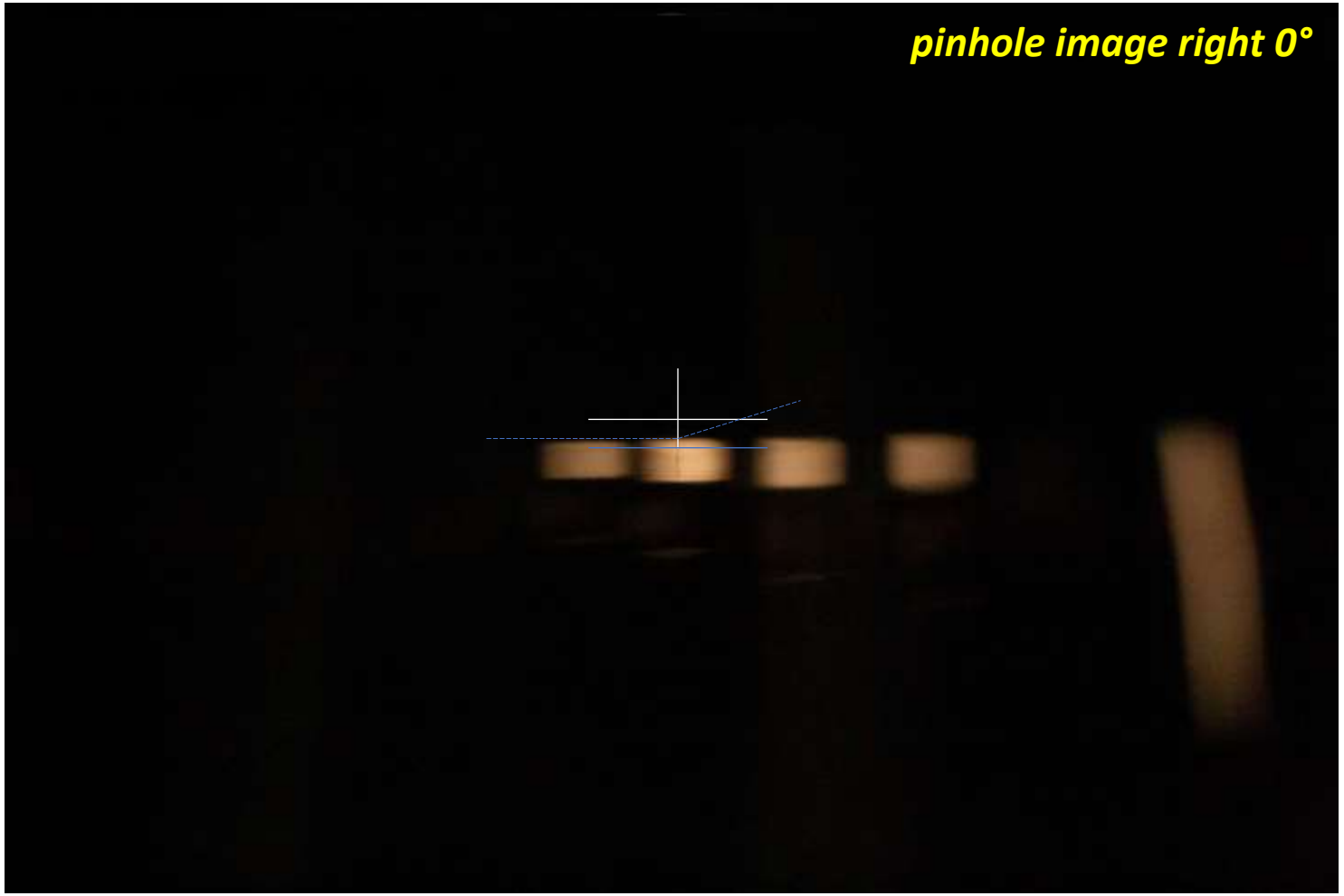
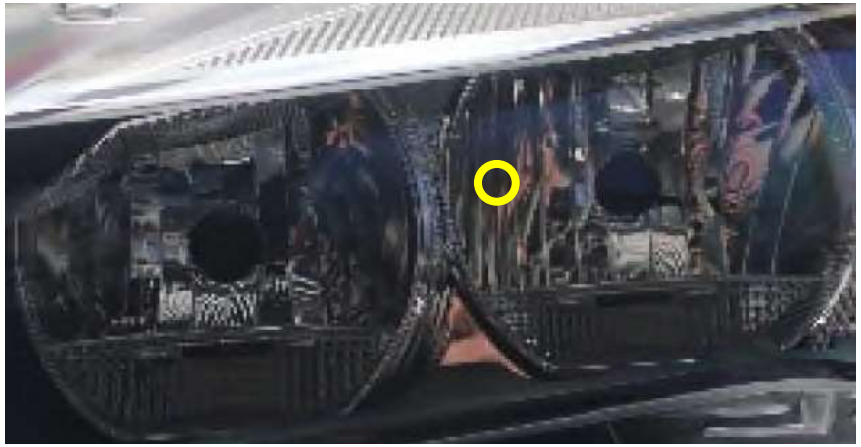
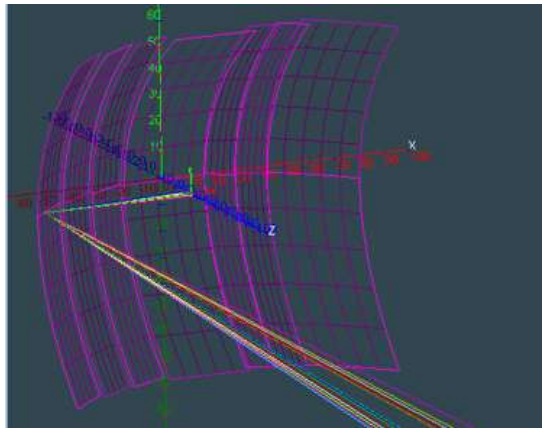
STEP 3

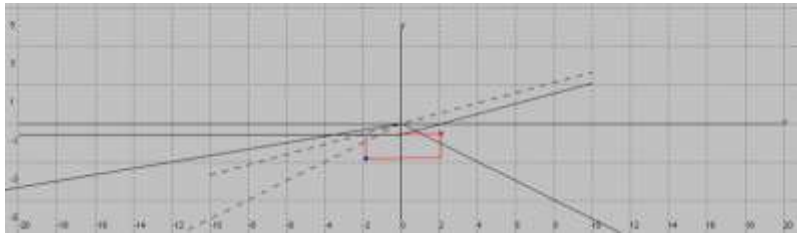
Basic principles *(5/7)*

Headlamp A, H7 halogen









STEP 1

STEP 2a

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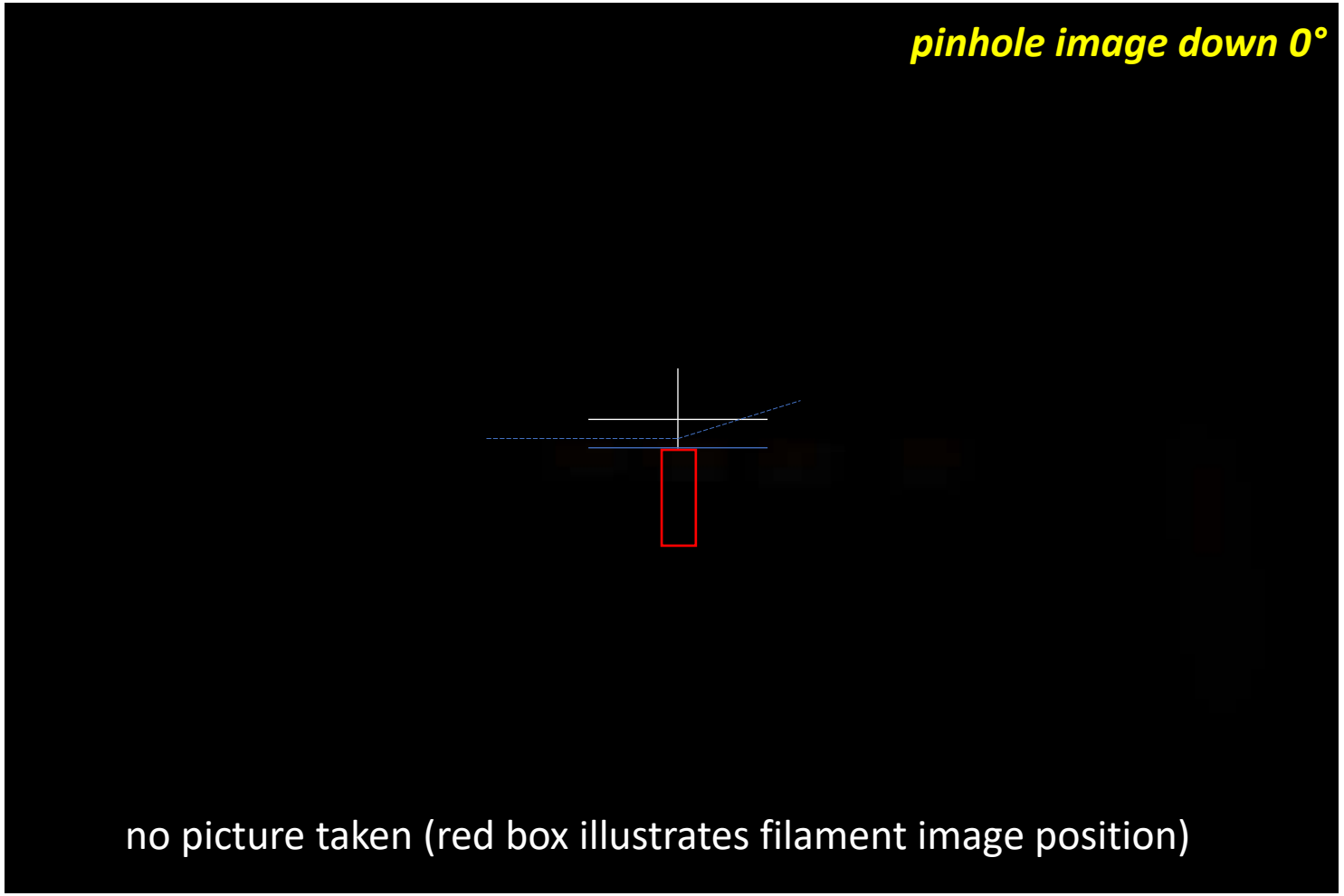
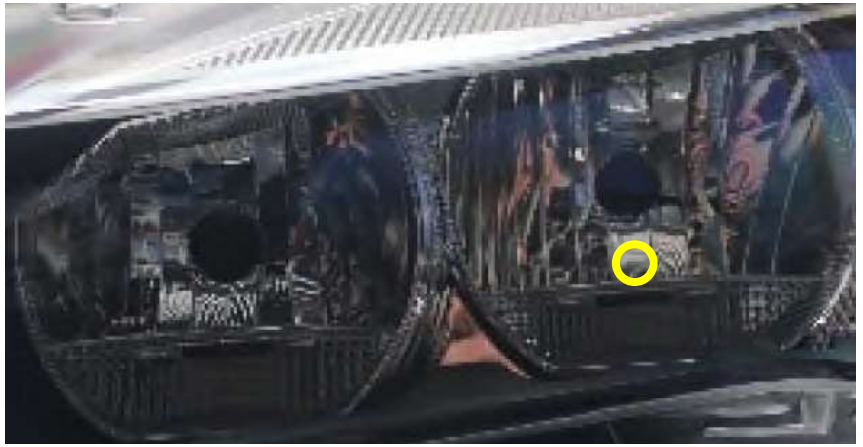
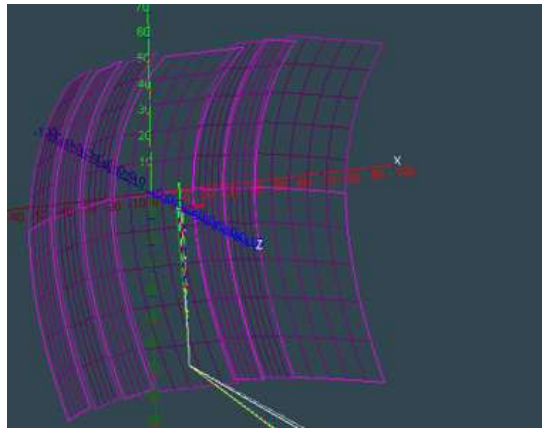
STEP 3

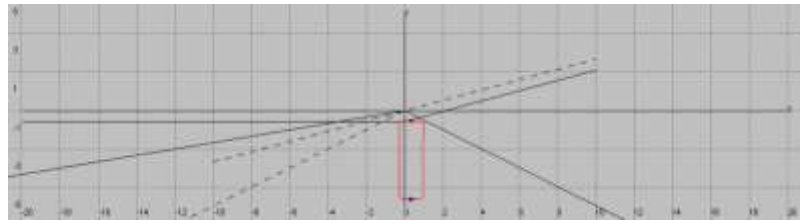
Basic principles *(6/7)*

Headlamp A, H7 halogen









STEP 1

STEP 2a

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STEP 3

Basic principles *(7/7)*

Learnings

Reminder: (R112, class B) beam requirements enable a safe balance** between light close to the vehicle versus light distant from the vehicle, while controlling glare

- Minimum intensities required at 25m and further away
- Maximum intensities defined between 10m and 25m (relative to 50R value)

➢ Horizontal reflector segments mainly contribute to beam close to cut-off, i.e. distant from the vehicle

➢ Vertical reflector segments mainly contribute to lower part of the beam, i.e. close to the vehicle

** Note: a good balance supports humans eye fixation behavior at night (insert of next two slides)

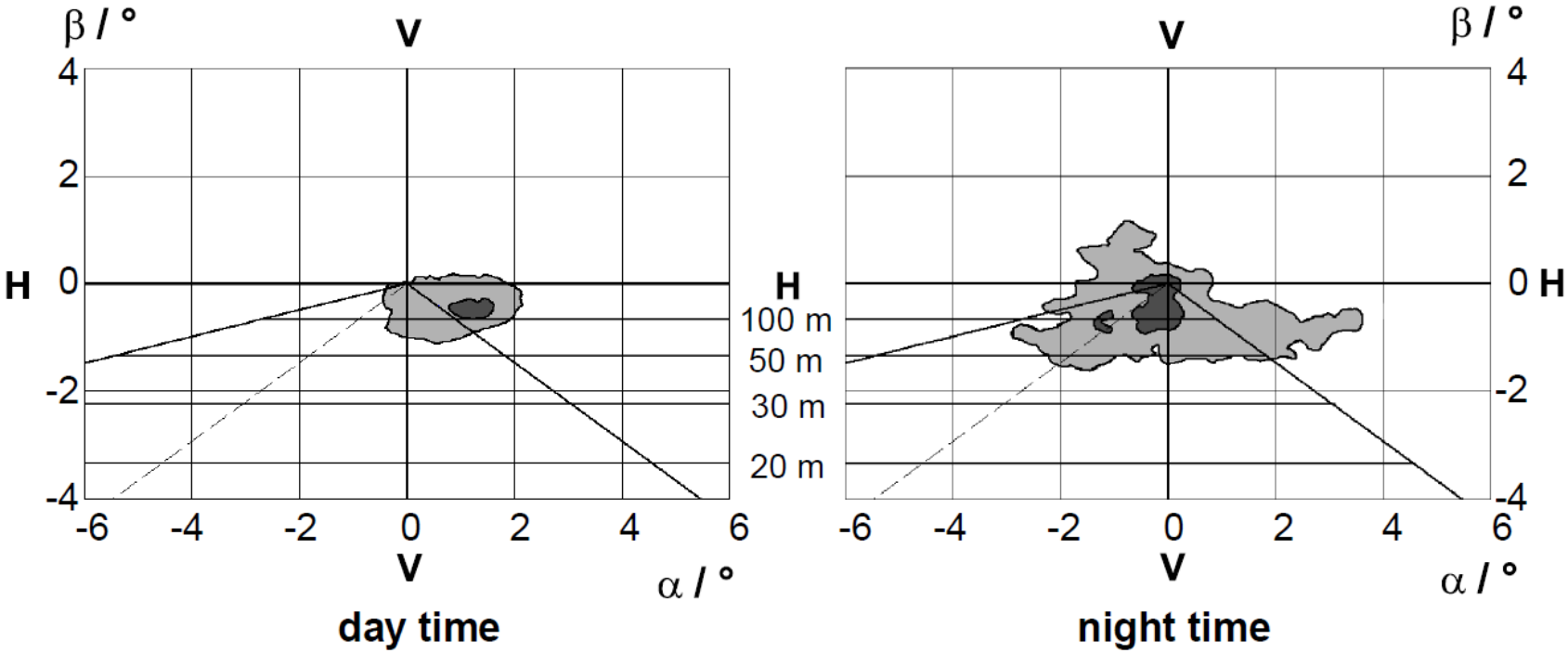
Drivers eye fixation point (examples)

- INSERT -

Eye Movement Behaviour of Car Drivers

Carsten Diem, Darmstadt University of Technology, Germany

proceedings ISAL 2005

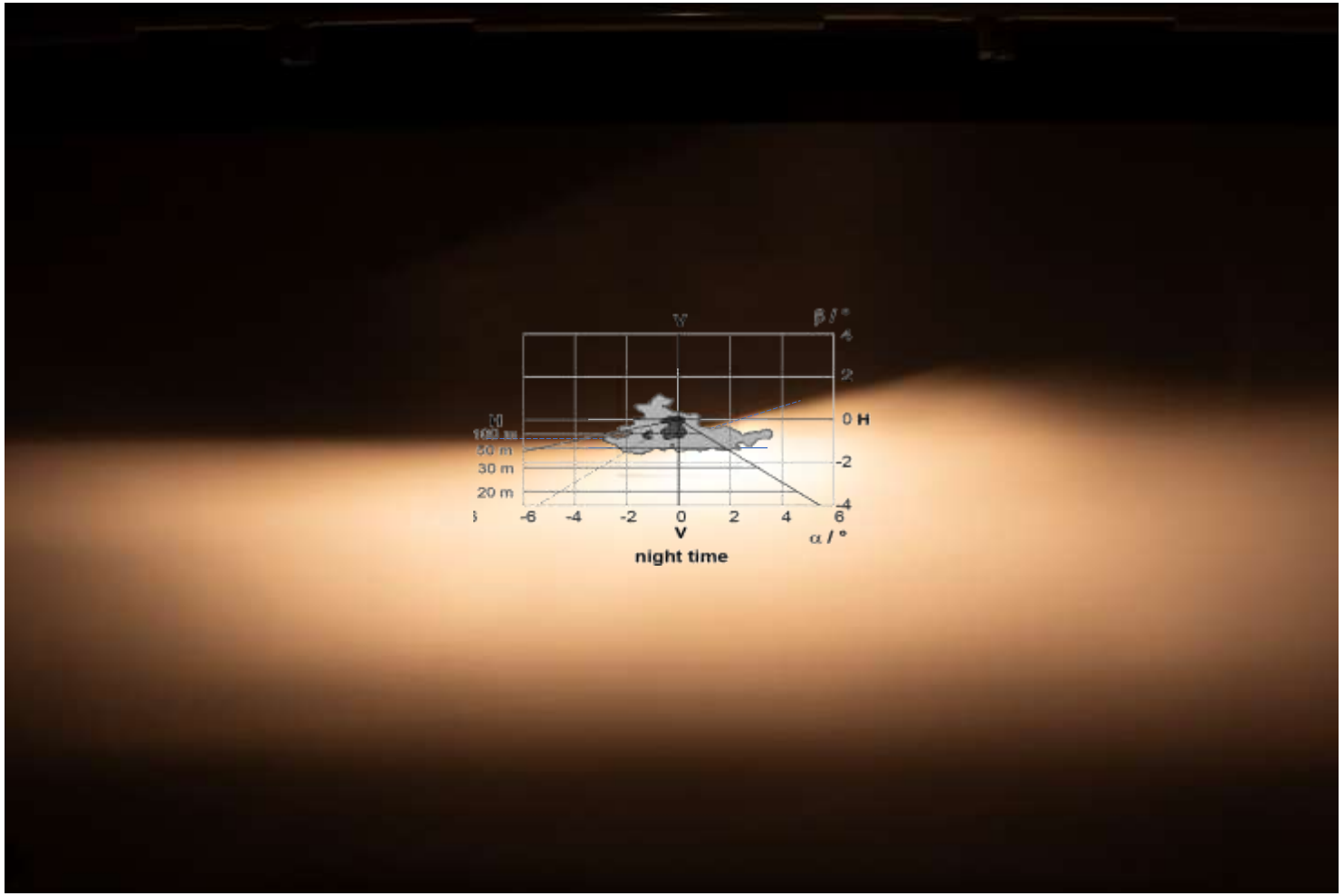


Graph 2: graphical representation of the fixation distributions on straight route sections on country roads

■: *10% - area* □: *50% - area*

Headlamp A, H7 halogen,
with eye fixation points (example: straight country road)

- INSERT -



STEP 1

STEP 2a

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2c

STEP 3

Type-approved headlamps with type-approved light sources

Type-approved headlamps *(1/9)*

Headlamp D, left (H7 Performance), right (H7 LongLife)

STEP 1

STEP 2a

2b

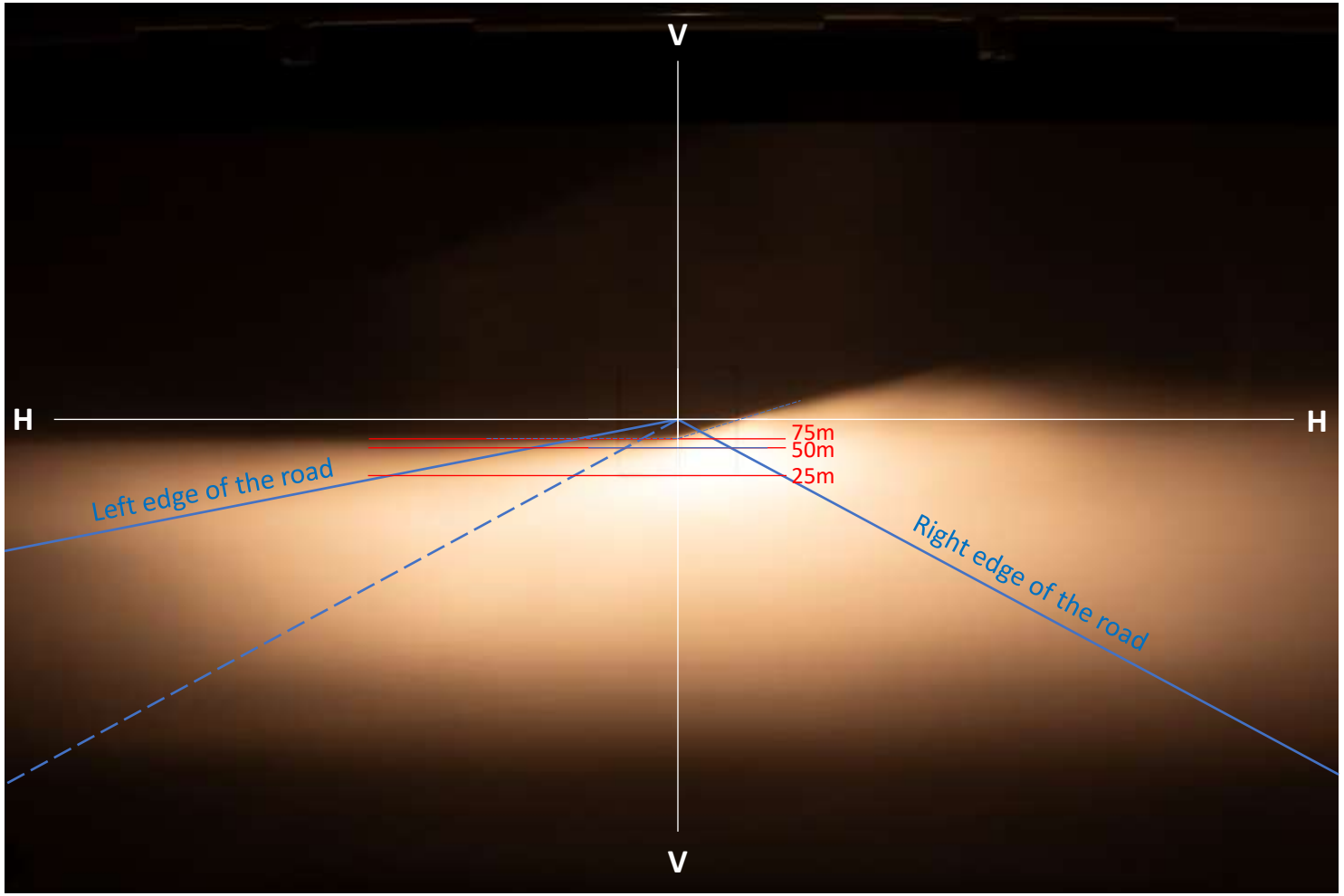
2c

STEP 3

Note, this is a different setting in the lab. The headlamps are mounted at ground floor at ~7 m distant from the wall.

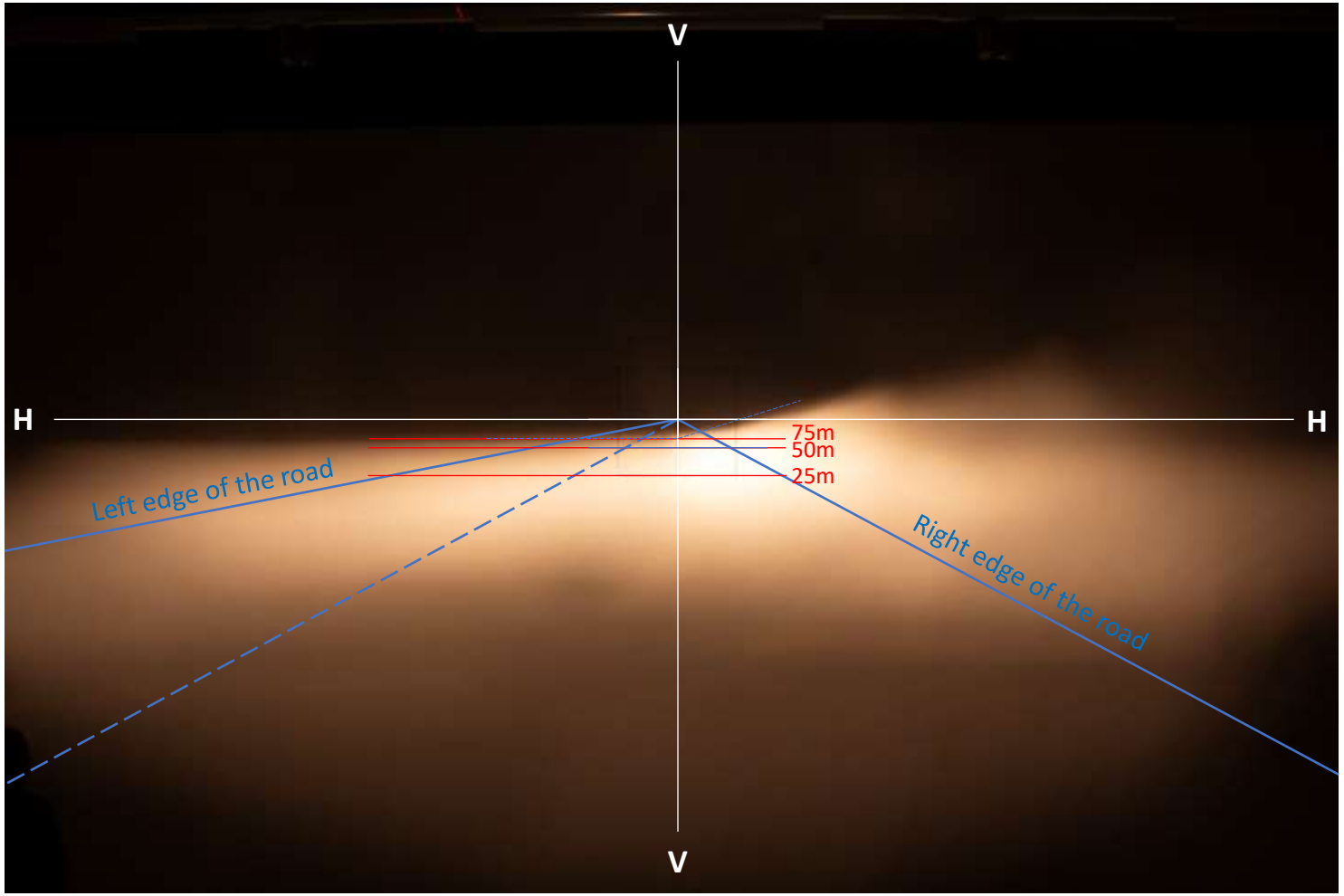
Type-approved headlamps *(2/9)*

Headlamp A, H7 halogen



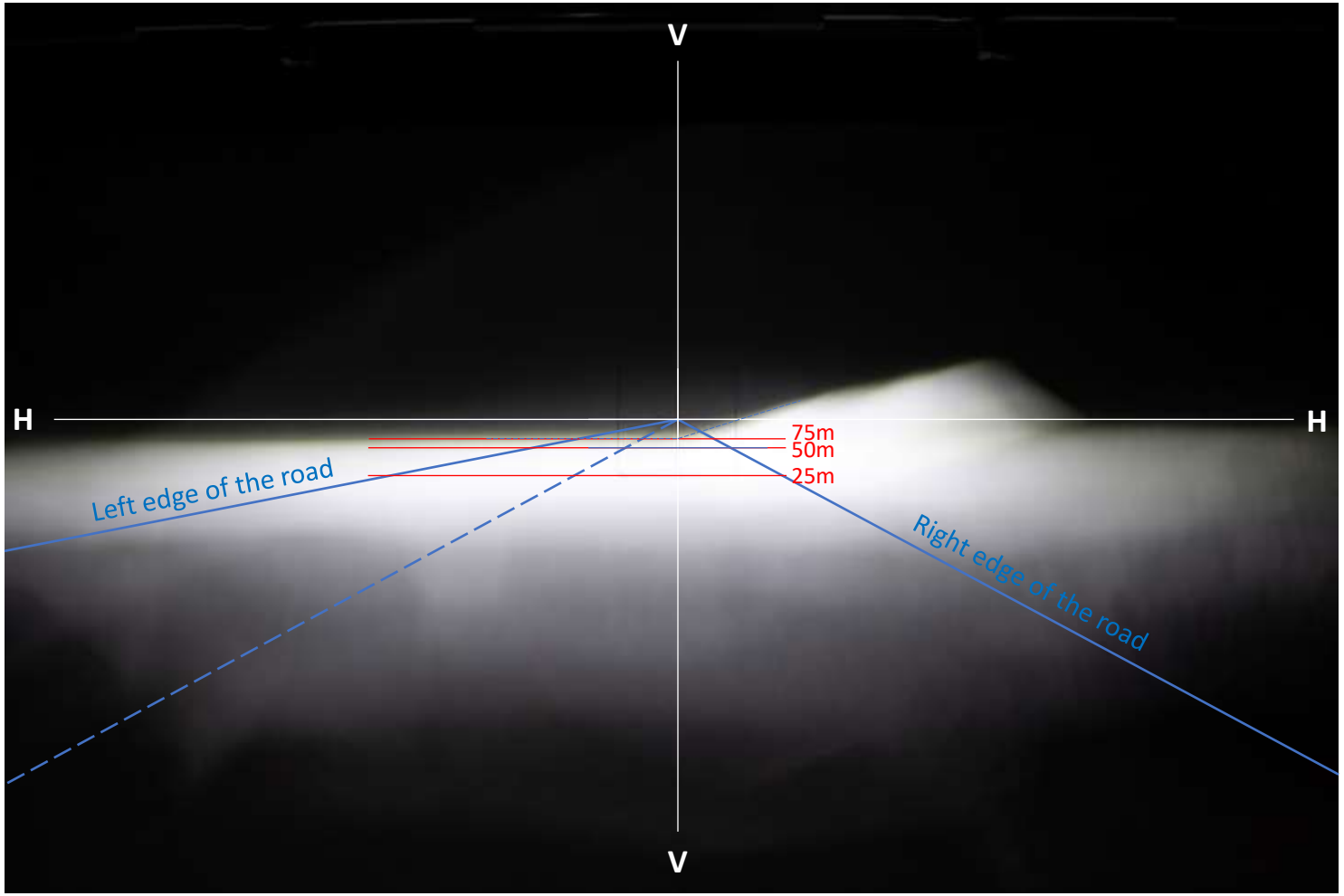
Type-approved headlamps *(3/9)*

Headlamp B, H7 halogen



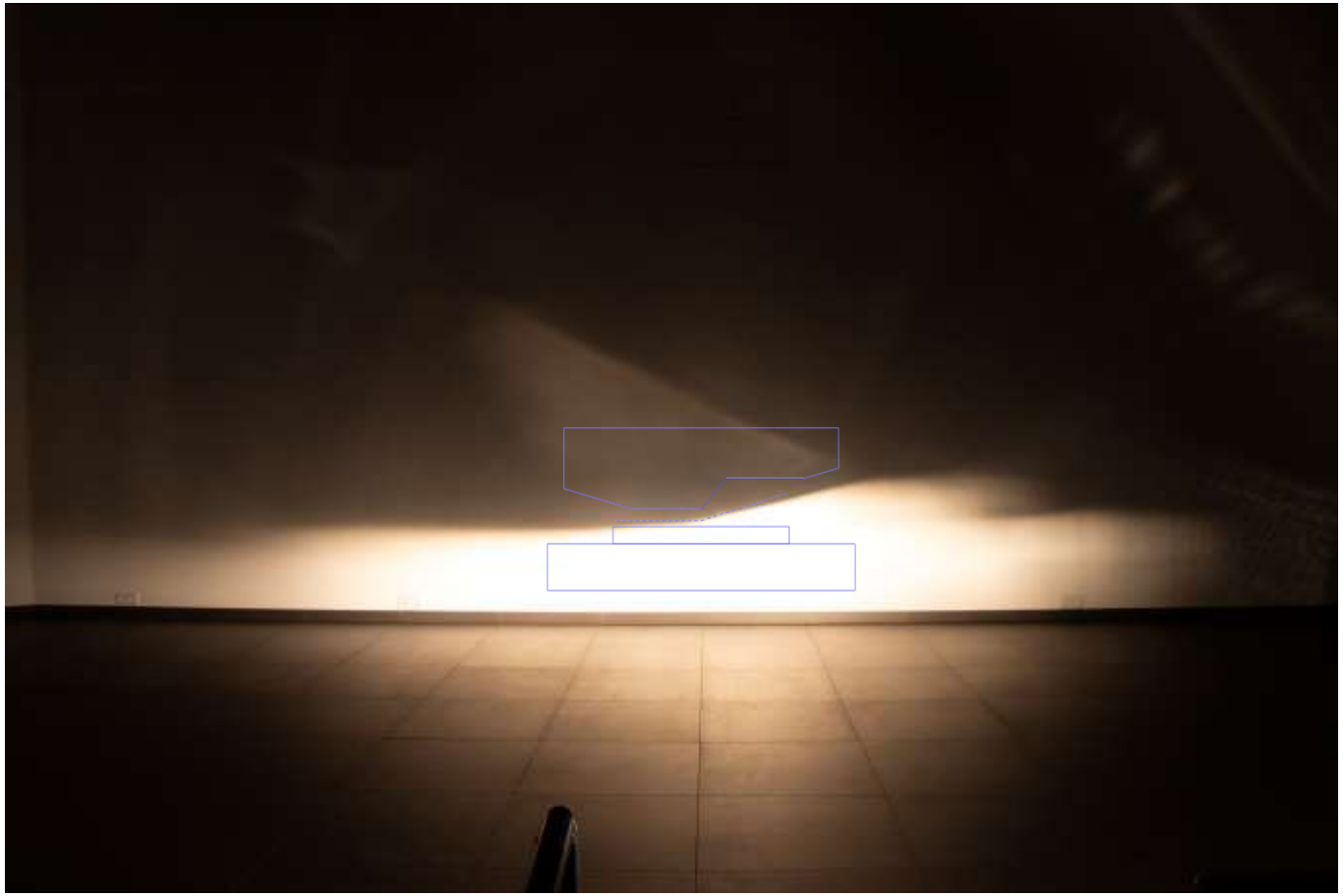
Type-approved headlamps *(4/9)*

Headlamp C, LED OEM



Type-approved headlamps *(5/9)*

Headlamp D, left (H7 Performance)

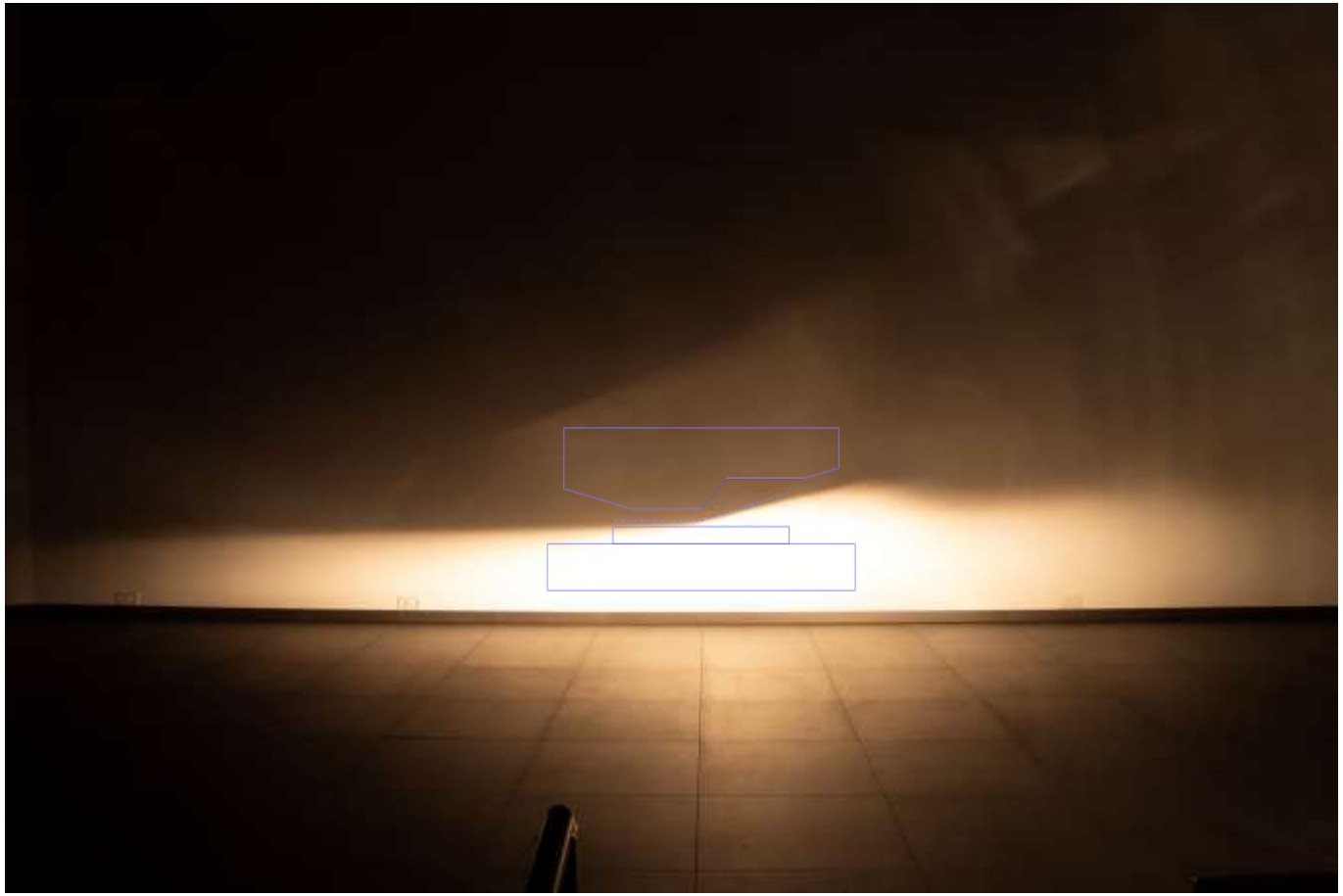


Note:
The zones and lines are only indicative, not calibrated to the distance.

Note, this is a different setting in the lab. The headlamps are mounted at ground floor at ~7 m distant from the wall.

Type-approved headlamps *(6/9)*

Headlamp D, right (LongLife)



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Note, this is a different setting in the lab. The headlamps are mounted at ground floor at ~7 m distant from the wall.

Type-approved headlamps *(7/9)*

Headlamp A, H7 halogen,

Headlamp C, LED OEM (on wall)

Type-approved headlamps *(8/9)*

Headlamp A, H7 hal.,

Headlamp B, H7 hal.,

Headlamp C, LED OEM

all headlamp beam patterns are compliant to ECE R112

Type-approved headlamps *(9/9)*

Learnings

Reminder: Type-approval system for headlamps and for replaceable light sources *(based on Etalon concept and CoP, for headlamp and light source)* is the foundation for minimum safety *("minimum and maximum intensity specifications")*

- Beam patterns can be significantly different (beam appearance and/or color) …
  - … between left and right headlamps (R112 class B)
  - … between different headlamp types (R112 class B)
  - … between OEM-filament-based and OEM-LED-based solutions (R112 class B)
- The amount of light outside specified zones and points can vary significantly

STEP 1

STEP 2a

2b

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STEP 3

2-sided LEDr designs

2-sided LEDr designs *(1/4)*

H7 halogen *and* *H7 LED replacement*

Headlamp E

Note, this is a different setting in the lab. The headlamps are mounted at ground floor at ~7 m distant from the wall.

STEP 1

STEP 2a

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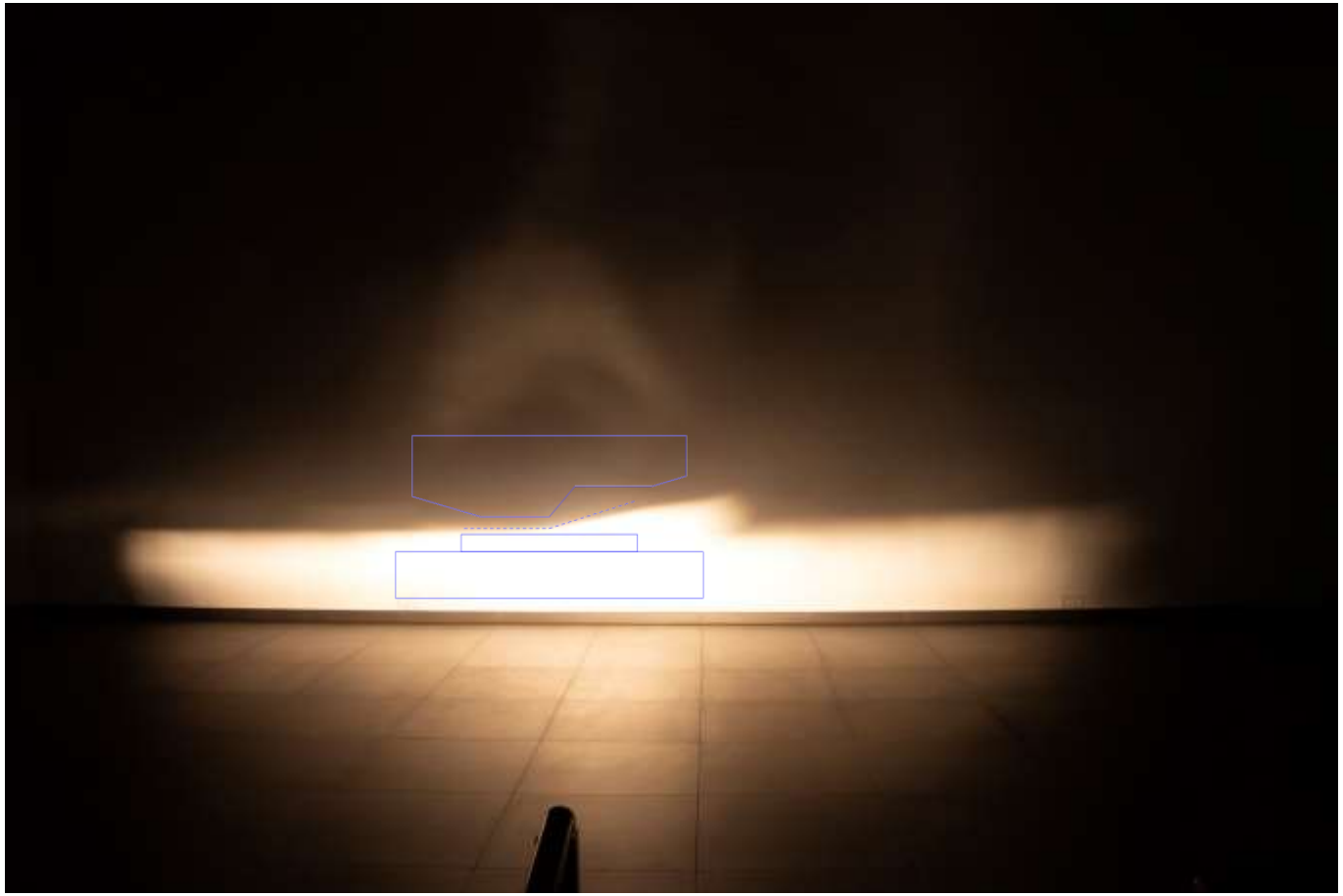
STEP 3

2-sided LEDr designs *(2/4)*

Headlamp E, H7 halogen



Note:
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Note, this is a different setting in the lab. The headlamps are mounted at ground floor at ~7 m distant from the wall.

STEP 1

STEP 2a

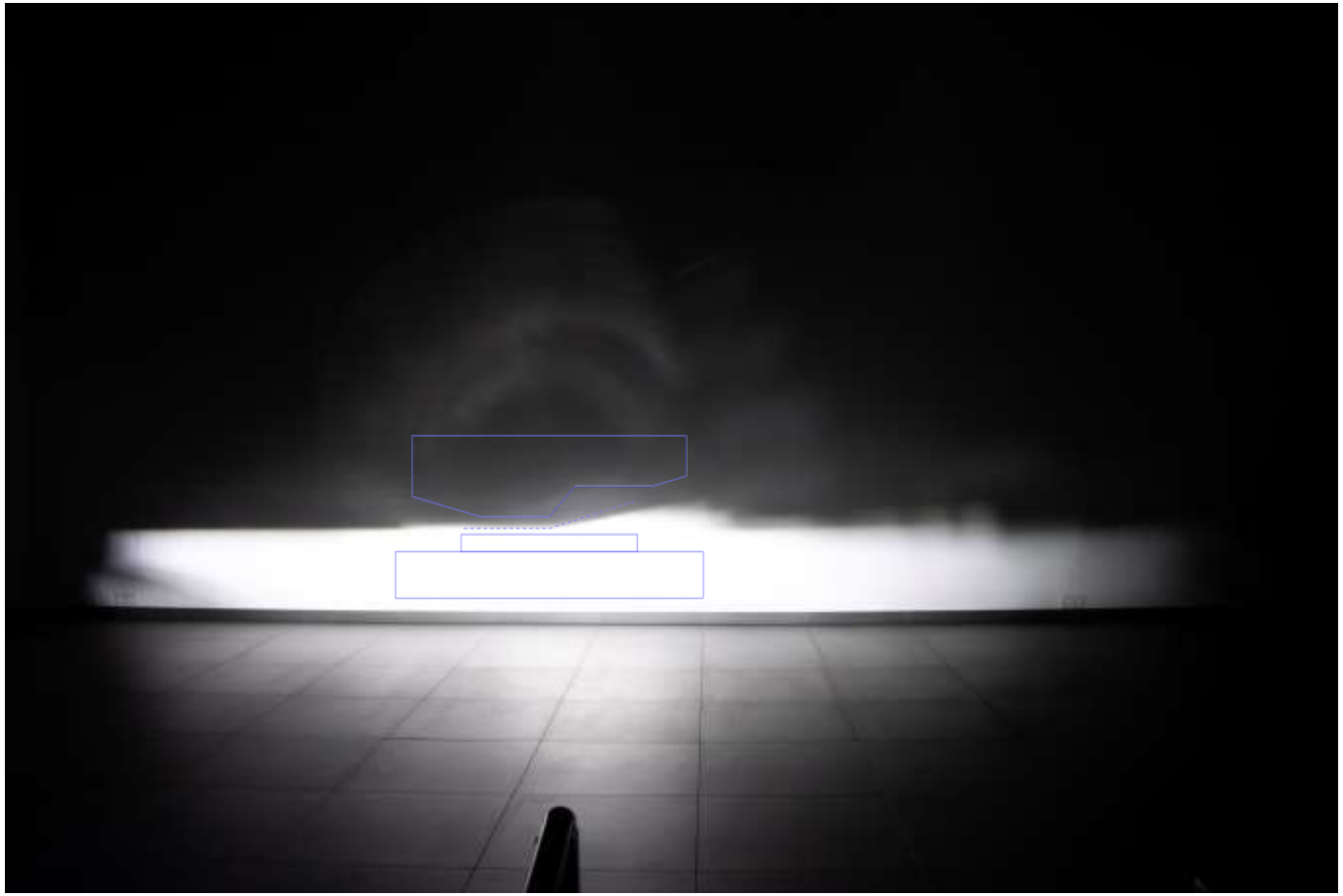
2b

2c

STEP 3

2-sided LEDr designs *(3/4)*

Headlamp E, H7 LED replacement



Note:
The zones and lines are only indicative, not calibrated to the distance.

Note, this is a different setting in the lab. The headlamps are mounted at ground floor at ~7 m distant from the wall.

STEP 1

STEP 2a

2b

2c

STEP 3

2-sided LEDr designs *(4/4)*

Learnings

Reminder: A 2-sided LEDr can generate fully compliant beam *(required minimum light on the road and full control of glare)*, as proven by approval tests of more than hundred of vehicle types *(left and right headlamps)*

- Observed intensity variations within the regulated part of the beam fall within the minimum and maximum limits
- There are no interferences of a 2-sided design to the regulated part of the beam *(see learnings of Step 1)*