Headlamp Illuminance on the Road and on a Target

Horizontal illuminance on the road and vertical illuminance on a target from a headlamp's luminous intensity, mounting height and distance, with the aim angle.

Method: Photometric inverse-square and cosine laws

Input parameters

Unit system: SI

Parameter	Value	Unit
Luminous intensity towards the point (cd)	20,000	
Lamp mounting height	0.70000	m
Distance ahead along the road	50.000	m

Calculated results

Parameter	Value	Unit
Horizontal illuminance on the road	0.11197	lx
Vertical illuminance on a target facing the lamp	7.9976	lx
Angle below horizontal to the road point	0.80209	°
Inclination (cm per 10 m)	14.000	

Notes for this case

• Inverse-square and cosine laws: E = I·cos θ/d², with θ measured from the surface normal. On the road the light arrives at a grazing angle, so horizontal illuminance (I·h/d³) is tiny even near the cut-off, while a pedestrian or sign facing the lamp receives I·x/d³. Low beams are aimed about 1–1.5 % (10–15 cm per 10 m) down so the cut-off reaches the road some 50–70 m ahead. Intensities come from the lamp's photometric data.

Formula and method

$$E_h = \frac{Ih}{(x^2+h^2)^{3/2}}, \quad E_v = \frac{Ix}{(x^2+h^2)^{3/2}}$$

Variables

I	Luminous intensity towards the point (cd)	-
h	Lamp mounting height	m
x	Distance ahead along the road	m
E_h	Horizontal illuminance on the road	lx
E_v	Vertical illuminance on a target facing the lamp	lx
γ	Angle below horizontal to the road point	rad
h/x	Inclination (cm per 10 m)	-

Method and standards

Headlamp illuminance.

Assumptions and limits

- Point source; flat road; no atmospheric loss.

References

Photometric inverse-square and cosine laws

Report details

Report reference	FCC-3WDJ-9465 (the same inputs always give the same reference)
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/automotive/vehicle-dynamics/headlamp-road-illuminance

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.