

## Laser pointer safety distances

Laser beams spread out over a distance. The green numbers in this table show how far a legal laser pointer beam will travel (in feet), before it spreads out so much that the power entering an eye falls below a given safety level.

Brightest legal laser pointer (5 milliwatts, 532nm green). Distance in feet to selected safety zones					
NOHD (distance laser becomes eye-safe)		Simulator study level 3	Simulator study level 2	Simulator study level 1	
FAA Normal Flight Zone	FAA Sensitive Flight Zone		FAA Critical Flight Zone		FAA Laser-Free Flight Zone
<2500 $\mu\text{W}/\text{cm}^2$	<100 $\mu\text{W}/\text{cm}^2$	50 $\mu\text{W}/\text{cm}^2$	<5 $\mu\text{W}/\text{cm}^2$	0.5 $\mu\text{W}/\text{cm}^2$	<0.05 $\mu\text{W}/\text{cm}^2$
52 ft.	262 ft.	371 ft.	1,171 ft.	3,707 ft.	11,712 ft.
<b>VERY BRIGHT</b> At this level, light is very bright but eye-safe for 1/4 second exposure. A person would naturally blink or turn away from the light within this time.	<b>BRIGHT</b> At this level, light can cause temporary flash-blindness and afterimages		<b>MODERATE</b> At this level, light can cause glare, making it difficult to see out the window		<b>DIMMEST</b> Below this level, light should be OK for pilots. It would not stand out against background lights, and would not cause a distraction.

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### NOTES

The laser power levels in this table have been selected based on three factors:

1. The "Nominal Ocular Hazard Distance". This is the distance at which a laser becomes eye-safe due to the blink/aversion reflex.
2. Power levels used in two FAA-run studies of pilot effects, in an FAA 727 simulator in Oklahoma City. The studies were done in August 2003 and June 2004.
3. FAA mandated laser safety zones. Within each zone, laser light must be below the specified power level.

The distance shown is the "slant range", directly from the laser to an aircraft. If the beam is at an angle, this is NOT the distance along the ground, or the altitude.

Calculations assume uniform beam profile (top hat), not gaussian profile. If calculated for gaussian ( $TEM_{00}$ ) beams, the distances would be a bit longer in some cases.

Actual exposure values would be less due to atmospheric attenuation and scattering. Values given here are therefore conservative (erring on the side of safety).

Beam diameter at the source is basically immaterial due to its small size compared to the spot size at a significant distance

Very short distances in the table will be more conservative than actual, due to disregarding of initial beam diameter. This effect is insignificant at longer distances.

## DISCLAIMER

Data in this table is for relative comparisons only. Due to a variety of variables, safety distances for specific installations or uses need to be calculated by qualified personnel.

## CREDITS

Calculations and data provided by Casey Stack, [Laser Compliance Inc.](#)

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