

What does a laser look like when it shines on pilots in an airplane cockpit?

The 14-second-long animation at right contains photos taken in a professional flight simulator during scientific studies. It shows the three visual effects of **startle and distraction** (dimmiest flash), **glare** (brighter, making it hard to see out the cockpit) and **temporary flashblindness** (loss of vision until the afterimage fades).

This animation is probably the most realistic way to understand what a laser exposure looks like. A still photo implies that the laser is always on the aircraft. But in real life, the laser flashes -- it is impossible to keep a hand-held beam fixed on a moving plane. Pilots generally experience one or more flashes as the beam sometimes hits, and mostly misses, the cockpit.

How the flash time was determined

A typical flash from a hand-held laser at 1000 feet lasts about 1/50 of a second. In the [FAA simulator studies](#), the flash used was one second long. The animation above "splits the difference" by using 1/2 second flashes. We feel this is a realistic portrayal of how long a typical exposure might last.

In addition, there is a 2-1/2 second fade-out after the brightest exposure. This demonstrates how an afterimage fades. To keep the file size down and the animation short, the fading was made faster than normal. In real life, it will take longer to fade and much longer for night vision to recover.

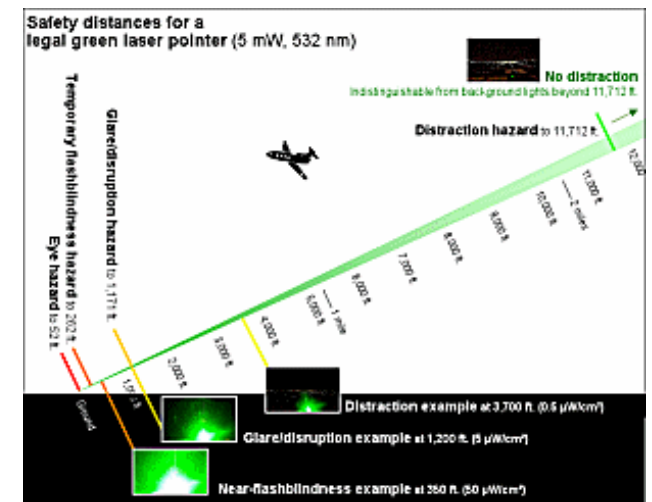
If the light was a laser pointer, how close is it?

In the animation, the power levels are known. From this, we can compute distances if the light was from a legal (5 mW) laser pointer. The dimmest level corresponds to a legal laser pointer 3,700 feet away, the medium level is a pointer about 1,200 feet away, and the brightest level is a pointer just 350 feet away.

The diagram at right shows this more clearly. The diagram includes FAA-determined safety distances for flashblindness, glare and distraction. You can see where the simulator photos fall, on this distance scale. Click [here](#) or on the diagram for an enlarged view.

Details about the photos which make up the animation

The graphic below explains details the various power levels, and the visual levels to which they correspond. As you read about the various levels, you may also want to reference the diagram above, as well as [this table](#) which shows distances for a laser pointer to reach various safety zones.



Example view from aircraft cockpit (in FAA flight simulator) during laser illumination flash

The simulator is showing the aircraft on the ground, at the take off position. The laser is steady for the photo; however, in the actual FAA simulator tests, pilots were exposed to a single flash lasting one second. So you

can imagine pilots see this for one second. (The laser flashes because in real-life a hand-held laser could not be held steady on the target. The light would flash instead of remaining steady.)



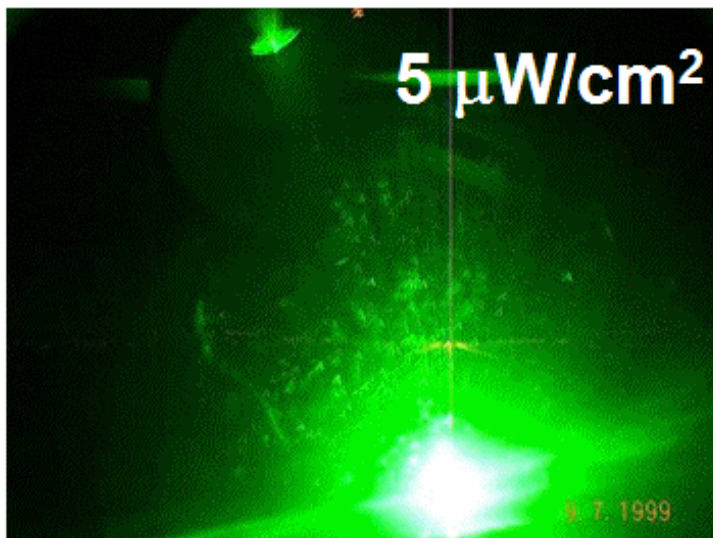
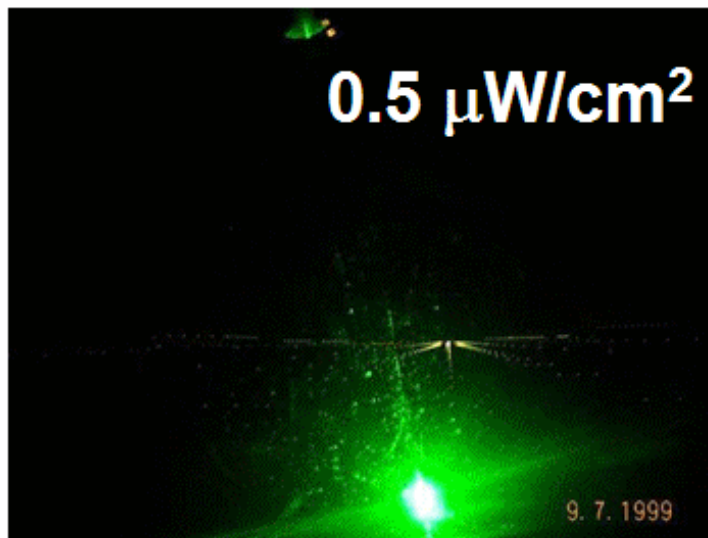
View from simulator cockpit, no laser illumination.

Runway fully visible

FAA Simulator Study, level 1 (10 times greater than FAA Laser-Free Zone level). Roughly equal to bright startle or distraction.

5 mW laser pointer at 3,700 ft.

Runway partially obscured



FAA Simulator Study, level 2 (FAA Critical Flight Zone), where glare is the primary hazard.

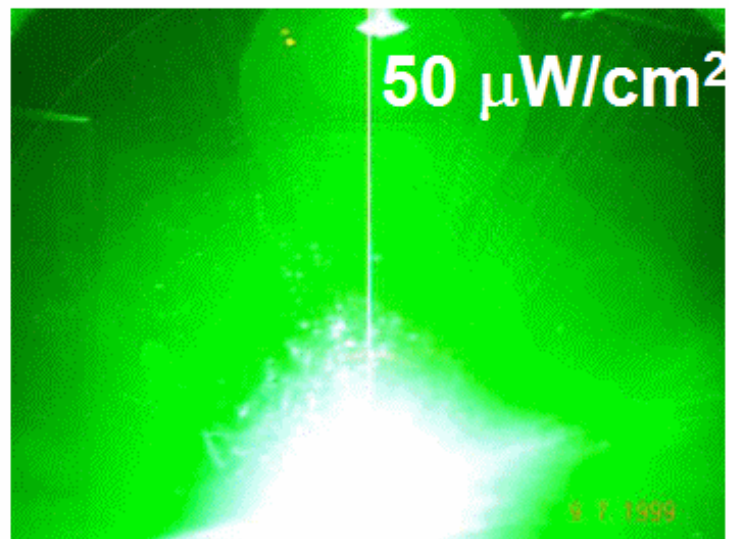
5 mW pointer at 1,200 ft.

Runway mostly obscured

FAA Simulator Study, level 3 (10 times less than FAA Sensitive Zone level), temporary flashblindness begins.

5 mW pointer at 350 ft.

Runway completely obscured



All photos taken with the same setting: Kodak DC240 digital camera, aperture f/2.8, shutter speed 1/6 second.