

Why and when to use expanders/collimators

What is an expander/collimator?

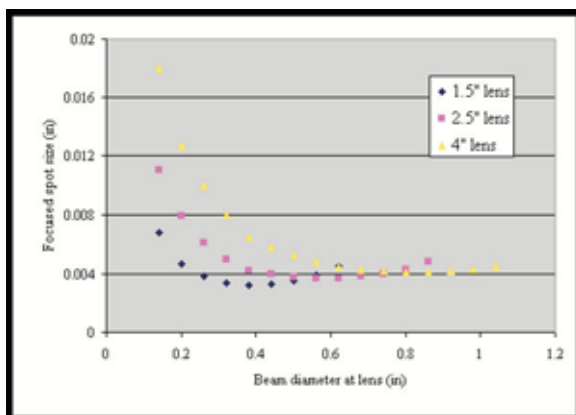
This is an optical device, usually comprising two lenses that produce an output laser beam with a near zero divergence. An expander/collimator also enlarges the beam diameter by selected amounts. For example, 1.6x, 2x and 2.5 times diameter of the beam are standard expansion ratios.

When to use an expander/collimator

Although lasers diverge slowly, the beam diameter enlarges sufficiently over a few meters to affect processing. For instance, a beam divergence of 3.2mrad (full angle), means that over a distance of 1 meter, the beam diameter increases by 3.2 mm.

If a system with a fixed beam length is being used, collimating the beam is not usually required, unless the distance between the laser and the lens is so large that the beam diameter will become larger than the aperture of the delivery or focusing optics. There are also other instances in which this sort of system may require a beam expander/collimator. For example, if a spot size of 100 microns (.004") is required for an application, and the lens is located a fixed distance of just 1 meter from the laser, an unexpanded beam could only achieve this small spot size using a 1" focal length lens. This working distance is not practical and is a non-standard lens focal length. By expanding the beam size by 2.5x its diameter, the required focal length becomes 2.5". This now means that the working distance allows room for nozzles and gas inlets etc, and the optic can be purchased as a standard lens size. (See chart below for focused spot sizes vs. beam diameter).

A moving or flying optics system is an ideal way to cover large areas. Such a system requires a collimated laser beam, as this sort of system configuration results in a varying distance from the laser to the lens. If the laser is not collimated, the lens focuses the beam to varying diameters as it travels across the length of the table. This results in varying focused spot sizes, and inconsistent processing. The collimation of the beam produces a consistent beam diameter over this varying distance, and thus a consistent focused spot size.



This graph shows the relationship between beam diameter and focused spot size for a number of standard lens focal lengths. If a flying optics system moves more than 0.5 m, the focused spot can be effected by around 5-25%, depending on the lens used. The graph is for a plano-convex shaped lens, and shows that as beam size increases, a point occurs when aberration effects become dominant.