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LASER BEAM PRODUCTS

CO_2 Laser Reflective Mirrors: Assemblies

Collimation

A collimated beam (i.e the beam diameter is near constant over a long distance) is desirable in many laser applications. Flying optics cutting systems and long beam paths are just two situations where a “collimator,” “beam expander” or “telescope” is used to achieve a level of collimation.

- The product of beam diameter and beam divergence is a fixed quantity, related to the quality of the laser. To lower beam divergence, beam diameter must be increased, so collimation always involves expanding the beam.
- There are many optical configurations that will expand and collimate a laser beam. Some are based on lenses; others use aspheric optics. For simplicity, ease of alignment and performance a “Z” configuration using copper mirrors is widely used for infrared applications.
- It is also possible to use a beam expander in reverse to reduce a beam’s diameter, perhaps to interface with test equipment or other optical systems with a limited input aperture.

Beam Expanders need careful design, and have to take account many factors. Laser Beam Products has the technical ability and software to optimize all the parameters to ensure the correct results for your system. An option is to have Laser Beam Products can supply just the optics and design data for beam expanders allowing laser manufacturers, researchers, and systems builders, to then incorporate a beam expander into their own equipment.

Focus Units

There are many situations where even the highest quality lens is just not suitable. High laser powers, harsh industrial environments, or hard to process materials can mean the use of mirrors as focusing optics is the only choice. There are several possibilities.

An Off Axis Paraboloidal (OAP) mirror

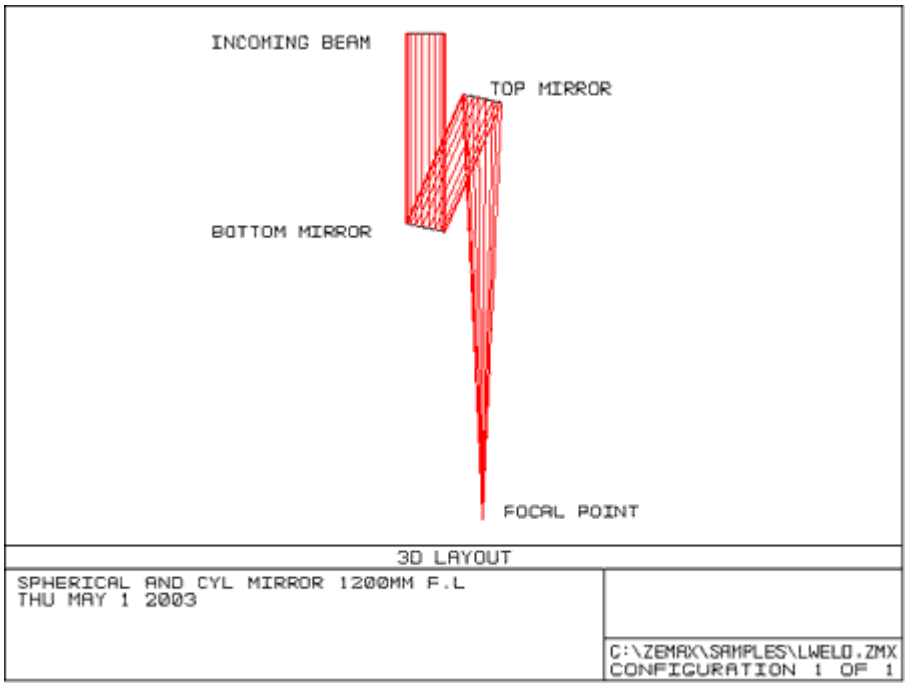
In theory these can offer perfect performance, but they are not without problems.

- Alignment is critical. Such mirrors can be 30 times more sensitive than a lens to align properly to the incoming beam. Costs are high, especially in small numbers, and the range of focal lengths is restricted, especially for long focal lengths. It is often not possible to reverse engineer existing OAP mirrors, forcing the user to return to the original equipment supplier for high priced spares.

Laser Beam Products can supply new OAP’s, and is often able to repair used OAP mirrors.

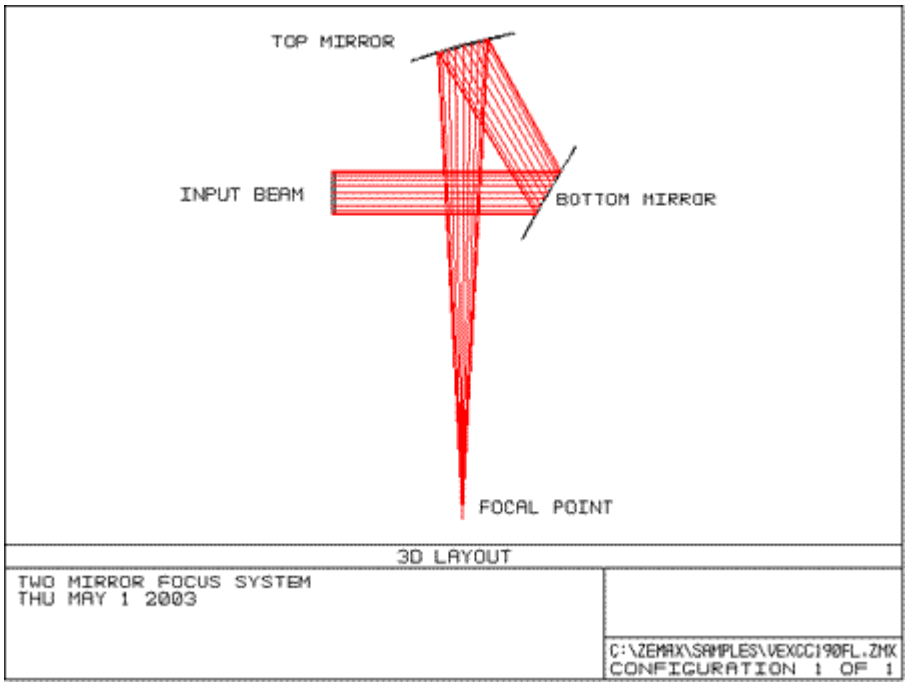
A Cylindrical & Spherical mirror

This offers a “straight through” design for a mirror based focus system. Alignment is simple and just about any focal length over 5” is possible. The mirrors are repairable, reducing costs even further.



Two spherical mirrors

Spherical mirrors cost a fraction of aspherical mirrors such as OAP's. They are also easily repaired and alignment is much less critical. Any focal length greater than 5" is possible up to 1 meter or more.



The performance of the two focus systems is extremely good, approaching diffaction limited in many situations.

Polarization

Most laser material processing is sensitive to the polarization of the laser beam. Laser Beam Products offers a range of components and assemblies that control or manipulate the polarization of a laser.

Zero Phase Shift Mirrors

Most lasers emit light with a known accurate polariztion, often circular polarization in the case of metal cutting and welding lasers. Since light undergoes a change of polarization on reflection, every mirror following the laser can degrade the polarization state. Ideally this should be eliminated as far as possible.

Degradation of the state of polarization is often measured as “phase shift” (an unwanted change in the electrical field of the laser beam). Solid metal mirrors have less than 0.5 degrees of phase shift, one of the lowest polarization effects known. Other vendors offer mirrors with phase shifts of up to 2 degrees, yet still misleadingly call these “zero phase shift.”

Phase shifts as little as 4 degrees can be seen to reduce the edge quality of laser cut metal, and this can happen with just two poorly specified mirrors. Where more than two mirrors are used in a laser beam delivery system, solid metal mirrors are the best choice.

Phase Shifting Mirrors

Sometimes called “polarizers,” “ECQ’s,” “retarders” or “wave plates.”

This type of mirror has a deliberate and large phase shift. To turn linearly polarized light into circularly polarized light, a phase shift of exactly 90 degrees is needed.

Some years ago coating limitations meant it was only possible to achieve a full 90 degrees of phase shift with two mirrors each of 45 degrees phase shift. Today, just one mirror with a sophisticated coating can give 90 degrees of phase shift. (90 degrees of phase shift is often called a ¼ wave shift since 90 degrees is ¼ of a 360 degree cycle).

Polarization Locking Mirrors

Laser resonators rely on small differences in the reflectivity of fold mirrors to different polarization states to give a stable linearly polarized output. In some cases the small reflection differences of the fold mirrors are not enough to keep the polarization from fluctuating. With dielectric coatings designed to give large differences in the reflection of S polarization compared to P polarization a truly stable “locked” polarization is achieved.

Beam Control

Lightweight mirrors – Aluminium has a low density (2.7g/cm3) and can withstand many kilowatts of laser power. Gold coated Aluminum is widely used for scanner mirrors, high speed shutter mirrors, high speed flying optics mirrors, and any application where lightweight and high power handling is needed. Aluminum is easily machined allowing mounting features to be made as part of the mirror. Click here to see scanning mirrors weighing less than 1 gram

Cylindrical mirrors – Used for generating a “line focus”. An intense line of energy can then be scanned over surfaces for heat treatment or for other applications. Weak cylindrical mirrors can also be used to correct the inherently astigmatic beams from slab laser discharges.

Shutter mirrors – When not in use, the laser beam is directed to a beam dump or some other collector. Shutter mirrors need to be lightweight to allow rapid movement in and out of the beam, and are often curved to disperse the beam into the dump. Convex axicons, convex cylindrical, and faceted mirrors are offered from copper and aluminum.

Cassegrain Mirrors – Mirrors with through holes are a specialty of Laser Beam Products. LBP's polishing technology allows surface form to be maintained right up to the circumference of through hole. Through holes can be central, angled through the mirror, or offset. Just about any shape that can be machined can be made into a mirror. Uniquely, our gold coating covers the mirror face, edges and internal surfaces of the mirror.

Knife edge mirrors – Used as a variable beam splitter, a knife edge can be passed into a beam to split the beam spatially, which is useful for beam profiling and analysis. Gold coated copper knife edges will work with many kilowatts of power, and are of course polarization insensitive.

Roof prisms – Are used to split a beam into two parts. This type of beam splitter is inexpensive, adjustable, polarization insensitive, and will work with high powers.

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