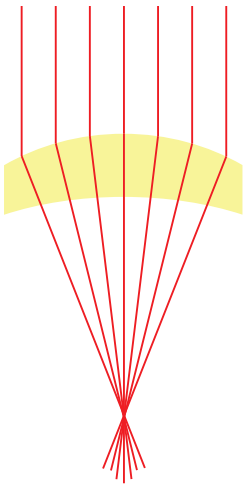
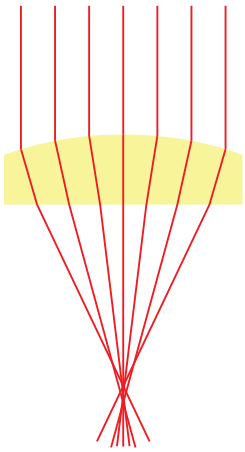
Perfect Laser Technologies

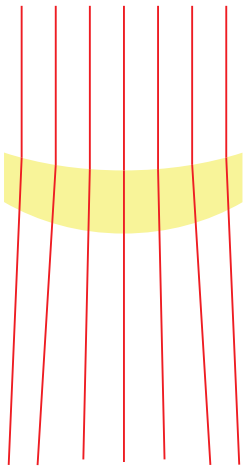
TECHNICAL BULLETIN # 4



Meniscus lens showing the light path - note the good convergence and focus point.



Plano convex lens showing the light path - note the poor convergence point and lack of



Meniscus lens installed upside down showing the light path - note the poor convergence point and very little focus.

Laser Lens Characteristics

In general, there are two types of focusing CO^2 laser lenses: Plano convex lenses - which have one convex surface (convex = dome-like curvature) and one flat surface, and Meniscus lenses which have one convex surface and one concave surface (concave = hollow curvature).

Whichever type your laser has, there is only one way to install it : the convex surface MUST face up.

In most professional CO^2 laser machines, meniscus lenses are used because they produce a smaller focus diameter (see drawings on left).

In some hobby and semi-professional CO^2 laser machines, plano-convex lenses are used because their production costs are a less.

It is important to note that even if a plano-convex lens and a meniscus lens have the same diameter, thickness and focal length, the focus position of the meniscus lens can be several mm higher if compared to the plano-convex lens.

A laser beam is an electromagnetic wave and therefore has properties similar to sound waves. One consequence of this is that a laser beam can not actually be focussed to a sharp point.

Instead the focus has a “spot size”. In general, by decreasing the focal length, the focus diameter is also decreased, with the consequence that the intensity of the laser beam is increased.

As high laser intensity is useful in most cutting applications, focal length should be as short as possible. However, a short focal length has the disadvantage that the beam diameter increases rapidly above and below the focus. Therefore, the maximum thickness of materials which can be cut efficiently is limited.

Absorption and thermal lensing

During laser operation, the focusing lens is heated because it absorbs a small portion of the laser power. Absorption takes place mainly in the coatings and at dirt on the lens. Heating of the lens causes additional surface curvature due to thermal expansion and increases the refractive index of the lens material.

As a consequence, the lens focal length becomes shorter, and the focus position cannot be predicted exactly because it depends on many parameters like laser power, laser intervals, cleanliness of lens, and others. If there are dirt particles on the lens, the lens material is not heated uniformly, but mainly at the areas close to these dirt particles, causing focusing properties to become worse; focus diameter to increase, and cutting quality to decrease.

Lesson for today : Keep your lens clean - and the right way up.

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