TECHNICAL BULLETIN # 9

More on lenses

Choosing the correct focal length laser lens

In general, the standard focusing CO^2 laser lens supplied with your laser is a multipurpose type of lens of 63.5mm focal length.

If you are cutting mostly 3mm or less MDF or plastics, the standard 63.5mm lens that comes with your laser should be more than adequate. However, if you are cutting a lot of thicker materials, such as 9mm or 12mm MDF, you may want to consider a longer focal length lens.

Your main concern here is the depth of focus requirement for the material to be cut. There are two main factors involved: the thickness of the material to be cut, and the distance between the lens and material.

So what is depth of focus?

Much like any form of light, the laser beam strikes the lens and converges to a focus point, after which it diverges. Optimal cutting occurs around the focused point. The depth of focus measurement is basically how far from the point of focus there is still likely to be sufficient power density to make a cut. This value varies from material to material, depending on its burning or melting threshold.

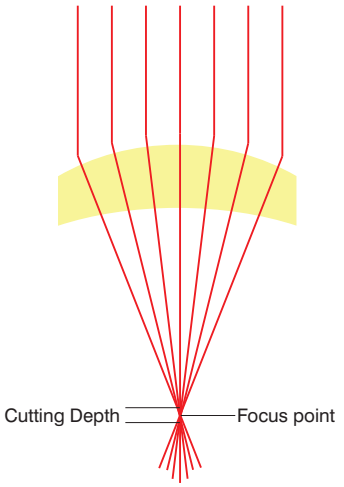
The drawings on the left show the cross section of the beam around the focus point for 63.5mm (2.5") and 101.6mm (4") lenses. Included on the bottom left is the 76.2mm (3") lens.

In summary, the focal length of the lens used in a cutting application should provide a depth of focus based on the material thickness, plus vertical height limitations on the laser head.

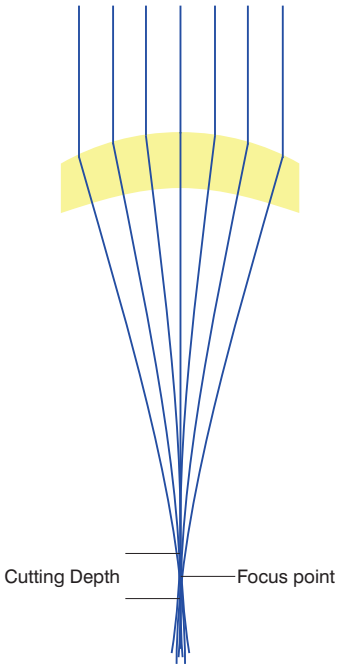
A laser beam is an electromagnetic wave and therefore has properties similar to sound waves. One consequence of this is that a laser beam can not actually be focussed to a sharp point.

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.

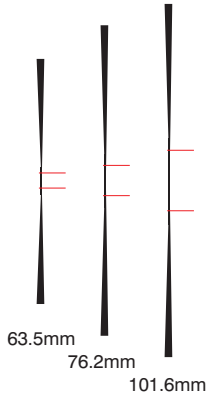
As high laser intensity is useful in most cutting applications, focal length should be as short as possible. However, a short focal length has the disadvantage that the beam diameter increases rapidly above and below the focus. Therefore, the maximum thickness of materials which can be cut efficiently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



Standard 63.5mm lens showing short depth of focus with small spot area.



101.6mm lens showing much deeper depth of focus with slightly larger spot area.



Effective depth of focus (or cutting depth) with the three main types of lenses mentioned in this bulletin.

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