INTRODUCTION

Recently, a new emerging technology of metal 3-D printing or LAM (Laser Additive Manufacturing) is recognized as the new advantageous process for metal parts manufacturing. For this application, lasers play a significant role since they can focus large amounts of energy on a wide range of material powders, fusing the particles into 3-D parts. Important laser and machine optical parameters need to be analyzed in order to insure repeatable and excellent results. The process is based on a layer-by-layer construction, wherein each layer is selectively fused on top of each other until the part is a finished product. Although many technologies are involved in making an LAM machine, this tutorial will concentrate in laser critical parameters and their measurements for better performance. Today, most lasers for 3-D printing machines are based on fiber optics high power technologies in conjunction with an optical scanning head for effectively placing the laser beam at the necessary locations.

PARAMETERS TO BE MEASURED

The most important parameters affecting the machine performance will then be: focus spot width and location, focal shift, centroid location, absolute power and the real time measurement of laser dynamics. Duma offers a measurement instrument that will perform these measurements in real time using knife-edge or camera systems technologies. Moreover, for ensuring precise measurements, the instrument has a special optical beam path design which is calibrated to the beam location at its fusing surface. To allow fitting the system into tight spaces, the system dimensions are minimal and in such a way that it can be integration as a part of the LAM machine.

MEASUREMENTS MADE EASY

The LAM Beam Analyzer is designed to enable exact positioning over the point to be measured by providing a reference hole on its bottom. Beams striking the input aperture will focus exactly on the surface layout where the instrument is stationed on. Laser beam position in 3 axis – XY and Z, will be displayed in real time relative to the reference hole. To complete required measurement parameters, the beam profile will be measured at this exact same location to yield a real time full test diagnostics.

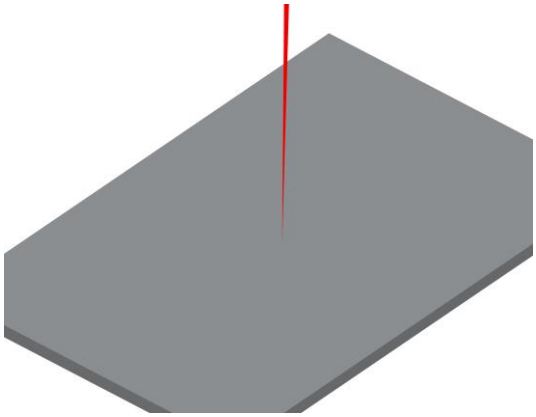

Figure 1

Figure 1 shows in a schematic way a focused beam designed to focus on the top plane. For quality assurance of laser beam performance, we'd like to measure the laser beam characteristics as follows: power, position & profile. In order to do so, the instrument will be accurately positioned at the point of interest – this is facilitated by a reference hole on the instrument's bottom, which exactly represents the measuring point of the instrument.

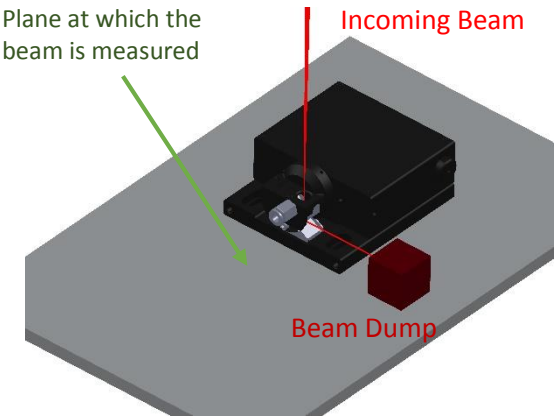

Figure 2

Figure 2 shows the instrument mounted on the point of interest on top of the plane, performing the necessary measurements. The ray trace design is such that the incident beam is sampled as if its position is exactly at the plane's incident point.