

# The Effect of Laser Beam Welding Parameters onto the Evolving Joints Geometry

Miklós Berczeli<sup>1, a \*</sup>, Gábor Buza<sup>2, b</sup>

<sup>1</sup>Department of Automobiles and Vehicles Manufacturing, Budapest University of Technology and Economics, Budapest, Hungary

<sup>2</sup>Bay Zoltán Nonprofit Ltd. for Applied Research, Budapest, Hungary

<sup>a</sup>berczeli.miklos@gmail.com, <sup>b</sup>gabor.buza@bayzoltan.hu

**Keywords:** disk laser, laser welding, welding parameter

**Abstract.** In our research the effect of a new type of laser beam parameters during the laser welding have been investigated with 80 different welding parameters. The laser welding parameters such as the laser power, laser beam spot size on the surface and feed rate greatly affect the resulting weld geometry. S235 grade steel has been used. The operating equipment was a TRUMPF 4001 4 kW disk laser with a diameter of 100 microns optical fiber. The effect of different welding parameters were evaluated from the metallographic cross-section of the welded joints. This article describes the effect of the different laser beam focusing and the welding feed rate.

## Introduction

The welding technology has become widely applied to aerospace, automotive, naval and other important industries. A possible solution to this, when the heat input is created by concentrated laser beam. The development of laser beam sources is one of the actual activities of the manufacturers, which can be achieved as a result of laser beam sources of better quality and performance. Not enough to concentrate to the laser welding technology parameters, also need to be specified the surface and it's properties of the connected materials [1-2].

One of the outstanding results of recent years is that a laser with multi-kW power could be attached to an optical fiber with a diameter of 100 microns [3]. Due to this, new laser beam parameters appeared, which are aught to be or barely known during laser beam welding. The laser beam welding has different technical parameters, the most important ones are the laser beam power, the welding speed and the beam spot position [4]. Different weld geometries are obtained by changing any of these parameters [5]. Previous experiments have shown that the selection of welding parameters can have a great impact on the weld shape [6]. For example high welding speed can form, in case of copper welding, a droplet-shaped weld having below the top surface even if the weld seam on the surface is narrow [7]. The new disk laser with the new optical fiber has better absorption, beam quality and electrical efficiency than the CO<sub>2</sub> laser [8]. The penetration depth and the welding speed obtained by the high-power disk laser are significantly improved. The new disk laser with the new optical fiber has great potential for industrial welding [9].

In our work therefore, we examined the effect of the laser welding on the results of this new type of laser beam source and unique optical fiber. S235 quality steel was welded with 80 different welding parameters using a 4 kW disk laser and an optical fiber with a diameter of 100 microns. The changes in geometry on the welded joints have been investigated, such as the effect of the focal spot position and the welding feed rate as well as the effectiveness of this laser beam source and optical system to the keyhole welding.