Powertrain Component Welding with HighLight FL-ARM Fiber Lasers

Introduction

Laser welding of high precision parts, like low carbon steel gears and powertrain components, requires a process that minimizes spatter. Spatter creates pores and voids which reduce component mechanical strength, and can also generate loose particles, which can get in between gears, potentially reducing powertrain lifetime. Powertrain component welding must also produce a heat affected zone (HAZ) that is small enough to avoid part distortion.

Process

CO_2 lasers typically provide good welding results, with minimal spatter, but many users prefer to employ near infrared solid-state lasers which can be delivered by optical fiber. However, in the past, these shorter wavelength lasers haven't provided adequate results. Here, we tested the ability of HighLight FL-ARM fiber laser (Fig. 1) to achieve similar results to the CO_2 laser.

The HighLight FL-ARM laser outputs a central laser spot surrounded by a ring, and the power in the ring and center can be independently controlled. In this case, the 0.2 mm diameter center and 0.6 mm diameter ring beams were focused by a standard welding head (3x magnification of the delivery fiber) on a workpiece mounted on a rotary stage. Argon assist gas was delivered by an off-axis nozzle (photo 2). To match industry throughput requirements we used a process speed of 5m/min. The required weld penetration was reached with a total laser power (ring and center) of 2 kW. We tested various ratios of ring and center power, and utilized a high-speed camera to assess the spatter.

Results

The HighLight FL-ARM fiber technology delivered a reduction of spatter by 70 to 80% as compared to standard fiber lasers. The weld seam was small, and so was the heat affected zone, leading to no part distortion. Figure 3 shows a cross-section (A) and the surface (B) of a weld produced using ARM (Adjustable Ring Mode) technology. This demonstrates that ARM technology is ideally suited for high-precision parts like powertrain components.

Application Field

Laser welding of power train components with adjustable ring and center mode high power fiber lasers.

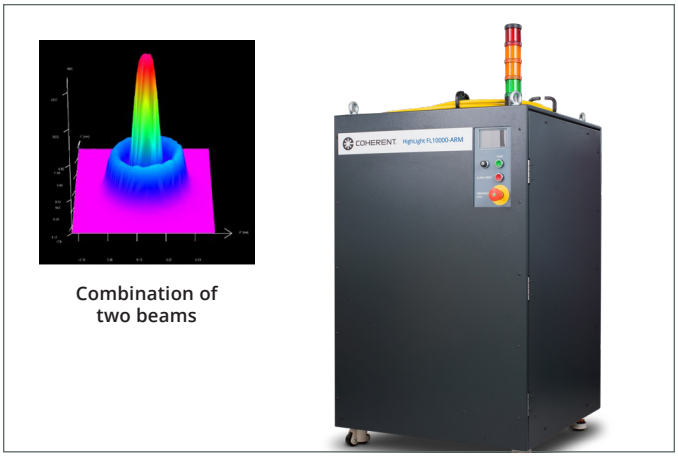

Figure 1. HighLight FL-ARM fiber laser

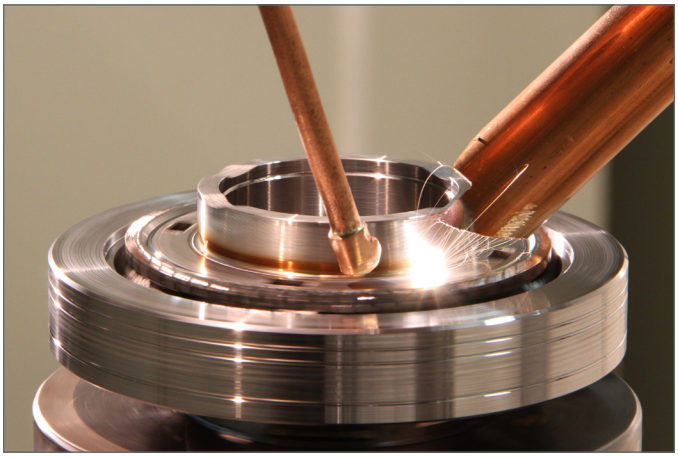

Figure 2. Powertrain welding test station

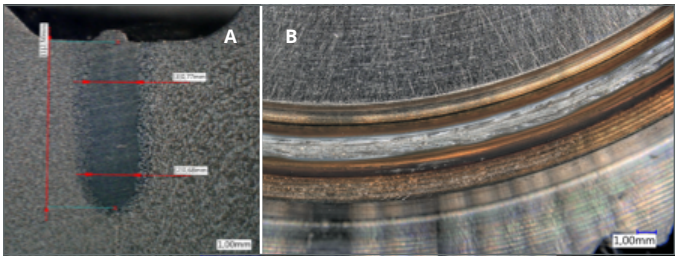

Figure 3. Cross section (A) and surface image (B) of HighLight FL-ARM weld in low carbon steel

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