

# APPLICATION NOTE

## Zero-Gap Welding of Galvanized Steel

### Introduction

Galvanized steel is widely used in the automotive industry for body in white (BiW) applications. In the past, zero-gap laser lap welding of this material has presented a challenge because the more volatile zinc evaporates first when the laser energy is applied. This resulting vapor pressure can blow out the molten steel, resulting in an inconsistent weld seam with pores, as well as spatter that needs to be subsequently cleaned.

### Process

In order to join two 1.25 mm thick electro-galvanized steel sheets, we utilized the HighLight FL-ARM fiber laser (Fig. 1). This laser delivers a dual spot, that is, a central spot, surrounded by another concentric ring of laser light, rather than the traditional, single peaked Gaussian distribution. Both the power and modulation of the core and ring can be completely independently controlled. This configuration enables more flexible and precise control over how laser power is distributed at the work surface. And the circularly symmetric power distribution means the beam doesn't have to be rotated when following a weld seam on a curved or oddly shaped part. This greatly simplifies practical implementation and enables the use of remote welding scanners.

In this particular case, the focused beam diameter used was 0.25 mm for the core and 0.6 mm for the ring. Laser power in the core beam was 600 W, and 4000 W in the ring beam. This configuration both pre- and post-heats the material, and also reduces the pressure at the center of the keyhole (Fig. 2). This allows the zinc gas to vent out easily through the center without producing any pores and spatter, even when the parts are clamped together with zero gap.

### Results

The HighLight FL-ARM fiber laser demonstrated the ability to weld galvanized steel without the need for a gap between the parts at the customer required welding speed of 3.3 m/min. This eliminates the need for the dimpling process to create that gap. The weld cross-sections shown in Figure 3 exhibit excellent quality with no pores.

### Application Field

Laser welding of galvanized steel for automotive BiW applications with adjustable ring and center mode high-power fiber lasers.

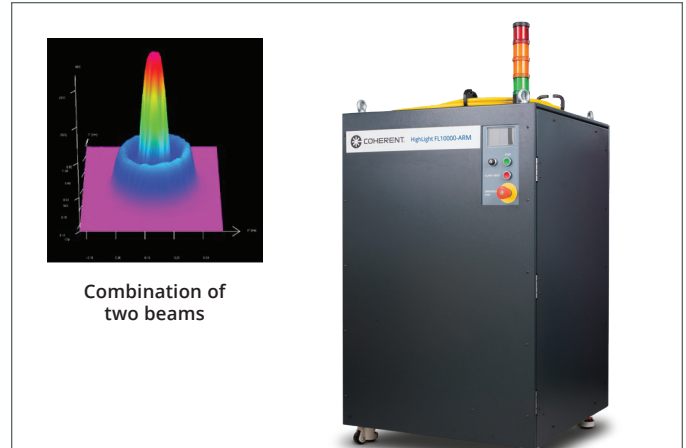


Figure 1. HighLight FL-ARM Fiber Laser

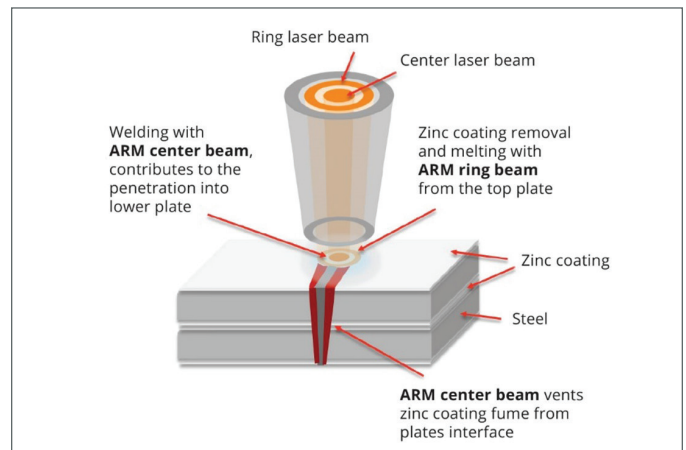


Figure 2. Welding process using HighLight FL-ARM Fiber Laser

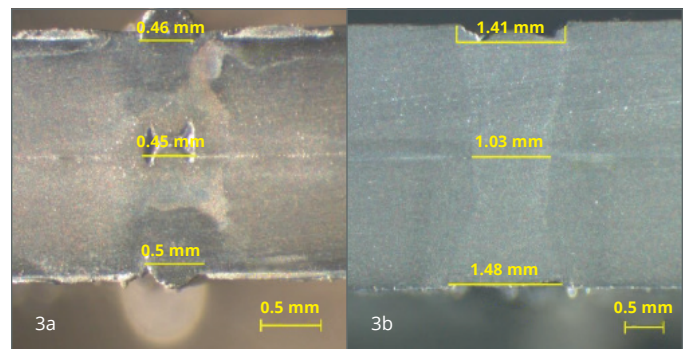


Figure 3a. Cross-section using a standard fiber laser resulting in pores.  
Figure 3b. Cross-section using HighLight FL-ARM fiber laser showing no pores.

### Contact

Coherent Application Lab: Hamburg, Germany  
Email: [appslab@coherent.com](mailto:appslab@coherent.com)