

### Introduction

There is a growing need to weld reflective materials used in the electrification of vehicles. The heart of these vehicles lies within the motor, in which, Copper coils are wound tightly creating a magnetic field that sets the stator in motion. The link between each coil is termed a “hairpin” and it is critical to ensure adequate electrical performance. Equally important, to achieving a good electrical interconnect, is ensuring that surrounding packaging and stator are left unharmed from the heat generated during the welding process.

### Current Process

Today hairpins are typically welded with a TIG or plasma arc process. These techniques generate a lot of heat, potentially damaging surrounding components, leave unwanted porosity creating a less than optimal electrical connection, and are limited in speed and automation. Conventional infrared lasers have also been investigated for this process – but poor coupling results in excessive power generating spatter, which can catastrophically damage the stator and induce inherent porosity within the weld.

### Testing

The [AO-650](#), in combination with the BlueWeld 100 focusing head, (Figure 2) was used to demonstrate the capability of using a laser for this process. Through this testing the hairpin joint was welded together in less than 10ms of laser on time. The result (Figure 3) shows a uniform spherical shape creating a strong bond between the two hairpins. Furthermore, the short period of time of concentrated heat has very little potential for damaging the surrounding component packaging or spattering metals to undesired locations.

The cross-sectional image (Figure 3) shows no defect from the weld, which ensures strong mechanical joint and good electrical performance.

### Summary

With a process speed of less than a few milliseconds, the ability to provide a defect-free and electrical sound weld was shown. The coupling efficiency of [NUBURU's](#) blue laser generates minimal heat input providing a clear advantage over current processes or other lasers, which can take far longer to achieve less than optimal results.

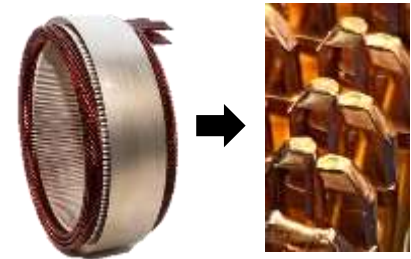


Figure 1. Electrical motor stator → hairpin



Figure 2. AO-650, BlueWeld 100



Figure 3. Top Image highlights the uniform spherical shape and heat affected zone generated from the process. Bottom image is a cross section showing no porosity or defect within the welded area.