

# Making Light Work



*Powertrain Part welded with Laser and Filler Wire*

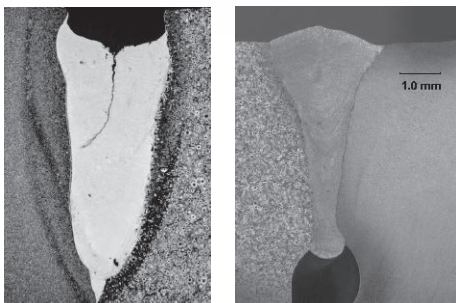
## Laser Welding of Powertrain Components

We are the experts in laser welding technology and have successfully developed many new applications which have now been transferred into volume production improving efficiency and product quality for our many industrial clients. Laser welding can be carried out autogenously (without filler material) or using metal filler wire or powder. Fraunhofer has state of the art equipment for both wire and powder delivery for specialist applications where it is required to close gaps or to improve the alloy composition of the weld metal.

**Laser Welding with Filler Wire** Cast Iron is used extensively in automotive powertrain components, particularly for differentials. In most conventional part designs a hardenable steel ring gear is bolted to a cast iron housing. If the bolting process can be replaced with welding, cost savings can be achieved through reduced material and processing costs, and an overall part weight reduction can be accomplished. Laser beam welding with filler wire addition can be used for joining cast iron to steel for powertrain components. The filler material changes the composition of the weld, preventing the formation of hard and brittle phases and improves the weld properties.



*Parts welded with Laser and Filler Wire*



*Laser Weld Joint without Filler Wire (left) and with Filler Wire (right)*

## PROCESS ADVANTAGES

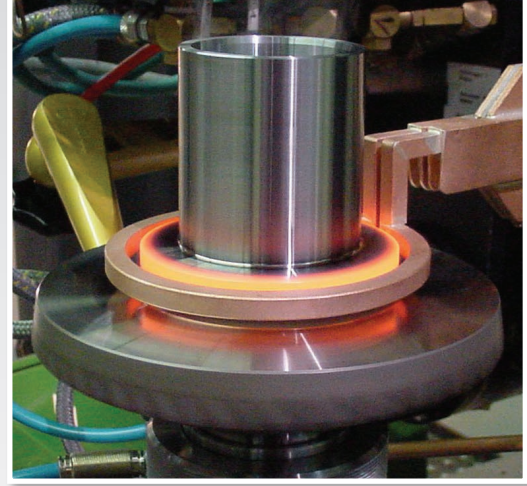
- High process speeds
- Low heat input and low distortion
- High automation and repeatability of the process
- Material and weight savings (by avoiding bolted assembly method and reduced flange sizes)



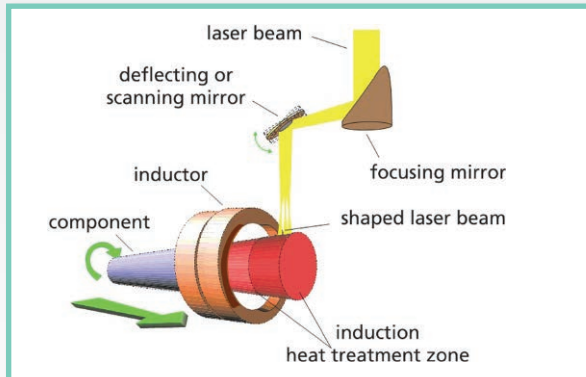
*Bolted Design vs. Laser Welded Design for an Automotive Differential Unit*

## Induction Assisted Laser Welding of Steel

Laser Welding is the preferred process for many joining applications due to its inherent low heat input and high welding speed. Until recently, laser welding of ferrous materials has been limited to low and medium carbon steels. Higher carbon content in steels leads to cracking in the fusion or heat affected zone, due to martensite formation during rapid cooling. The presence of undesirable weld microstructures and increased crack susceptibility limits the industrial applicability of laser welding for these materials.



Induction Pre-Heat Process

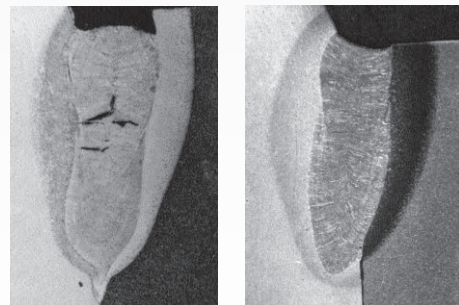


Schematic Overview of Induction assisted Weld Process

In order to prevent cracking, an additional heating source can be applied. Induction heating has the advantages of being fast, localized, and easily automated. The additional heat input from the pre-heat process reduces the cooling rate of the solidifying weld, in order to influence the time-temperature behavior of the material. By slowing down this cooling rate, more ductile phases can be produced in place of brittle martensite, leading to softer welds and crack elimination.

### FRAUNHOFER SERVICE

- Consulting & Part Design for laser welding
- Process Development
- Induction Coil Design & Induction Generators
- Clamp Tool Design
- Metallurgical Analysis
- Feasibility Studies
- Prototype Production



Laser Weld Joint without Induction (left) and with Induction (right)



Powertrain Components previously welded by Fraunhofer

### ADVANTAGES OF INDUCTION ASSISTED LASER WELDING

- Fast preheat time
- Crack-prevention in high carbon equivalent materials
- Prevention of undesirable microstructure formation
- Reduction of transient stresses
- Increase of welding speed
- Easily automated

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 **Fraunhofer**  
USA  
Center for Laser Applications