



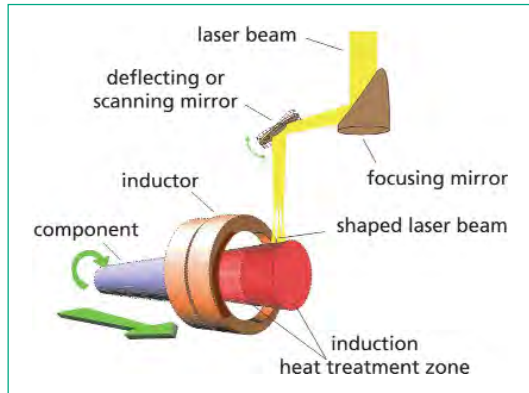
Induction Assisted Laser Welding of Steels

Issue

Laser welding is the preferred method for various joining applications due to a low heat input and fast welding speeds. Until recently, laser welding of ferrous materials has been limited to low and medium carbon steels. Higher carbon content in steels leads to a cracking in the fusion or heat affected zone, due to martensite formation during rapid cooling. This cracking limits the industrial applicability of laser welding.

Solution

To prevent cracking, an additional heating source is needed. 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.



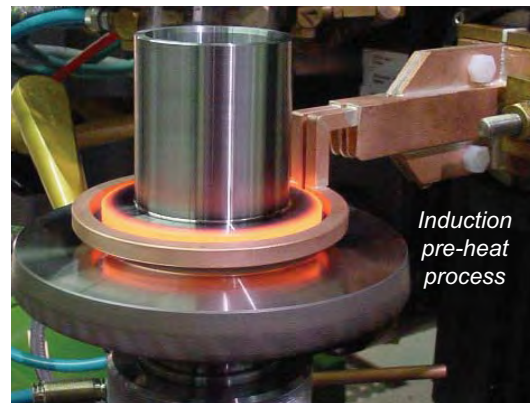
Schematic Overview of Induction assisted Weld Process

Advantages of Induction Assisted Laser Welding

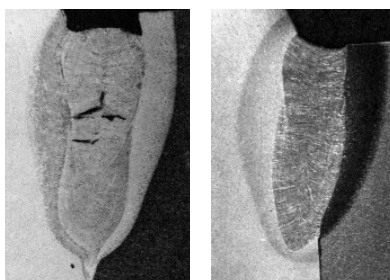
- Crack-prevention in high carbon equivalent materials
- Prevention of undesirable microstructure formation
- Reduction of transient stresses
- Increase of welding speed
- Easily automated

Fraunhofer Services

- Consulting, Part Design for laser welding
- Process Development
- Metallurgical Analysis
- Feasibility Studies
- Prototype Production



Induction pre-heat process



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



Making innovation a reality



Laser Welding of Cast Iron with Filler Wire

Issue

Cast Iron is used extensively in automotive powertrain components, particularly for differentials. In most part designs a cast iron housing is bolted to a hardenable steel ring gear. 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. However, the welding process must ensure low distortion and crack free welds to be considered.

Solution

Laser beam welding with filler wire addition can be used for joining cast iron to steel for powertrain components. Due to the low heat input of the laser process, minimal distortion and run-out are created by the weld process. The filler material changes the composition of the weld, prevents the formation of hard and brittle phases and improves the weld properties. This also makes it possible to weld heat treatable steels to cast iron without removing the carburized layer. For these applications, lasers with a high beam quality such as a CO₂, Disk or Fiber are used.



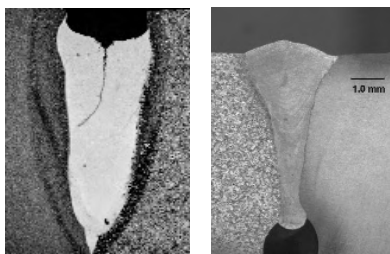
Laser Welding of Cast Iron with Filler Wire

Advantages of Laser Welding

- High process speeds
- High automation and repeatability of the process
- Low heat input and low distortion
- Material savings by the substitution of bolts and reduced flange sizes



Bolted Design vs. Welded Design of a Differential



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



Parts welded with laser + filler wire

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