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FRAUNHOFER INSTITUTE FOR PRODUCTION SYSTEMS AND DESIGN TECHNOLOGY IPK

Laser beam hybrid welded pipe rings,
outer diameter 914 mm,
wall thickness 16 mm

LASER BEAM AND HYBRID WELDING

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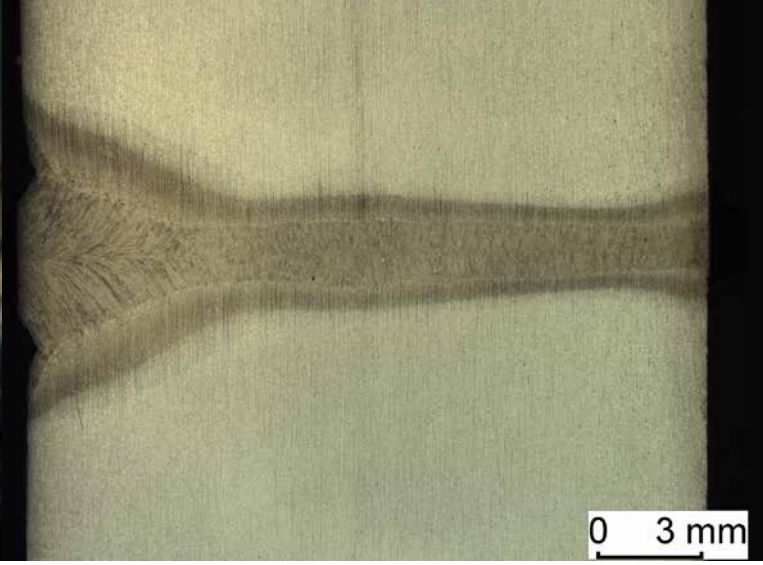
The output power of solid-state lasers has increased dramatically over the past few years. Not only do modern high performance solid-state lasers come with high energy efficiency, they also boast superb beam quality which is one of the decisive reasons why this technology holds such great potential for the welding of thick-walled components. The high focusability of the laser beam means that even great seam depths can be reached, while the greatly reduced weld cross-section in laser welding of thick plates offers tangible economic advantages. The laser welding technology developed jointly by Fraunhofer IPK and the BAM Federal Institute for Materials Research and Testing can weld together steel plates of up to 20 mm thickness in one pass. Multipass welding is recommended for plates of superior thickness. Special preparation of the welding edges, for instance, can lead to savings of extra material by a factor of 2.7 in a welding seam for 37 mm thick parts.

Laser beam hybrid welding technology is rapid, has a remarkable capacity for bridging gaps between the joints and is suitable for use in a variety of different spatial positions. Such flexibility makes this technique ideal for welding circumferential seams in the laying of pipelines where the welding process is carried out fully automatic around the pipe. With the appropriate parameter settings, pipeline sections with a wall thickness of up to 16 mm can be joined in a semi-orbital welding process with a maximum speed of 2.5 m / min.

Laser beam and hybrid welding produces minimum heat in the base material which makes it ideal for joining materials sensitive to excessive process heat as is the case with modern ultra-high strength pipeline steels. Furthermore, proper matching of the filler metal also makes it possible to metallurgically influence the mechanical / technological properties of the hybrid welded seam.

1



2

The advantages offered by the laser beam and hybrid welding technology not only benefit the pipeline construction industry, but are also interesting for such sectors as shipbuilding and machine and turbine construction. Construction of offshore wind turbines is another rich field of possibilities for laser beam hybrid welding.

Our expertise

Our work at Fraunhofer IPK is essentially concerned with application-oriented research and development of novel laser-based welding techniques for cost-effective reliable use in industry. In the field of laser beam and laser hybrid welding our focus is on the weldability of thick-walled components, alloyed and high-alloyed steels, nickel-based alloys, lightweight metals and crack-sensitive materials.

In our research work we deploy laser beam sources with an output of up to 20 kW. Our systems technology – two work stations with 6 axis industrial robots and external additional axes together with a 5 axis portal – offers a wide field of application for 3D processing. Our laser beam and laser hybrid welding technology is highly flexible and can accommodate components of up to 1.5 m in length.

Use of modern microprocessor-controlled welding equipment in association with a variety of pre-heating and process control techniques enable improved heat control and welding process diagnosis. Intensive research on the interdependencies between material behavior and process parameters enables us to use the advantages of laser beam and laser hybrid welding technology for new materials previously unamenable to processing. The quality of the welded parts is verified by extensive mechanical technological testing. Customer-oriented solutions that can be rapidly and flexibly engineered are always our prime concern.

Our services

We offer our customers a broad and needs-oriented range of research and development services related to the use of laser beam and laser hybrid welding in production processes. Our service portfolio is designed to offer companies across-the-board support from the product idea, consultancy and feasibility studies through to the implementation of the laser beam or laser hybrid welding technique in the existing manufacturing chain.

Working in close collaboration with the customer, we identify the exact process parameters that will generate quality welding seams that meet set requirements and with our proven scientific expertise we develop and steer novel welding techniques to the point of commercial maturity. As a competent partner, we also evaluate the economic viability of laser beam and laser hybrid welding for particular enterprise contexts.

Your benefits

Use of laser beam and laser hybrid welding in manufacturing is increasingly seen as an innovative alternative to other forms of welding. High processing speeds, deep welding seam depths, low heat loads, extreme precision and high automation potential are the decisive advantages offered by this technique. Leverage of this potential delivers laser beam and laser hybrid welded components endowed with technological and economic benefits that can sharpen the manufacturer's competitive edge. The team at the Joining and Coating division at Fraunhofer IPK is ready to assist and support you with its expertise. As an experienced independent partner, we engineer optimal solutions for your individual applications.

1 *Laser beam hybrid welding in the horizontal-vertical (PC) position*

2 *A laser beam hybrid welded seam on a 20 mm thick plate*