



LASER MSG HYBRID WELDING OF MOBILE CRANE BOOMS

THE TASK

Mobile cranes with their telescoping booms reach lifting heights of 100 m and, with a luffing jib, extend to 195 m. They can lift up to 1200 tons (Fig.3). Driving such cranes on regular roads requires lightweight designs. Those use fine-grained structural steels of the highest strength. Fabrication tolerances have to be low and welded components have to be as flat as possible.

The core components of such cranes are the telescoping boom sections. They consist of 2 to 16 m long edged and laser-cut half shell sections with sheet thicknesses of 3 to 12 mm. The two sections are welded along their length with two seams to build a boom section. Previously this weld consisted of two layers. A root weld was performed using MSG welding. Then the top weld was done using a UP welding process. Both processes were performed on different welding machines at welding speeds of less than 0.5 m/min. The process combination also caused large warpage due to the long and thin sheets, which in turn require much time for alignment.

An IWS industry partner funded the process development to reduce warpage and alignment time without sacrificing the performance of the welded parts. A requirement was to fabricate up to 7 segments of a single boom without the need for complicated retooling and costly clamping fixtures.

OUR SOLUTION

The solution applies a fully automated single layer laser-MSG hybrid welding process. The process combines high speed and deep laser beam welding with safely supplying the molten filler material.

The technology was developed at the Fraunhofer IWS Dresden (branch Dortmund) to weld steel constructions. Welding gaps between 0 mm (for stitching) and 1 mm are typical for steel constructions, which also may require welding sheets of different thickness in butt joint or fillet weld configurations. In steel construction, instead of being milled as is common in the ship building industry, the sheet edges are laser cut instead.

The solid-state laser has 12 kW of power to weld fine-grained construction steel sheets of 3 - 15 mm (welding gap 0 - 1 mm) at speeds of 1 - 6 m/min. The sheets are welded in PC position without bath support in a single layer. The energy input of the MSG process into the part is minimized using modified pulsed arc technology.

Prior to the laser-MSG hybrid-welding, one can use an autogenous laser welding process to hand-stitch the sheets (Fig. 1). The hybrid process welds directly over the stitches.

Naturally it is also possible to weld aluminum and stainless steel sheets that are thinner than 3 mm. Single-sided fillet welds can be made as well.



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RESULTS

At a customer site Fraunhofer engineers constructed a complete manufacturing plant for hybrid welding of mobile crane boom sections using the IWS process. Three laser-stitching booths are used to pre-attach the shell segments prior to applying the laser-MSG hybrid welding process. Therefore no expensive clamping fixtures are required.

A single production lot can consist of up to 7 different mobile crane boom sections. The lot is processed without changing the machine setup. The upper and lower edged section halves are up to 16 m long. By pressing them together, the local welding gap is reduced to less than 0.3 mm. Then they are stitched together using a 4 kW fiber laser with a handheld stitching head.

Double-sided rail systems and a crane are used to insert the stitched segments into the hybrid-welding machine. The laser-MSG hybrid welding machine is equipped with a 12 kW fiber laser. It is a large gantry plant with a work volume of 19.5 m x 3.5 m x 2.5 m. An industry partner developed this system especially for this application. The laser hybrid-welding head is automatically positioned using a weld seam-tracking sensor (Fig. 2).

A test series of 1000 sections was welded to demonstrate that all warpage and weld seam quality (Fig. 4) requirements were exceeded by the plant.

- 1 Tack welding of mobile crane segments
- 2 Hybrid welding process
- 3 Modern mobile crane with telescopic section boom

Polished cross section and strength values of a MSG/UP weld seam compared to a laser hybrid weld (SZW Union NiMoCr).



	MSG / UP	Hybrid
Re _H [N/mm ²]	950 - 971	1247 - 1255
Rm [N/mm ²]	983 - 998	1268 - 1262
A [%]	24/10 - 23/11	7/11 - 7/10

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