NASA TECH BRIEF

Marshall Space Flight Center

Industrial Laser Welding: An Evaluation

A report has been issued documenting a 10-kW laser welding system. The laser system was designed to laser-weld large structures made from 1/4-inch and 1/2-inch (0.88-cm and 1.77-cm) aluminum (2219) and D6AC steel of the same thicknesses.

The study, based on 150 separate weld cycles, determined that good-quality welds could be achieved in both the 1/4-inch and 1/2-inch D6AC, but a limited amount of preheat was required. If no preheat was used, the welds usually cracked. The 1/4-inch aluminum was successfully welded only after a heavy-duty, water-cooled shielding hood was developed. While full penetration of 1/2-inch aluminum was easily achieved using this hood, excessive and erratic dropthrough prevented the generation of good welds. By milling the material down and increasing the welding speed, acceptable top and underbead geometries were produced. However, these welds showed excessive porosity near the weld root. Limited reductions in material thickness reduced porosity.

The collimated laser beam is focused by a telescope positioned at the joint of the pieces to be welded. To aline the laser beam to the joint, the red beam from a He-Ne laser, coaxial with the high-power beam, is folded into the optical system. Gasses for both top and underbead shielding are controlled and metered from a gas manifold located just outside the work station.

For all of the D6AC welds, a hood containing both a forward-facing gas jet (used to prevent ionization of the laser-generated metal vapor) and a trailing shield (to prevent oxidation of weld molten metal) was used. For the successful aluminum welds, a hood that had evolved through several design states was used.

The original hood was built from pressed stainless-steel mesh which served as a diffuser both along the bottom and around the chimney. After the first welds were made in the thinner aluminum with this hood, the mesh at the bottom of the chimney burned out. The mesh was replaced with a porous bronze plate bonded in place with epoxy resin. Other problems occurred with epoxy contamination and soft-solder diffusion. The final hood was made from heavier-walled material with a machined seat for mounting the diffuser. Water cooling the chimney added to its durability.

Note:

Requests for further information may be made in writing to:

Technology Utilization Officer
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Patent status:

NASA has decided not to apply for a patent.

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