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Editorial

# An Overview of Laser Beam Welding

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## EDITORIAL

Laser beam welding (LBW) is a welding process that uses a laser to join metal or thermoplastic parts. The beam acts as a focused heat source, enabling for thin, deep welds and fast welding speeds. The procedure is commonly employed in high-volume, automated applications, such as the automotive sector. Welding in the keyhole or penetration mode is used. Laser beam welding, like electron-beam welding (EBW), has a high power density (on the order of 1 $MW/cm^2$), which results in small heat-affected zones and rapid heating and cooling. The laser's spot size can range from 0.2 mm to 13 mm, however only lower sizes are employed for welding. The depth of penetration is related to the amount of power delivered, but it also depends on the placement of the focal point: when the focal point is just below the workpiece's surface, penetration is maximum. Depending on the purpose, a continuous or pulsed laser beam may be utilised. Welding thin materials like razor blades is done with millisecond-long pulses, while deep welds are done using continuous laser systems. Carbon steels, HSLA steels, stainless steel, aluminium, and titanium can all be welded using the LBW technique. When welding high-carbon steels, cracking is a risk due to high cooling rates. The weld quality is excellent, comparable to electron beam welding. Welding speed is related to the amount of power applied, but it is also affected by the type and thickness of the workpieces. Gas lasers are ideal for high-volume applications because to their high power capability. LBW has a stronghold in the automobile industry.

The following are some of the advantages of LBW over EBW:

- Instead of requiring a vacuum, the laser beam can be transmitted through air.
- Robotic machinery can easily automate the procedure.
- There are no x-rays produced.
- Welds with LBW are of greater quality.

Laser-hybrid welding is an LBW derivative that combines the laser of LBW with an arc welding technology like gas metal arc welding. Because GMAW provides molten metal to fill the joint, this combination allows for more positional flexibility and the use of a laser boosts welding speed above what is generally feasible with GMAW. Weld quality is generally better as well, because the risk of undercutting is lessened. Although laser beam welding can be done by hand, the majority of systems are automated and rely on a computer-aided manufacturing system based on computer-aided designs. To create a final product, laser welding can be combined with machining. The RepRap project, which formerly focused on fused filament fabrication, has recently extended to include open source laser welding devices. These systems have been thoroughly defined and can be employed in a variety of applications while saving money on traditional manufacturing costs.

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