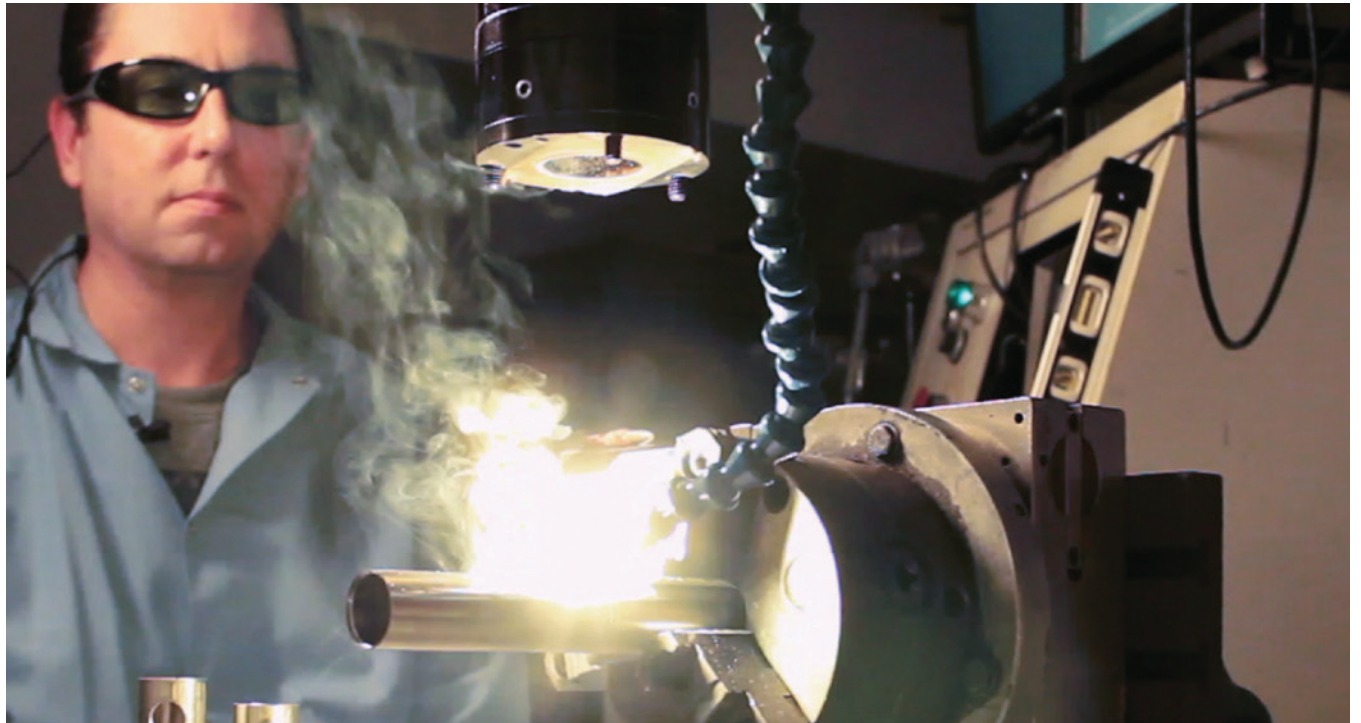


Tech Brief

The Advantages of Laser Welding Over Arc Welding



INTRODUCTION

Product designers and process engineers considering laser welding as an alternative to more conventional types of welding, such as MIG/TIG arc welding, will find each has its plusses and minuses. But for many applications laser welding is a cleaner, more precise, and more controlled method of welding and is especially useful when looking to bond small, thin materials such as medical tools, foils, and wraps.

Before comparing the two methods in detail, it's helpful to review how each of them works:

How Each Method Works

Laser Welding

In laser welding a laser beam is focused to a point usually just below the surface of the metals to be welded, causing the metals to heat and melt at the point of the weld. In their liquid state the two metals combine so that when they cool they are bonded. The laser beam has a high-power density (typically 1 MW/CM²) producing very small, heat-affected or HAZ zones. These are typically fractions of a millimeter to a few millimeters in diameter and they heat and cool very rapidly.

ARC Welding

Say the word "welding" and most people will immediately think of a person holding an acetylene torch like the kind they may have used in high school shop class. Today's industrial welding, however, is typically arc welding in which the heat source is an electric arc formed between an electrode and the base metals being welded. The two main types of arc welding are TIG and MIG.

In TIG (tungsten inert gas) an inert gas flows around the electrode to protect the weld from contamination. In addition to the electrode the welder also holds a stick of filler (flux) that melts in the heat of the arc and that, when cooled, bonds the metals. Excess filler that solidifies around the weld, called slag, must then be removed, usually by grinding. As filler sticks are consumed during welding they are replaced.

MIG (metal inert gas) is similar to TIG except that the electrode itself is composed of the filler material. The electrode is therefore consumed during welding and must be replaced when depleted.



Welding Methods

From the top: Laser Cutting, Water-jet Cutting, Mechanical Cutting.

Comparing Laser Welding to MIG and TIG Arc Welding

Types of material to be welded. Lasers can weld many types of materials together including many types of stainless steel, titanium, copper, and aluminum (although the two pieces being welded must be different kinds of aluminum). However, not all metal combinations are “bondable.” In conventional welding the metals don’t bond directly with each other but with the filler. So metal-to-metal compatibility is not an issue — which is why conventional welding can weld more types of metal than laser welding.

Material thickness. Laser welding is suitable for jobs ranging from as thin as .005 inches up to about a quarter inch (in the case of steel). That means that laser welding can be used for jobs where the metal is so thin that conventional welding would destroy it. On the other hand, conventional welding can easily handle large pieces — such as large pipes or structural beams in a building — that laser welding can’t.

Precision. The power output, size of weld, depth of weld, speed of weld, and the track of the laser beam on the metal surface are all highly controllable. The result is a very precise weld — you heat just what you want to heat to the degree you wish to heat it. Among other advantages versus conventional welding, there’s less likelihood of damaging or deforming the surrounding surfaces or components like electrical components that may already be installed.

Automation. Another benefit of a highly controlled process is that laser welding is highly programmable and robotic. Since it’s easier to automate compared to MIG or TIG welding methods, greater repeatability and faster throughput can be achieved.

Contamination. With laser welding, the only materials involved are the metals to be welded. For best results the metals must be cleaned of any oil and dirt prior to welding. The welding itself introduces no filler or slag that could contaminate application environments, such as an operating room in the case of surgical instruments.

Environmental impact. A cleaner process also means there’s much less impact on the environment.

Corrosion. With some metals such as steel, aluminum and titanium alloys, brittleness can result from conventional welding if the electrode used for welding contains traces of moisture. The heat of the welding causes the water to decompose and release hydrogen that enters the metal causing it to become brittle. This can’t happen with laser welding because there is no electrode.

How the Methods Compare

LASER WELDING ADVANTAGES
- Cleaner — no excess bonding material or slag to clean off
- Less possibility of contamination
- Can weld more complex shapes
- More precise — for smaller objects, tighter spaces
- Can weld thinner metals
- More highly repeatable results
- Easier to automate
- Less chance of deforming or damaging nearby areas
- More environmentally friendly
- Less likely to corrode

How the Methods Compare

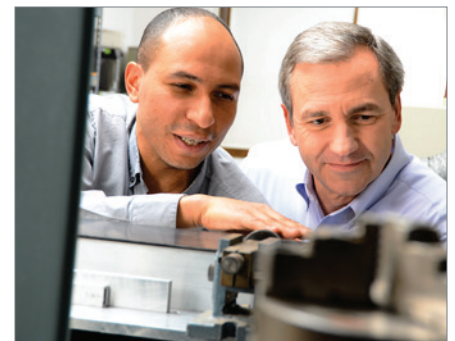
ARC WELDING ADVANTAGES
- More suitable for welding large structures
- Wider range of materials can be welded
- Can weld thicker materials

CONCLUSION

The best way to compare laser welding to arc welding is on the basis of your own product and production requirements.

- Are you looking for a very precise weld?
- Do you require an intricate weld pattern or is the area to be welded difficult to reach?
- Is minimal cleanup, low contamination risk, and low environmental impact important?
- Do you need to integrate welding with other manufacturing steps — so automation and high repeatability are both key?

If you answered yes to any or all of these questions then you may wish to consider laser-welding, especially if the metals to be welded together are thin. One way to know for sure which method of welding is best is by discussing your application with a laser-welding expert first, before you commit to a process.



Next Steps:

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