

**With past columns addressing design concerns, this month's installment asks—and helps you to answer—whether laser welding is feasible for your particular application.**

For the past few months the goal of this column has been to discuss the design requirements for laser welding. With an understanding of the basics for the designing of laser welded products, and some process knowledge, the engineer is able to decide if laser welding is feasible for an application. This month the feasibility considerations for a basic application are presented, followed next month with approaches to some more challenging applications. To determine the feasibility of an application one needs to answer the following questions: firstly, is it economical to laser weld; and secondly, is it technically feasible? Often these questions are determined concurrently, while creating initial samples for testing.

The evaluation for technical feasibility starts with the evaluation of part design and material consideration. A basic application complies with the design considerations of access, joint design, and material weldability. Since we have discussed these issues in prior columns we continue on with issues related to the performing of the weld process. The most common of laser welds are those that are performed autogenously and without the incorporation of other processes, such as induction pre-heating. Repeatability is the key element to consider when evaluating performance of any process. With laser welding repeatability is often the output, but only if there is suitable repeatability of the inputs. The basic application requires repeatability in part machining and preparation in order for the weld process to be executed with confidence in the quality of the product. When components are prepared for laser welding they must be free of contaminants which can cause blow-outs or porosity in the weld. Solvents, rust inhibitors, coatings, and other materials


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which can vaporize during welding are the leading cause of quality problems. Washing systems are ideal for the purpose of providing consistent preparation, but an experienced operator can be just as effective.

The next leading cause of quality problems arises from the design or machining of the components. Not only must the part come together without a gap at the joint interface, but machining tolerances need to be tight enough that once the assembly is placed in the fixture the joint is aligned with the focus point of the laser. Because a typical laser weld is approximately 0.060" in width, a general rule of  $\pm 0.010$ " tolerance in location of the joint relative to the focus axis is common. If two welds are to be performed on an assembly the design, tooling and process may have to accommodate the stack-up of tolerances. The CNC based laser system is not able to judge joint location without vision options.

Economic feasibility can be more difficult to determine than technical feasibility. Some organizations have experience with laser systems, having operators and maintenance staffs trained to support them, and are ready to implement new applications at minimal cost. For most shops a laser welding cell will be their first of a kind. Economic feasibility must include costs associated with additional equipment, facility preparation, and staff training. Since there is a great variation between shops we will look at a few of the common process factors to consider.

Laser welding equipment is expensive, efficient, and productive, relative to the more traditional joining processes of TIG and MIG welding. Research your need and buy only as much machine as your shop requires. Motion, controls, and material handling options can add up rapidly, possibly doubling the system cost over a manually loaded cell. Consider a laser source that operates at 80-90 percent of its power capacity. Most lasers perform well in this range, and by leaving 15 percent capacity in reserve you will reserve tolerance for adjustments between maintenance cycles, and some room for more aggressive process setting in your future. Since most laser welding applications are performed at travel speeds between 60 and 200 inches per minute, a laser cell has the potential to be as productive as three to 10 conventional welding cells. For this reason shops with volumes greater than 100,000 units per year find laser welding to be an attractive alternative. Basic laser welding is performed autogenously, without filler material, which is a positive attribute at higher volumes to reduce costs.

A final consideration not to be overlooked is the potential reduction in subsequent operations. Distortion is a major issue as heat input increases, so some second operations may be reduced or eliminated by implementing a low heat input process like laser welding. It is not unusual that laser welding is a final step in the manufacture of gear components. 

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