

Studying Increase of Speed Using Different Laser Welds

Dr Masoud Sabbaghi, Shahla Arabshahi and Shahrzad Arabshahi

Department of Electrical Engineering, Ashtian Branch, Islamic Azad University, Ashtian, Iran

Abstract: Laser welds are executed as single and double edge weld which are applied for sensitive welding and welding the steel aluminum etc dependent on sensitivity of the weld. In welding with double edge laser, a laser of CO₂ 6-KW is divided into two lasers with equal power and low space using a piece of mirror and then lasers are split and used for steel and aluminum welding. Double edge laser process is studied using high speed camera. In aluminum and steel, double edge laser is executed better and more flatly. In steel, welding quality increases with better coating and they have no defects of undercut, roughness, zegal, and crack.

Key words: Laser welds, Plasma, Laser transfers, Vapor Planes

INTRODUCTION

In double edge laser welding, when there is large space among laser, the main laser acts as a source of thermal weld and sequence ray deviates and has less role in increase of heat in weld. The weld created by laser process is flat and clean but single laser weld is rough and irregular. Use of high speed cameras, seam planes of the piece work cause to find changes in steel welding and unsafe planes and drops cause to keep the elongated holes open to prevent from eruption of planes during welding. Welding mechanism may be changed into main hole in weld pool with an increase laser space and welding speed with a decrease in laser force. Anyway, double edge laser welds are always flat and have equal welding parameters. It holds true in steel. But in aluminum laser welds, low welding point causes defective welding due to high flexibility high thermal conductivity and voltage of the manufacturing sections and for this problem, double edge laser welding Nd:YAG is used instead of CO₂. Laser welding is performed using method similar to drilling with laser machine. In fact, that machine can perform both activities. Focus and cycle of passes are considered only by changing auxiliary gas. The most effective method is deep laser welding method or Keyhole. For this work, a lens is used for centralizing laser on a surface of a metal point. In many of CO₂ lasers, mirror is used instead of lens; of course, work principles are equal in both of them. Although most metals reflect infrared light well, high bulk density of the reflected ray heats metal even above melting point. Liquids are usually more absorbent than the metals so that they are heated until evaporation. Then, some of the metal is evaporated after adding heat. The evaporated metal opens a cylinder like hole which is called keyhole and progresses to the end of the piece. By maintaining the surrounding liquids, this vapor is ionized by adding jet gas and turns into full absorbent due to the applied ray.

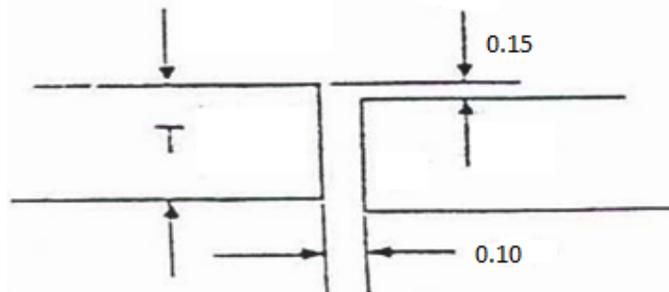


Fig. 1: limitations of weld joint size in laser welding

This action is called conductive welder of which effect is lower than that of keyhole welding.

Excessive power is also problematic. Power densities with coefficient of 10 watts in each sq cm (which is easily obtained with YAG laser) causes excessive evaporation and loss of metal.

Plasma Control:

Keyhole welding depends on the presence of stable plane of plasma. Many problems in laser welding result from unwanted plasma.

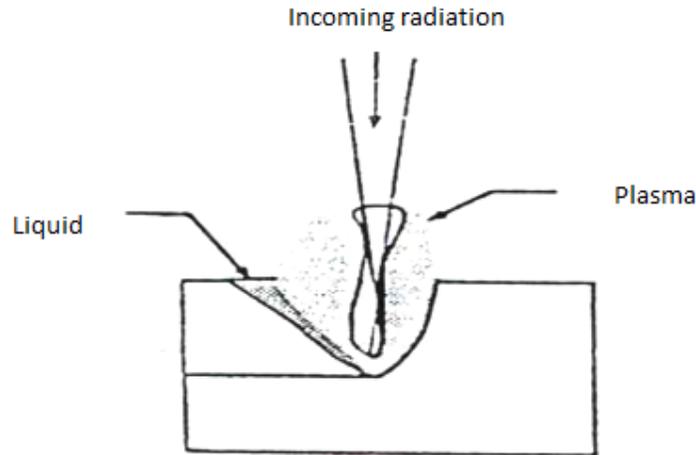


Fig. 2: plasma absorption

Laser transfers energy to plasma and plasma forms a cloud through the keyhole. This action usually occurs with laser power of above 1 kilowatts and argon protective gas. Plasma cloud absorbs a part of laser before reaching the keyhole and transfers it to its surrounding environment. Therefore, it causes reduction of power and inadequate penetration. The energy reflected from plasma widens the welding place. In addition, plasma cloud is mostly unstable and makes penetration production uncoordinated which is the worst thing. Laser powerful welders usually use helium gas as protective gas. It is imagined that high thermal conductivity of helium leads to suppression and prevention of plasma escape from keyhole and also density of the available cloud will be reduced. In order to reduce plasma, jetgas is used which repulses plasma from keyhole.

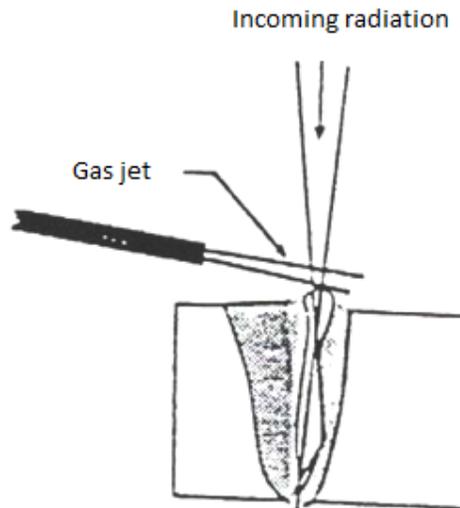


Fig. 3: dispersion of plasma

The highest efficiency of jets shows that its returns plasma to keyhole and maximizes useful power of laser. Such devices cannot be generally used probably because the keyhole should be exactly targeted and it is very difficult to control them at the beginning and at the end of welding phase.

Laser -welded matters:

Almost all lasers welding operations are performed on metal (quartz and thermoplastics stick in laser welding. the most important point which should be considered in laser welding is the welding action in which all metallurgy laws are observed. In metallurgy, laser welding centralizes on a small point intensively. Then, melting point is small and the desired part is heated and cooled rapidly. High temperature of keyhole evaporates the constituents. If the volatile matters are impure, welding piece will be pure. Matters such as zinc and magnesium escape from melting pool and lead to creation of a hole in the piece and because most stages of laser welding are immediate, some welded alloys cannot be welded with laser. A high power laser CO₂ is divided into

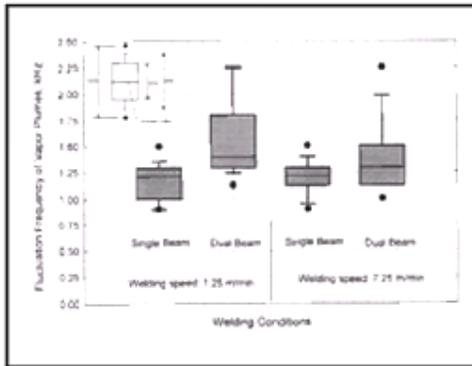


Fig. 6: Fluctuation frequency of the vapor planes

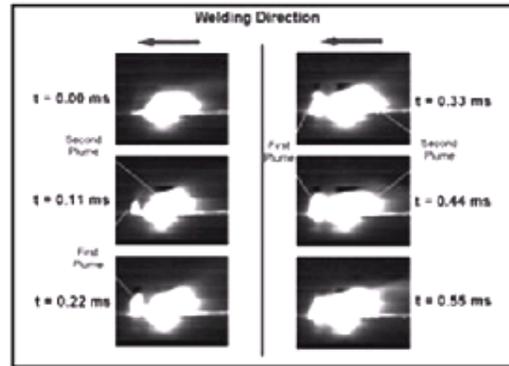


Fig. 7: two vapor planes in high speed

Advantages of Laser Welding:

- ✓ Molten pool can be created inside a clear environment (unlike the ordinary methods in which molten pool is created in the external surface).
- ✓ Very widespread range of materials such as alloys with very high melting points, heterogeneous materials etc can be welded to each other.
- ✓ In this method, one can weld inaccessible places to each other.
- ✓ Since no electrode is used for this purpose, there is no need for high currents for welding.
- ✓ Laser doesn't need any protective gas or vacuum for performance.
- ✓ Due to high focus of the laser, very narrow HAZ is formed in weld.
- ✓ Laser welding is cleaner than other welding methods.

Limitations and Disadvantages of Laser Welding:

Laser welding systems is more expensive than other traditional welding systems and some lasers such as Ruby have lower forward rate (25 to 250 mm/min). This kind of welding has depth limitation. Laser beam is used for cutting and welding. This kind of welding is applied in welding of very small electronic parts and other micro welding. Laser beam can be used for welding alloys and super alloys with high melting point and for welding heterogeneous metals. Generally, this welding method is used for precise and sensitive purposes. This method can be used in automotive industry and its assembly for welding the long joints.

Conclusion:

A 6-kw CO2 laser beam was divided into two beams with equal power with short distance with a piece of mirror and then the laser beam was split or double edge beams were used for steel and aluminum sheets welding. Results of welding were analyzed and double edge laser process was studied using high speed camera for better understanding of effect of double edge laser beams on welding quality. The following results were obtained:

- 1- Quality of welding surface was improved for both aluminum and steel using double edge laser welding technique. Using double edge laser welding technique, they may obtain applicable aluminum welds for use of CO2.
- 2- Use of high speed cameras, vapor planes were detected above the instable piece work and height and volume of planes dramatically changed single laser welding in steel. Unsafe planes may lead to defects of welding such as holes on irregular grain surface and drops.
- 3- Fluctuation of vapor planes should be detected to prevent double edge laser welding. The strengthened vapor plane showed double edge laser beams which could stop elongated main hole to prevent eruption of planes during welding.
- 4- In the present experimental installation with two laser beams parallel to a small beam space, a common main hole was created in a welding pool under most welding conditions. Welding mechanism may change to two main holes in welding pool with an increase in beam space and welding speed with a decrease in laser power.

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