Diesel Emission Sensor – Laser welding case-study

Inconel alloys are heat- and corrosion-resistant, suitable for service in extreme environments. In this case study, and Inconel 625 alloy tube is laser welded to a machined part made from similar material.

An 8mm outside diameter Inconel tube is required as a corrosion- and heat-resistant shield in this application, where diesel emissions at elevated temperatures would corrode a lesser alloyed steel assembly. A strong, gas-tight rotary laser weld between the outside of the tube and an Inconel machined part is shown. Inert gas is used to shield the weld area from oxygen during the welding process. A close fit between the tube and component is required, as no additional filler metal is used.

Laser welding of similar alloys containing nickel tends to lead to good strong welds, whilst welding dissimilar alloys requires investigation and the possible use of fillers to ensure good welds. Similarly, titanium, stainless steel and other materials can be subject to good strong laser welds.

Like electron beam welding (EBW), laser welding has high power density, of the order of 1 megawatt/cm² (MW), resulting in small heat-affected zones and high heating and cooling rates. The spot size of the laser can be varied between 0.2 mm and 2.0 mm. The depth of penetration is proportional to the amount of power supplied, but is also dependent on the location of the focal point: penetration is maximized when the focal point is slightly below the surface of the work piece.

A continuous or pulsed laser beam may be used depending upon the application. Milliseconds long pulses are used to weld thin materials such as razor blades whilst continuous laser systems are employed for deep welds, which can take on a keyhole shape, down into the joint between the metals.