SOLDERING VS WELDING

Background

Soldering is a technique that has been used for many years in the dental field. As solder became an industry standard, innovative technologies were creeping into the market to rival this technique. Although lasers have been around for many years they were never precise enough to be able to differentiate between metal thickness. Today's lasers are smarter and more user friendly than ever before. This article will discuss the differences between solder and laser welding and how laser welding has become a very important part of laboratory production.

Soldering Technique

The technique of soldering has been utilized for hundreds of years and has been applied to the dental field ever since the development and fabrication of appliances. Soldering, by definition, is the process in which two or more metals are joined together by flowing a filler metal into a joint. In order for the solder to flow properly around the two parts being joined, flux (Latin for flow) is needed. Although solder has been used without problems for many years, there are some qualities of solder that cannot compete with the laser welding technique currently entering the industry.

When soldering, the solder is heated to a temperature that will allow it to flow evenly. In this process if too much heat is applied it can anneal or weaken the surface resulting in a joint that has been compromised. This can result in a break at the weakest point, usually where the solder meets the band.

Solder is a material that is composed of many different metals including silver, copper, nickel, zinc and tin. Since these metals have different melting points, most solder joints are not porosity free. Appliances with these solder joints go into the mouths of patients with small voids where the materials do not come together, as seen in the picture below. These spaces can harbor food and bacteria making the appliance unhygienic, causing bad breath. In addition, this traditional solder joint allows for saliva to penetrate the joint weakening it over time.

Soldered Joints

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Since solder is an added material that holds other metals together, it will slowly wear away like water washing over a rock, smoothing it. The porosity of the solder combined with the penetrating saliva and the movement of the patients' tongue running over the joint greatly increases the likelihood for appliance failure.

Laser Welding Technique

A lot of noise has been made in the past few years about CAD/CAM systems and its innovative impact on the dental industry, but it seems that the laser welder has made the greatest functional impact. Laser, by definition, stands for light amplification by the stimulated emission of radiation. This technique of welding uses a specialized laser to fuse two metals together with electricity.

During the laser welding process, two parent metals are fused together without the use of any added material. Once welded the two metals have literally become one and we are over 250% stronger than a solder joint. Due to the laser's supreme accuracy the heat given off by this process is so minimal that the joint is not adversely affected. This technique results in a durable and precise joint without porosity resulting in a hygienic appliance that has little to no failure rate.

Laser welded appliances have a longer life span and are easier to place in the patient's mouth. Solder incases the lingual surface of the band from the occlusal to gingival margin. This often results in blanching of the tissue at the gingival level as well as the inability to adjust the band position from the lingual side. With a laser welded joint, the welds can be placed higher occlusally on the band so blanching does not occur. A laser welded joint also doesn't "lock" the entire lingual surface of the band with material. The smaller and stronger laser joints result in high patient comfort, better adjustability and an appliance that can go the distance without failure.

Laser Welding Detail

You can't really join metals with adhesive—not with ordinary glue, anyway. But you can join them by melting them together in a process known as **welding**. The basic idea is simple: you apply a source of heat to melt the two metals so they fuse and form a

secure joint. Usually (though not always) you add other materials as you apply the heat: a **filler** (an extra piece of metal, supplied from something called a **welding rod**, which seals up any gaps where the main metals meet) and a **flux** (a nonmetallic chemical that helps to stop the molten metals forming oxides and nitrides with gases in the air, which weakens the joint). As an alternative to using a flux, you can weld in an atmosphere from which the air has been removed (filled with other, nonreactive gases such as argon, for example).

Most forms of welding involve joining metals with heat alone. But they differ in where the heat comes from. One common form of welding involves using an **oxyacetylene gas** torch, which makes an intense flame by burning acetylene (an energy-rich fuel made from a simple hydrocarbon molecule) in a rich supply of oxygen. Although convenient and portable, oxyacetylene torches are relatively expensive to use (because the fuel is supplied in gas cylinders). In factories, it's usually more convenient to weld with electrical power using a technique known as **arc welding**. Instead of a gas torch, you use a piece of metal called an **electrode** connected to a high-current power supply (hundreds of times higher than the ones that flow through appliances in your home). As you bring the electrode up to the joint you're welding, it creates a spark or arc that melts the metals together. Arc welding produces both bright visible sparks and discharges of ultraviolet light, both of which can lead to blindness; that's why you'll always see people arc welding behind wraparound protective visors. Other heat sources for precision welding include ultrasonics, lasers, and electron beams.

You can also weld materials by forcing them together through sheer pressure, with or without extra heat. This is known as **pressure welding**; used for many hundreds of years by blacksmiths and other artisans, it's one of the oldest metalworking techniques. The basic process involves heating metals in a forge and then hammering them together so they fuse.

One way to make arc welding safer is to get an industrial robot to do it for you. Car bodies have been welded by robots for decades. The first welding robot, the Unimate, made its debut in a General Motors plant in 1961.