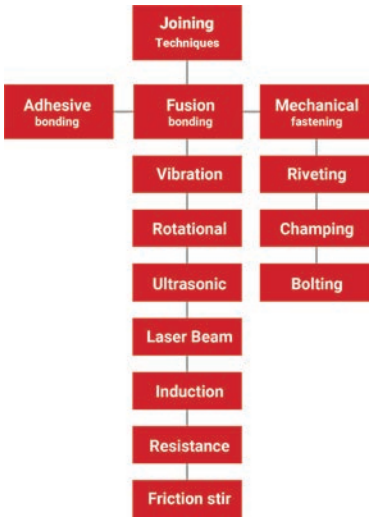
Which assembly technology is right for my application?

Ultrasonic Welding or Bonding? (For structural applications)

At VIAL Automation we help our customers assemble components for their projects and more importantly, we help them find the best way to do it.

Initially, we look at the project in the planning stage and decided which technology to recommend, based on many aspects, such as materials to be assembled, cost (CAPEX and running cost), process and qualification costs, process time, and space requirements among others. Then we accompany our clients through the industrialization process, by making initial samples in our laboratory, building a suitable automated and handling process around the assembly itself, and supplying a line to assemble the parts – alternatively, we can make also assemble the parts for our customers.

Our initial recommendation is based on both theoretical and practical knowledge of the various process, here we would like to share some of the theories behind such a recommendation.



In this article, we will compare Ultrasonic Welding with Bonding. Important to remember there is no “One Size fits all”, it always depends on your project and application.

Both Ultrasonic welding and bonding, using an adhesive in liquid or solid-state (tape), lead to a permanent assembly, which cannot be dis- and re-assembled at wish.

Material compatibility

There are no absolute rules, but very clear tendencies.

Bonding – used with the right surface treatment, adhesive system, and primers – has the unique quality of being able to join almost any 2 materials, irrespective of the physical and chemical properties, and can accommodate almost any combination (metals to plastics, thermoplastics to thermosets, wood, ceramics, etc.).

Material with low surface energy (such as polyolefins) tend to be difficult to bond to, and their surface must be activated, flame treatment is the method of choice, and primers can also be used to improve the wettability of these plastics.

Ultrasonic welding is more suited to joining similar classes of materials (plastic to plastic or metal to metal). Semi- or non-crystalline polymers (Polystyrene, ABS, Polycarbonates, and PVC) are better suited to Ultrasonic welding than highly crystalline polyolefins, this has to do with the broad melting temperature range of semi-crystalline polymers.

General bonding guidelines

- Adhesives can easily be applied manually or by a robot to various shapes without retooling
- Adhesives need time and space in which to cure (or dry)
- The adhesive itself adds to the variable cost of the joining process, which can be an important cost consideration

Thus, bonding is well suited for small series or bespoke applications, that is one of the reasons bonding is extensively used in industries where smaller series, like the railway and aerospace industries.

The Bonding Process

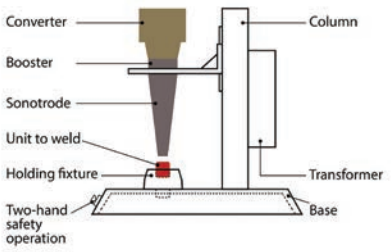
With bonding, particular attention must be given to the quality of the process. It is well known that quality must be built into the product and not tested afterward, this is particularly true for bonding, since there is no non-destructive way of ensuring that a bonded joint is true and will perform.

The aviation industry is an extraordinary example of quality assurance in the bonding process, it is used extensively in all forms of airplane making, civil aviation being one of the safest means of transportation, proves how well the process is controlled.

A well-controlled process must be established and regularly audited making it a highly reliable and valued way of making long-lasting joints. On the downside, the process costs for bonding are high and must not be forgotten when planning the process fixed costs.

General Ultrasonic welding guidelines

The energy of the ultrasonic waves must be transferred to the part as near as possible to where the weld will be. This is done by using a sonotrode, which is an ultrasonic loudspeaker, and is a bespoke part that must be designed and manufactured to fit each application.



The process itself is very quick, a few seconds at most, it ends as soon as the ultrasounds stop, meaning the part can immediately be handled and continue to the next operation.

The Ultrasonic Welding Process

An ultrasonic welding unit only consumes a small amount of electricity, has no extra materials, and is almost maintenance free meaning variable costs are almost nil.

Importantly a 100% testing is built into the Ultrasonic Welding process, if for any reason the ultrasonic joint is not being formed, the energy dispensed will not be absorbed, which the welding apparatus with register and immediately reject the part.

CAPEX for Ultrasonic welding equipment is relatively high, the tooling is bespoke and variable cost is low, making Ultrasonic Welding the method of choice for large series of identical parts, such as in the automotive industry, EV-batteries being a rapidly emerging field for Ultrasonics.

Using ultrasonic welding as the joining process can bring a clear return on investment because it requires a one-time investment in capital equipment, which can be scaled up using existing equipment and processes. There are no incremental consumable or assembly costs.

Conclusion

Substantial improvement to the joining behavior – both for bonding and ultrasonic welding - can be achieved by optimizing the joining surfaces, **we recommend discussing your joining options with a specialist in the part design stage.**