

Ultrasonic Welding of Thermoplastic Composites

Process Summary

Ultrasonic welding is a process technique for joining materials via the application of heat which has been generated through the conversion of high frequency mechanical vibrations and combined surface/intermolecular friction. This energy conversion results in a solid weld between materials.

Welding, also known as fusion joining, is considered to be a technique ideally suited for the joining of thermoplastic composites. It aligns well with the main characteristics of thermoplastics, which allows for them to be melted and re-set whilst retaining their properties. There are several fusion joining techniques and they are usually classified by the type of heating being used.

Laminate thicknesses of up to 5mm can be welded using the ultrasonic welding technique. Beyond that thickness the materials begin to dissipate the input energy to a level where it becomes unfeasible to employ this process.

The current HVM Catapult capability can weld continuous fibre reinforced thermoplastic laminates up to 3mm in thickness.

With additional consideration the joining of thicker or dissimilar materials is possible.

Process Advantages

Some of the process advantages offered by ultrasonic welding include:

- Extremely short weld times, potentially less than one second
- Homogenous welds
- Easily automated
- No need for foreign filler material
- Low energy input

HVM Catapult capability

The HVM Catapult ultrasonic thermoplastic welding capability is a Branson®2000X series 2.5kW welding system located at the National Composite Centre (NCC). . Further details are provided in the table below.

This system is currently used on early stage thermoplastic material joining to establish and better understand bond limitations and factors affecting these.

This equipment has been demonstrated to weld coupons of approximately 3mm in thickness in its current configuration.

Branson®2000X series	
Maximum power	2.5 kW
Converter output	20 kHz
Maximum force	50 kN
Maximum vibration amplitude	120 µm (peak to peak)
Stroke distance	150 mm
Booster Options	1:1, 1:1.5, 1:2.5
Horn Options	Various flat face (inc. one knurled)

Table 1 Branson 2000x series specification

Typical applications

Ultrasonic joining of composite fibre reinforced thermoplastics remains a relatively new facet of the wider welding processes and as such has not yet been wider adopted by industry. Typical examples of potential applications are envisaged to be wide ranging and could include:

- Non-structural aerospace components; brackets, skins & stiffeners etc.
- Automotive parts; body joints, interior panels etc.

Recreational components; sports equipment



Figure 1 NCC's ultrasonic welding machine.

Contact Details

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