



## Industrial Member Report Summary – Key Findings for Industry

### Development of a Thermally-Assisted Piercing (TAP) Process for Forming Holes in Thermoplastic Composites

#### TWI Core Research Programme

Authors: Nick Brown and Chris Worrall

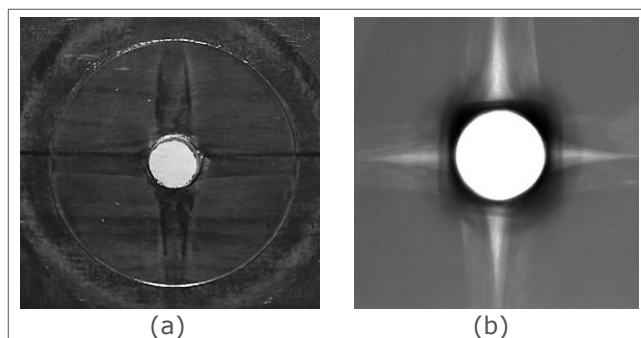
#### Industrial need

Machining of composites is a complex issue due to the heterogeneous material composition and the impact this has on tool wear, tolerances and the resulting mechanical performance of the part. The majority of machining processes adopted by industry cut the reinforcing fibres and remove material – hindering structural performance and possible weight savings.

Thermally-Assisted Piercing (TAP) is a material displacement process that can be used to displace fibres while forming a hole in Thermoplastic Composites (TPCs) at various stages of manufacture or subsequent processing. The aim of this study was to identify key material micro-structures after piercing and how they affected the mechanical performance of pierced composites, compared with conventionally drilled composites.

#### Key findings

- The microstructural architecture after piercing was significantly different to that of both a drilled specimen, and the parent material.
- Open-hole tension and compression strengths were higher for pierced specimens when compared with drilled specimens.
- The pierced specimens showed a reduction in pin and bolted bearing strength when compared with drilled specimens.
- Digital Image Correlation (DIC) results suggested that the resultant material architecture, created when piercing, reduces the concentration of strains caused by the hole and increases open-hole performance.



Pierced holes (using the TAP process):  
(a) Photograph of hole; (b) X-ray image of hole.

#### How to benefit from this work

- As an Industrial Member of TWI, you have free access to the [full report](#)
- If you are not an Industrial Member of TWI, find out how your company could benefit from Membership [www.twi.co.uk/membership](http://www.twi.co.uk/membership)
- Find out about a related follow on CRP project that is developing the technology further for more specific industrial application
- Contact [chris.worrall@twi.co.uk](mailto:chris.worrall@twi.co.uk) to learn more.



TAP rig with pierced composite laminate.