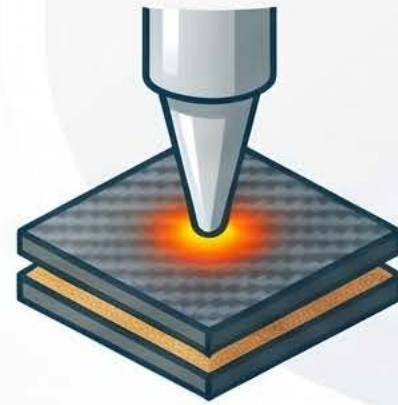
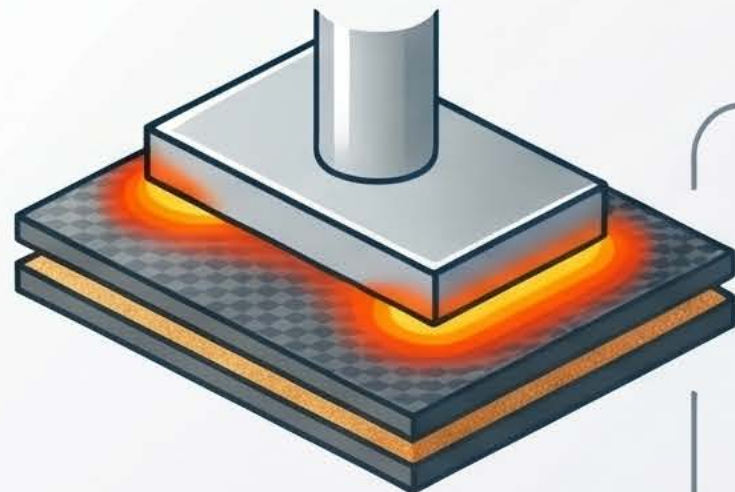


# Optimising Ultrasonic Welding for PEEK/SCF Composites



Ultrasonic welding (USW) is a high-productivity technique for joining thermoplastic composites. This research identifies the optimal balance between welding duration, anvil geometry, and energy director thickness to maximise joint strength in PEEK composites reinforced with 40% short carbon fibres.

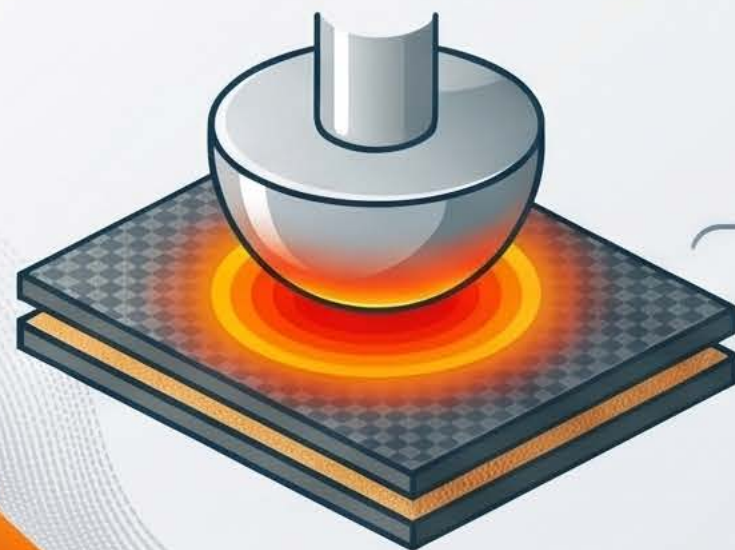
## ANVIL PERFORMANCE: FLAT VS SPHERICAL



**Flat Anvils Cause Peripheral Heating**  
Frictional heat develops primarily along the edges of the fusion zone.



**Fusion Area Dictates Fracture Mode**  
Total fusion areas exceeding 200 mm<sup>2</sup> are required for acceptable shear strength.

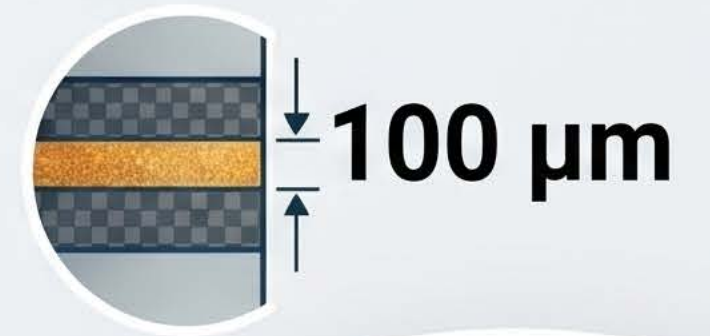


**Spherical Anvils Localise Central Heating**  
Energy concentrates in the centre, creating more uniform structures with lower energy input.

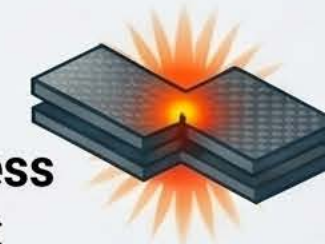
## OPTIMAL PARAMETERS FOR JOINT STRENGTH



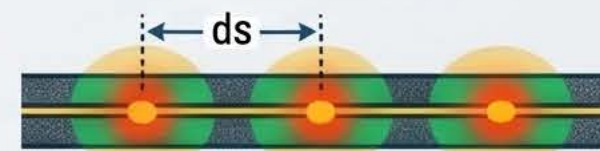
**100 μm is the Rational ED Thickness**  
This thickness achieves >11 MPa shear strength and minimises material damage.



**No-ED Welding Achieves Peak Stress**  
Single-spot joints without directors reach stresses >60 MPa but have limited load capacity.



**Balance Multi-Spot Pitch and Thickness**



Spot distance must be precisely calculated to prevent overlapping heat-affected zones.

## Comparison of Joint Performance

