Damage detection and mechanical performance of self-piercing riveting joint of CFRP and Aluminium 5754

Background

Project Aim
To examine if SPR joint is suitable for composite material

Objective
• To investigate the mechanical performance of SPR joint of CFRP and Aluminium 5754 with tensile testing
• To damage detect and analyse the damage of SPR joints through NDT testing
• To examine if the SPR joint can be used in an industry standard

Experimental Method

Damage detection
• 2.7mm CFRP as top layer and 3mm Aluminium 5754 as bottom layer used as sheet material
• 40x40mm coupon
• Different combinations process parameter used such as die and setting velocity

Tensile testing
• 40x120mm coupon

Results & Discussion

SPR Joint Quality Criteria
To determine a good quality joint, the joint criteria was determined using three factors:
1) Head height: In between 0.3 to -0.5
2) Interlock distance: Minimum 0.4
3) Remaining bottom material thickness: Minimum 0.1

Material Elastic Modulus (GPa) Yield Strength (MPa) Ultimate Tensile Strength (MPa) Elongation (%)
Aluminium 5754 70 215 260 14
CFRP 165 1315 55 2.15

Joint number Head height Interlock distance (Average) Remaining bottom material thickness Status
1 (A) -0.06 0.635 1.19 PASS
2 (C) 0.1 0.275 0.91 FAIL
3 (K) 0.07 0.48 0.73 PASS
4 (T) 0 0.435 0.41 PASS
5 (Custom) -0.04 0.6 0.1 PASS

Future Work
• Carry out NDT testing such as infrared technology, ultrasonic testing and digital shearography to evaluate the damages seen from electron microscopy
• Evaluate damages by changing rivet geometry

Reference