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Effect of drilling parameters on hole quality and delamination of hybrid GLARE laminate

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Abstract: The hole-drilling technique of hybrid GLARE laminate described herein utilizes conventional high-speed steel cobalt and carbide tools with two cutting parameters such as feed rate and cutting speed. The selection of the optimal cutting parameters is important when drilling multi-layered material because each constituent material in the GLARE laminate requires a different set of cutting parameters. The parametric influences on thrust force, torque, surface qualities and delamination extent were experimentally evaluated. In addition, the mechanical model for predicting the critical thrust force at the onset of delamination was established based on classical bending theory and the mechanics of GLARE laminate. The analytical findings were consistent with the delamination extent quantitatively measured by ultrasonic inspection. The carbide produces better hole quality and size tolerance compared to the HSS-Co. Furthermore, feed rate is considered to significantly impact the indentation over the uncut thickness of the material, resulting in a greater influence on delamination onset at the metal-prepreg interface. The faster penetration of the cutting tool through the work-piece due to the increase of the feed rate increases the hole deflections and vibrations in the cutting tool causing higher circularity errors. Compared to the feed rate, the cutting speed effect is relatively insignificant.

Keywords: FML (Fiber Metal Laminate); Drilling; Cutting parameters; Hole quality; Delamination

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