

## Influence of the non-singular terms and the crack velocity on $K_{IC}$ of an epoxy resin

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**Abstract** Organic matrix laminated composites are increasingly used in the aeronautical field to reduce the weight of the structure. These materials are designed for certain elements such as the fuselage or wings of aircraft. These elements are subjected to impact such as bird strikes or hailstone impacts that can lead to delamination. This is a process of macroscopic decohesion of the interlaminar environment, which can be characterised by GIC (or KIC). GIC is the critical energy release rate, it is determined in mode I using a standardized experimental setup under quasi-static loading with a Double Cantilever Beam (DCB) sample [1]. A global analysis method with an energetic approach is applied to analyse this experiment. In the case of dynamic loading, there is no standardized experimental setup. Nevertheless, some authors have developed extensions of the global method used for quasi-static loading. However, the literature shows a wide disparity in measurements [2] due to incomplete decoupling of the effects of resin confinement by fibers, non-linearities behaviour and/or velocity effects. Others authors have used a microscopic approach at the local scale on epoxy resin using local measurements with strain gauges near the crack tip to determine KIC [3]. Lastly, other authors have considered non-singular terms to highlights geometrical effects of the sample and their influence on KIC [4] [5]. This work proposes to develop an experimental protocol to characterise pure resin using fullfields measurements based on Digital Image Correlation (DIC) associated with the Williams' series to methodically study the couplings described previously [6]. The goal is to evaluate the impact of the crack propagation velocity and the structural effects on the fracture behaviour. Mode I fracture experiments on the resin HexplyM21 used in aeronautical field have been carried out to determine KIC and the non-singular terms T and B, considering crack propagation velocities ranging from quasi-static to 600 m.s<sup>-1</sup>. Tapered Double Cantilever Beam (TDCB) specimens and triangular specimens of Hexply®M21 epoxy resin have been used on a servo hydraulic jack with different loading rates. Finally, a model has been proposed to describe the evolution of KIC with respect to the non-singular terms T and B and the crack velocity  $\dot{a}$ .

### References

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