

## RE-INFILTRATION REPAIRS OF COMPOSITES IN CIVIL AVIATION

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### ABSTRACT

This work deals with a re-infiltration repair procedure for fibre reinforced plastics potentially applicable to components used in civil aviation. Based on Compression-After-Impact (CAI-) testing, it is shown that the re-infiltration repair approach exhibits the potential to extend its field of application from cosmetics to structural repairs. As not only mechanical issue but also the fulfilment of certification standards is one major key for establishing a new repair procedure in civil aviation, the chance to achieve certification regulations as well as the corresponding development steps are discussed.

**Keywords:** fibre reinforced plastics, impact damage, repair, compression-after-impact testing.

### INTRODUCTION

In civil aviation, repairs of fibre reinforced plastics (FRP) are usually carried out by removing the damaged area and introducing a repair patch using mechanical fastening. This repair procedure has to be applied from impact energies on where the impact damages are barely visible (i.e. from Barely Visible Impact Damages, brief BVIDs on). This gives rise to various shortcomings. Among others, the repair process is time-consuming and only certified, well-equipped repair workshops are allowed to carry them out. Moreover, the repair adds additional weight to the structure and it weakens the structure as the strength of the parent component cannot necessarily be fully restored. However, due to safety reasons, it doesn't matter whether the damage is indeed so severe that such an extensive repair is justified or not.

An alternative is the so called re-infiltration strategy. It is simpler and more cost-effective as in contrast to conventional repairs no removal of the damaged area is needed. The damaged area is re-infiltrated with a low viscosity resin closing matrix cracks and delaminations. The risk that the damage accumulates to a significant size endangering the load bearing capacity of the component is consequently reduced. However, the re-infiltration of the damage has to be treated as an adhesively bonded repair from a certification point of view. As the corresponding regulation standards are difficult to achieve [Schmid-Fuertes, 2015], re-infiltration repairs are only carried out due to cosmetics reasons in civil aviation today.

### RESULTS AND CONCLUSIONS

Re-infiltration repair solutions have been first studied in the beginning of the 1990's (cp. e.g. [Russell, 1991 and 1992]) indicating their potential to slow down or to limit completely crack growth. During the past years, research work (cp. [Hautier, 2010]) is documented that deals again with the re-infiltration repair of FRP components. This is due to the up-coming of new

resin formulations with very low viscosities allowing better fillings of delaminations (cp. e.g. [Thunga, 2013]). These works are the starting point of this article. It is shown that the re-infiltration repair can also be used to restore sample strength in CAI-tests not only for energy levels around BVID but also for higher impact levels where no complex sample preparation for resin infiltration is needed (see Fig. 1). As the certification aspect is one major key for establishing re-infiltration repairs for structural components in civil aviation, the certification requirements are discussed and potential research steps to achieve them are illustrated.

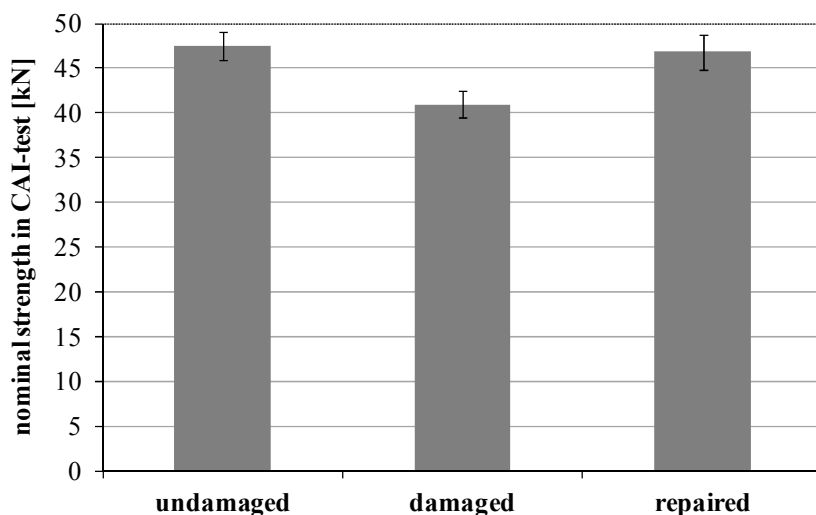


Fig. 1 - Results of Compression-After-Impact test for undamaged, damaged and repaired specimens

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