

Utilising the Potential of Adhesive Bonding Technology in the Repair of Modern Means of Transport

Modern means of transport are made of lightweight materials such as carbon fiber epoxy laminate or aluminum. If the outer skin is damaged, e.g. due to loading and unloading, it needs to be repaired. Repair methods commonly used today are riveting and welding. This increases the weight or impairs the visual appearance. Adhesive bonding technology enables light and smooth repairs. Unknown safety factors have so far limited the use of adhesive technology to small, non-critical areas. Current research shows that the safety factors exceed aviation standards. This enables the safe use of adhesive bonding far beyond current repair applications.

Safety through reliable construction and repair processes

The safety of an adhesive joint depends on adhesion and cohesion forces. Adhesive forces hold the adhesive layer on the surface of the bonded parts. Stable adhesion can be ensured by robust and reliable processes. These include machining, cleaning, surface inspection, and pretreatment. Several repair layers of fiber composite material are applied to the pretreated surface, supported by intermittent vacuum compaction. Finally, the arrangement is cured in a vacuum at an elevated temperature.

Cohesive forces hold the adhesive layer together. The strength of the joint is ensured by keeping stresses and strains low through appropriate design. Once the properties of the repair materials have been tested, the repair bond can be designed in such a way that the load-bearing capacity of the undamaged structure is restored. Fraunhofer IFAM has extensive expertise and an accredited test laboratory for the development of design and verification methods.

Safer than safe

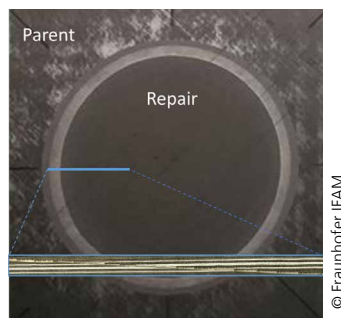
For constructions made of carbon fiber epoxy laminates, strain is often used as a target value for the design. In many cases a limit of 0.3 % applies, which must not be exceeded during operation. Repair and design processes developed at Fraunhofer IFAM ensure that this can also be adhered to in the event of repair. Fatigue tests show that a repair bond can withstand a strain of more than 0.3 % over an unlimited number of load cycles and that the safety factor even exceeds the value of 1.5 recommended in aviation. It can therefore be said that the advantages of a light and smooth adhesive bond can be utilised not only for safe repairs, but also for safe primary structures.

We support you

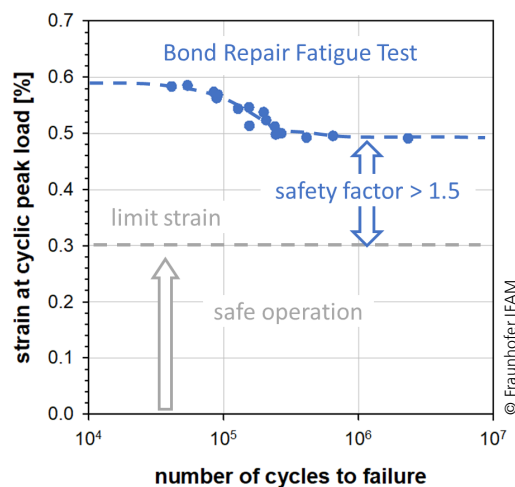
We support you in your adhesive bonding projects with our expertise and our test laboratory on the following topics:

- Mechanical testing of adhesives and bonded joints
- Material cards for FE modelling of bonded joints
- Strength analyses for bonded structures
- Service life assessment and long-term tests

Get in touch with us!



Bond repair of a laminated carbon fiber epoxy plate.



Proof of a safety factor higher than 1.5 in fatigue tests of bond repair specimens consisting of carbon fiber epoxy laminate.

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