

# Adhesives Up in the Sky

Did you know that some parts of airplanes are bonded? The worldwide market size of aerospace interior adhesives amounted to nearly USD 849 million in 2016, and it is projected to increase steadily. Bonding is a common joining method because it allows broad flexibility in design. This aspect of design plays a major role especially in the aircraft interior since airlines can clearly distinguish themselves from each other visually. And this is the business card for the passengers.



1 Adhesives used in aircraft are tested for flammability, optical smoke density, and flame smoke toxicity.

Above all, bonding is lightweight. What is becoming increasingly important in the automotive industry applies in particular to aircraft sector — the lighter, the better. Adhesives are able to reliably join various materials, like lightweight composites, without adding further weight as screws or rivets do. Unlike other joining methods, bonding does not damage the material, and, for this reason, the load-bearing stiffness of material remains uncompromised. Tension, resulting from the different coefficients of expansion of different materials, can be equalized as well because of the adhesive's tough-elastic properties.

## Secure two-component adhesives

In aircraft interiors (Fig. 1), two-component adhesives are mainly used: more than 80% of the adhesives are epoxy resins but polyurethanes are also applied. As soon as the resin and hardener are mixed, a chemical reaction starts, and the adhesive cures at room temperature. Acceleration of the reaction by heat, e.g., at 60 °C (140 °F), is possible.

“DELO develops and produces tailor-made, high-tech industrial adhesives and equipment systems — made in Germany — ensuring the highest quality of design and manufacture. The area of application is wide and ranges from consumer electronics, smart cards, or radio-frequency identification (RFID) to automotive and aerospace applications. For aircraft interiors, various adhesives are qualified according to the Airbus AIMS 10-04-001 (Airbus Material Specification). All of our aircraft interior products comply with RoHS Directive 2015/863/EU (Restriction of Hazardous Substances). For adhesives used in aircraft interior, DELO uses Sulzer's double-chamber application systems.”

**Nicole Guggenmos,**  
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Because security is an important aspect, every material used in an aircraft is tested. Adhesives have to run through FST tests (flammability, optical smoke density, and flame smoke toxicity) according to Federal Aviation Regulation FAR 25.853. Further requirements for adhesive applications in aircraft depend on the area of the aircraft where the connections are used. For linear bonds, the adhesive requirements are different from those of fixing elements.

## Linear bonds in aircraft cabins

For linear bonds, adhesives are pasty and thixotropic for high run resistance. Because of the mostly manual production processes, a long processing time (> 30 minutes) is needed to allow for any adjustments of the material after the application of the adhesive.

In addition, the adhesives in aircraft interiors usually have to be adapted to the color of the cabin equipment. For visible applications, like the bonding of overhead



2 Composite sandwich panel from FACC Operations, bonded with two-component epoxy DELO-DUOPOX AB8390 from DELO Industrial Adhesives. (Source: DELO)



3 Illustration of bonding an insert into a composite sandwich panel. (Source: DELO)

storage compartments, an ideal adhesive product should remain colorfast and not change color over the whole product lifetime (Fig. 2).

This flame-retardant, white construction adhesive is extremely colorfast and keeps its white color even after 1 000 hours of storage at 70 °C (158 °F) and air humidity of 85%. Thus, FACC Operations can rely on consistent colors to maintain the appearance of their aircraft components, such as those used for luggage storage compartments.

#### Fixing elements in the plane

One solution to avoid screws is to insert a threaded pin, a so-called “insert,” into a cavity within the substrate. The next step is to fill the cavity with adhesive in order to bond the insert into the substrate. After the adhesive has reached functional strength, counterparts, such as a cable holder device, can be fixed into it (Fig. 3).

For this application, the adhesives have to show good flow behavior during dispensing and a non-sagging effect within the cavity. Furthermore, the adhesives have to react fast to accelerate the subsequent processing.

If fast adhesive solutions are required, different adhesives can be used. For example, a two-component epoxy DELO-DUOPOX AB8162, which performs with a fast processing time of 10 minutes and reaches initial strength within 2 hours at room temperature, would make a good choice. Acceleration by heat, e.g., at 60 °C (140 °F) results in functional strength within only 15 minutes.

#### Viscosity of thixotropic fluids

Thixotropy describes the characteristics of a fluid as follows: the viscosity continues to decrease to a certain level — at a constant shear rate over the time. After the shear rate is stopped the fluid returns to its initial viscosity after a certain period of time. In other words, when a thixotropic fluid is agitated, its viscosity drops. After a phase without movement, the viscosity increases again.

Alternatively, a two-component polyurethane, like DELO-PUR AD948, which is qualified and released for Airbus (AIMS 10-04-001), could be used for this application.

#### Sulzer’s dispensing solutions

Two-component adhesives can be dispensed easily using double-chamber cartridges, which Sulzer offers. The mixing ratio of the resin and hardener is determined by the respective diameter of each chamber. Each chamber contains one adhesive component. Together with an attached mixing tube (static mixer), the products can be processed comfortably like one-component products. Various mixing tubes are available but only mixing tubes approved by DELO and Sulzer may be used to ensure that the product is sufficiently homogeneous for further use.

There are manual or pneumatic dispenser solutions available. A special stop function helps to apply the adhesive exactly and without any loss of material.

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