

# High-Quality Piezo Elements as Sound Transducers in the Airplane Doors: on Tour with the A380

In the Antiquity, flying was only the privilege of the gods but today, travelling by air is taken for granted. The motto is larger, faster and further. However, the requirements on the components used in airplane technology are increasing because above all, safety has the highest priority. Whatever may be used in the airplane must be “airworthy” which means it must be reliable, durable and on top of that, as small and light as possible. This also applies to sound transducers that generate acoustic signals or warning sounds during automatic processes such as closing the cabin doors of the Airbus A380.



*Fig. 1*  
The largest passenger airplane currently in series production is the Airbus A380. Its doors are large and too heavy for manual closing (Source: Airbus)

## Introduction

The calculation is simple: the more passengers on board, the lower the operating costs per seat. It's therefore not surprising that there are more large airplanes now than in the last years and decades. The

## Keywords

piezoceramic, sound transducer, automatic closing and locking device

largest passenger airplane currently in series production is the Airbus A380 (Fig. 1). This wide-body airplane has two passenger decks extending along the entire length and can transport more than 850 travellers. In the more usual allocation of economy, business and first class, that is still considerably more than 500 passengers who are able to travel comfortably, particularly on

long-range flights: The four-engine airplane with a wing span of 79,8 m can fly a distance of 15 400 km without landing, which means it could fly around the world once with only two-and-a-half tank fillings and therefore fly all connections nonstop between the most important hubs in Europe, North America and Asia.

## Monitoring the door locks

The beginning of a long-range flight is the takeoff. But, before an airplane taxis to the runway, the various checklists must be processed. Although this may seem to be a trivial matter to the layman, this is of great importance for the safety of the flight. For example, before the airplane is allowed to taxi in the direction of the runway, it must be ensured that all outside cabin doors are properly closed.

When the doors are closed by hand, the locking mechanisms engage distinctly. In the case of the A380, this is not so easy

Birgit Schulze  
Physik Instrumente  
76228 Karlsruhe  
Germany

[www.pi.ws](http://www.pi.ws)

because the doors are large and too heavy for manual closing. Motor force is therefore necessary. However, the automatic closing and locking mechanism must be monitored. When the doors are properly closed, an OK signal is emitted. If the locking mechanism was incomplete, a warning sound is generated. For this purpose, 14 sound transducers are built into each airplane next to the doors (Fig. 2).

Holmberg GmbH, who develops and produces electroacoustic devices for professional use under demanding environmental conditions in Berlin/DE, has been a specialist for this type of airworthy sound transducers for a long time. The company is a certified manufacturer and maintenance organization for aviation devices, and in addition to Airbus, a large number of other renowned airplane manufacturers put their trust in the electroacoustic devices from the Berlin manufacturer. This also includes the sound transducers, for which the aerospace industry requires comprehensive certification of the reliability and lifetime. The piezo sound transducers for the airplane doors are not to be compared with the mass-produced buzzers that are used for example, in microwave ovens, washing machines, toys etc. They are subject to considerably higher quality requirements.

Basically, sound transducers consist of two piezo disks glued to each other, a plastic membrane and a waterproof case (Fig. 3). When electrical voltage is applied, the piezoceramic begins to deform rhythmically according to the frequency. This is the so-called inverse piezo effect; the piezo element converts the electrical energy to mechanical energy. The motion is transferred to a membrane which then radiates sound waves.

Depending on which of the piezo disks is operated, two different tones are generated according to the respective resonant frequency; the OK signal for “door closed” or the warning tone. The “volume” of the small sound transducer is 160 dB and after installation, it is reduced to 84 dB, which is still quite remarkable.

**Piezos “Made in Germany”**

The piezoceramic used in the sound transducers plays a key role. Reliability, durability and exact adherence to the technical specification are important requirements for their use in an airplane component.

“We obtain the two piezo disks which are already glued together, from PI Ceramic”, explains Peter Köppel, Technical Director at Holmberg, and quickly explains the reasons: “The piezo disks meet our high standards of quality and are distinguished by a very low tolerance to all piezoelectric parameters relevant for sonic performance such as resonant frequency, electrical capacitance and coupling coefficients”.

PI Ceramic has been developing and manufacturing piezoceramic materials and components for standard and OEM solutions since 1992 and is able to respond quickly to customer-specific requirements. “The piezo specialists have proven this in the case of our sonic transducers”, emphasizes Köppel. “When we were looking for the fastest possible replacement for our previous supplier, PI Ceramic understood our requirements right from the very beginning and was able to comply with all required specifications with the first prototype.”

The piezoceramics “made in Germany” can also be easily adapted to the respective application requirements because, in addition to the material selected for each application, it is possible to realize different geometric versions and resonant frequencies (Fig. 4). “The geographical proximity to our supplier is a further argument that is not to be underestimated”, concludes Köppel. The piezo elements have not only convinced the specialists for electroacoustic devices from a technical, but also a practical point of view and there will most likely be further joint projects in the future.



Fig. 2  
The automatic closing and locking mechanism must be monitored and indicated. For this purpose, 14 sound transducers are built into each airplane next to the doors (Source: Holmberg)

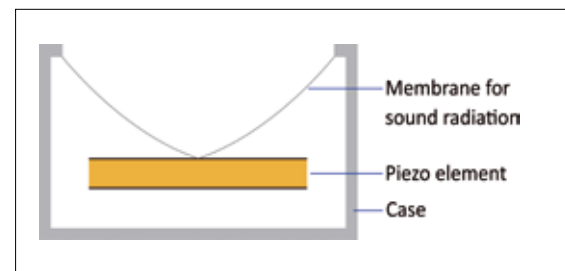


Fig. 3  
Basic design of a sound transducer, which consists of two piezo disks glued to each other, a plastic membrane and a waterproof case (Source: PI)



Fig. 4  
Different variants of piezo elements are possible, which allows them to be adapted to the respective application (Source: PI)