

# MAGNET VS. AIR FOIL BEARING

## AERZEN AIR FOIL BEARING - MORE THAN ONE STEP AHEAD!



# SIMPLE AND EFFECTIVE: AIR AS BEARING SYSTEM

**Construction and functional principle of a turbo blower of the current AERZEN AT series are simple and at the same time effective. As the air supply of modern wastewater treatment plants is clearly designed for maximum availability, high energy efficiency and long maintenance cycles, AERZEN uses for the demanding bearing system within turbo blowers neither oil nor other lubricants - but simply air.**

## Bearings with simple physics

As effective bearing system without mechanical friction AERZEN relies on compressed air in the two radial bearings of the drive shaft and in the axial bearing for absorbing axial forces. In doing so, in no case air is pumped with high pressure externally into the bearing shell, but rather in a brilliantly simple way the compressor principle is used. Due to natural unbalance, when starting the turbo blower, the rapidly rotating shaft generates an eccentric circular motion in the air gap of the bearing. As the shaft increases the pressure in this section on the minimal way to the bearing wall, counterforce is generated in form of a pressure increase. This counterforce pressed down the shaft - similar to a compressor or a Wankel engine - in the opposite direction. Due to the rapidly increasing speed the shaft centers in the bearing itself and increases the pressure in the air gap to more than 30 bar. The prevailing force couples are so high, that they keep the shaft permanently in the centre of the bearing even in case of considerably varying and challenging operation conditions - and this free-floating without surface contact.

The brilliance of this principle is the fact that in operation the air cushion forms automatically - and thus without further energy input. Alternatively, turbo blowers made by other manufacturers run with a magnetic bearing system which also aims to handle high speeds free of a mechanical bearing system. Concerning magnetic bearings, however, electric current is needed, so that the coils arranged circularly around the drive shaft can develop their forces during operation and have the shaft rotating free from mechanical friction. Particularly changing operation conditions put the highly complex regulation system of the magnetic bearings to a test. Frequently it

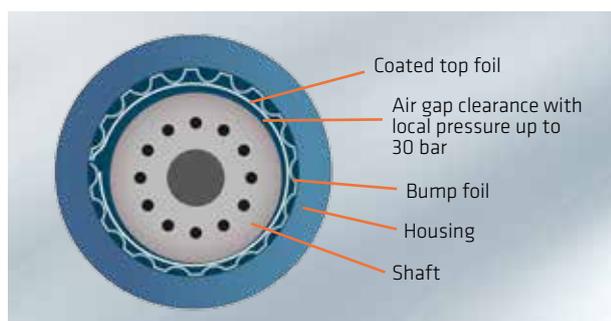
comes to safety shutdowns of the entire turbo blower due to technological reasons.

## Long service life with decreasing operation costs

Concerning the air foil bearing principle no electrical, mechanical or pneumatic regulations are necessary - not even in case of dynamic load changes. Nevertheless, critics of the simple and efficient air foil bearings decry the fact, that when starting the turbo blower the driven shaft lies on the bearing



and generates wear friction up to the development of an air cushion. AERZEN is addressing this theoretically existing disadvantage with innovative air-foil bearings. A specialist for blower and compressor technology uses as maintenance-free friction partner a 2-pot coating. One of these materials is polytetrafluorethylene. PFTE is one of the thermoplastics used as anti-stick coating due to their very low friction coefficient. To ensure, that this construction can absorb the friction forces



## Air foil bearings in cross section:

- Shaft centres automatically with increasing speed
- Topfoil with double layer coating for reliable support in case of contact between shaft and topfoil
- Any unbalance or extreme force is dampened and absorbed by the bump foil

#### **Air foil bearings:**

- simple construction, reliable technology
  - no maintenance expenditure for motor and stage
  - no additional regulation, battery or periphery required
  - long service life with low operation costs
- exchangeable at site: quickly and economically
  - robust and unsusceptible to malfunctions even at extreme operation conditions

occurring within a fraction of a second when starting a turbo blower even stable, high surface quality is necessary. All in all, with the new Turbo Generation compared with the highly complex magnetic bearings, AERZEN succeeded in finding a considerably more simple and more favourable-priced solution. But PTFE as tough bearing material alone is not yet a durable bearing. As the compressor effect in the bearing compresses the air so significantly that the layer between bearing ring and shaft is virtually hard as steel, AERZEN designed a dampening layer specially tuned for this application. This is a sheet plate with a thickness of one millimetre, rolled undulatingly, supporting the sliding layer of the bearing and simultaneously absorbing the vibrations.

#### **Air offers reserves for higher speeds**

With the sophisticated conception of the air foil bearings AERZEN succeeded in maintaining the simple construction of a turbo blower with the high-frequency permanent synchronous motor as energy-efficient drive. This bearing type still has reserves to support higher speeds as this is possible with magnetic bearings. As a consequence, the performance density of the turbo blowers can be increased further as a result of faster rotating blade wheels, if the appropriate motors are used. Mainly performance limiting for the magnetic bearings is the electronic control system, which has to readjust the forces of the magnetic fields permanently. Sensors permanently query where exactly the shaft is located in the magnetic field. "This is a complex and extremely expensive control circuit," says Helmert. To ensure, that in case of a malfunction, an emergency shutdown, or a power failure, the system remains active for a certain period of time turbo blowers must always be provided with an uninterruptible power supply. A

battery storage guarantees in case of electricity failure, that the magnetic field is maintained as long as the shaft has reached an uncritical speed for the mechanical back-up bearing. The simply designed back-up bearing is needed to absorb the motor shaft with the blade wheel in case of standstill and for maintenances.

But an uninterruptible power supply only offers the necessary safety if it is really safely available. Therefore, sophisticated load cycles are as necessary, as the regular exchange of the battery cells within a fixed maintenance plan. Consequently, an uninterruptible power supply inevitably increases the life-cycle costs. A similar expenditure is necessary for the magnetic bearing system, as - permanently in operation - it uses electrical energy continuously. Its complex regulation technology necessitates regular maintenance intervals. In comparison, air foil bearings, with their energetically adjusted no-load operation, are maintenance-free and can be changed very easily at site during plannable revisions of the blower technology in case of need due to their simple construction. Moreover, expert opinions confirmed that the total amount of service costs in connection with an air foil bearing is considerably less, as the design of the system is more simple and service providers are available in Germany. This detail finally leads to an increase of the availability of the turbo blowers - an aspect which becomes important at the latest when concerning the design and modernisation of e.g. wastewater treatment plants the provision of redundant systems is considered.

Air foil bearings with bump foil





**AERZEN. Compression as success principle.**

AERZEN began life in 1864 as Aerzener Maschinenfabrik. In 1868 we built Europe's first rotary lobe blower. The first Turbo compressors followed in 1911, the first screw compressor in 1943, and in 2010 the world's first rotary lobe compressor unit. Innovations "made by AERZEN" keep driving the development of compressor technology forward. Today, AERZEN is among the world's oldest and most significant manufacturers of rotary lobe blowers, rotary lobe compressors, rotary lobe meters, screw compressors, and Turbo blowers. And among the undisputed market leaders in many areas of application.

More than 2,000 experienced employees in over 43 affiliates the world over are working at full speed to advance compressor technology. Their technological expertise, our international network of experts, and constant feedback from our clients form the basis for our success. Products and services from AERZEN are setting standards when it comes to reliability, lasting value, and efficiency. Go ahead: challenge us!

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