Press News

Innovative approach to noise minimization of small fans

# Fan blades with winglets for quiet fans

Modern fans operate reliably and usually behind the scenes. They are required to fulfil their job of cooling electronic components as unobtrusively and quietly as possible. At the same time, the mass production of small fans must be cost-effective. To produce a device that meets all these requirements is not easy. Innovative solutions therefore, are required that achieve improvements in service life and performance without additional costs. A completely new approach to the reduction of noise is the aerodynamic design of the annular gap between the fan blades and the inside of the housing.

As far as the mechanical structure is concerned, today's small fans are designed to operate with the minimum of noise. Only completely new paths in the further development of small fans can create new chances for significant improvement and for this purpose, all possible noise emitters must undergo rigorous testing on the test bench. In addition to continuous improvement and noise minimization of the drive and its components, aerodynamics, present a special reduction potential for acoustical diffusion.

## Gap, turbulence, costs

To separate the suction side from the pressure side, small fans usually have an external housing panel. The size of the gap between the panel and the impeller depends mainly on the following factors and is required for tolerance reasons:

- Tolerances of the components
- Linear expansion of the blades due to the effects of centrifugal force
- Linear expansion of the blades due to thermal effects
- Environmental influence, e.g. linear expansion due to the absorption of humidity by plastics.

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For this reason, a relatively large gap must be allowed for fans and in particular, mass produced small fans where reworking of components to reduce the tolerance cannot be given consideration for reasons of cost. (Fig. 1). To avoid or minimize aerodynamic interference in this sector, ebm-papst is treading new paths and is applying for the first time a solution that is well tried in other sectors and which has high noise reduction potential.

## Not only small but different

In large-scale technology as in nature, vortices at the at the tips of the blades are minimized by so-called winglets. Birds spread the feathers at the edge of the wing and on aeroplanes the differently designed ends of the wings causes a vortex to form around the wing tips. The objective is to minimize turbulence and in turn the loss of energy.

However, this principle of action cannot be applied in this form to small fans. A further reduction of noise is not based on the separation of large vortices into smaller ones, the idea rather more is to create a type of labyrinth seal (Fig. 2) by thickening the extreme wing tips. This winglet-type of end plate should increase the fluid resistance rather than reducing the required gap. This can be achieved by the wider end of the winglet that reduces the transportation of the air mass in the gap. At the same time, the force of the blade tip vortex that induces the noise is reduced. Examinations of different types of winglet shapes showed a considerable noise reduction in all operating points. Reduction in the most practical area of application at the right of the saddle point in the fan diagram (Fig. 3) is 2 to 4 db(A). Also, the special noise of blade rotation of approx. 500 Hz audible to the human ear and the noise percentage of over 6 kHz is considerably reduced by the winglets.

Thus use of winglets at the blade tips of small fans thus results in a distinct reduction in noise. The advantage of this ingenious solution: The fans can continue to be produced by injection moulding and the air gap between the impeller and the housing which is necessary for cost favourable mass production no longer needs reducing. This is an extremely cost-efficient way of reducing the operating noise of small fans without having to make major alterations to the existing production.

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Fig. Intro: Winglets – new technology in fans

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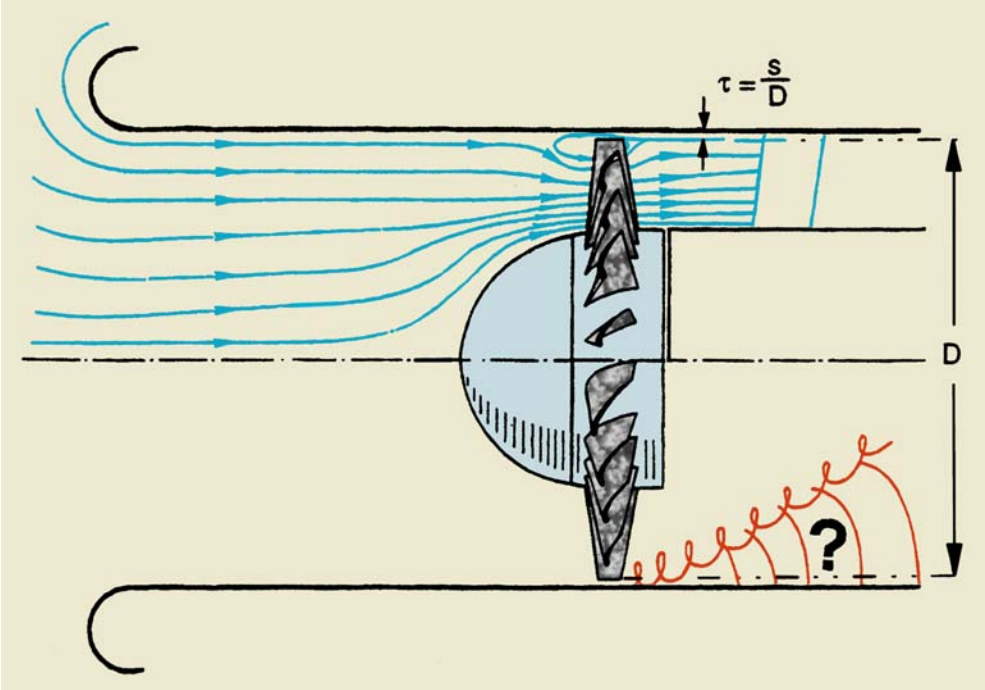


Fig. 1: Schematic flow diagram with generation of turbulence at the annular gap by difference in pressure

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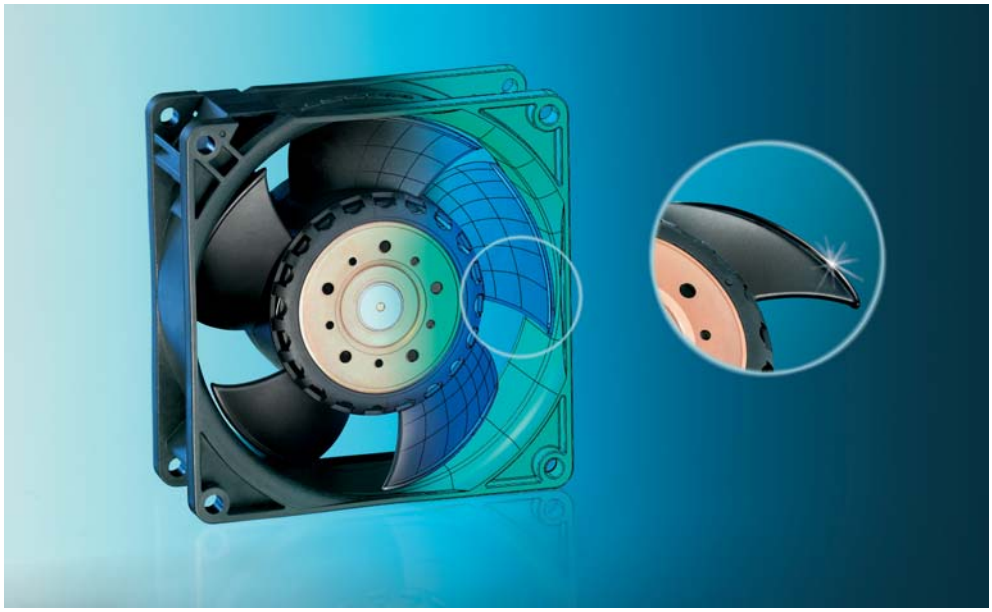

Fig. 2: The new blade design, winglets at the blade tips reduce the generation of turbulence

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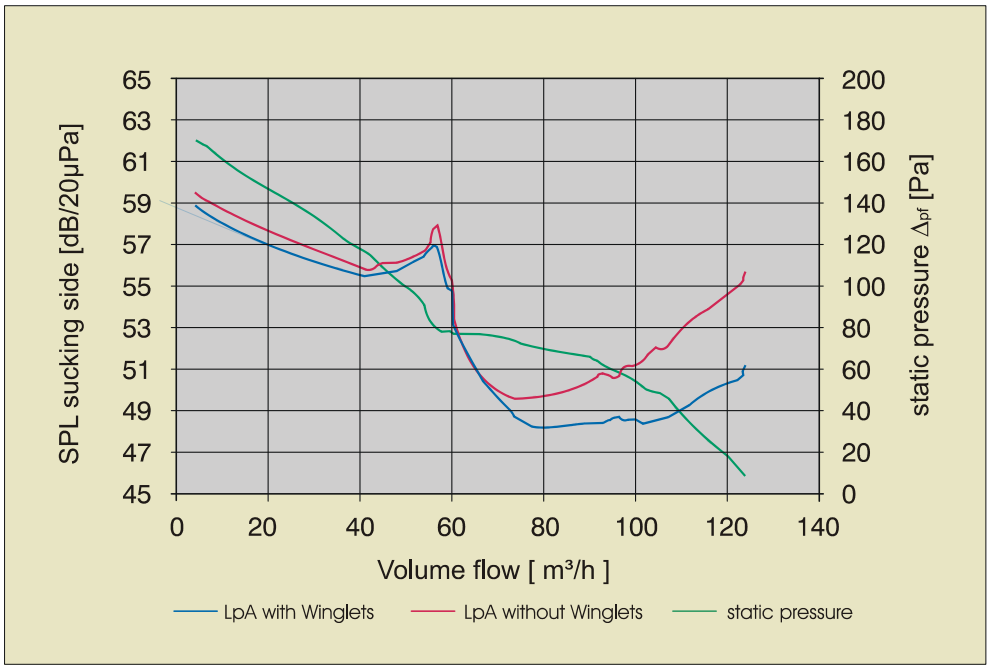


Fig. 3: Evidence that the winglets reduce the suction noise by up to 4 db(A)

Text and photos/graphics can be found on the CD supplied.

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