Abstracts of the International Conference
ACOUSTIC CLIMATE INSIDE AND OUTSIDE BUILDINGS
held in conjunction with the workshop

"Aircraft Noise Reduction by Flow Control and Active / Adaptive Techniques"

23–26 September, 2014, Vilnius, Lithuania

eISBN 978-609-457-704-8
Abstract Number: *acoustic.19*

http://www.acoustic.vgtu.lt/

ACTIVE CONTROL OF FAN TONES BY MEANS OF TRAILING EDGE BLOWING

Lars Enghardt[1], **Philip Kausche**[2]

DLR, Engine Noise Department, Berlin

E-mail: [1]*lars.enghard@dlr.de,* [2]*philip.kausche@dlr.de*

Abstract. At DLR in Berlin, a series of experiments was performed on a laboratory scale fan rig to explore the potential of trailing edge blowing (TEB) for the attenuation of tonal noise of an axial fan stage for the first three blade passage frequencies (BPF). The ventilator consisted of 18 blades, each blade of which was equipped with five internal flow channels, commonly provided with pressurized air through the rotor hub. In configuration 1, all five channels were utilized for noise control. The success of the treatment was monitored over the whole operating range of the fan stage using different mass flow rates of blowing with hardly any positive effect on the noise in the duct. In configuration 2, the outmost two internal channels were blocked by means of aluminium tape (comp. Fig. 1). The latter case provided substantial tonal noise reduction, the result of which is depicted in Fig. 2.

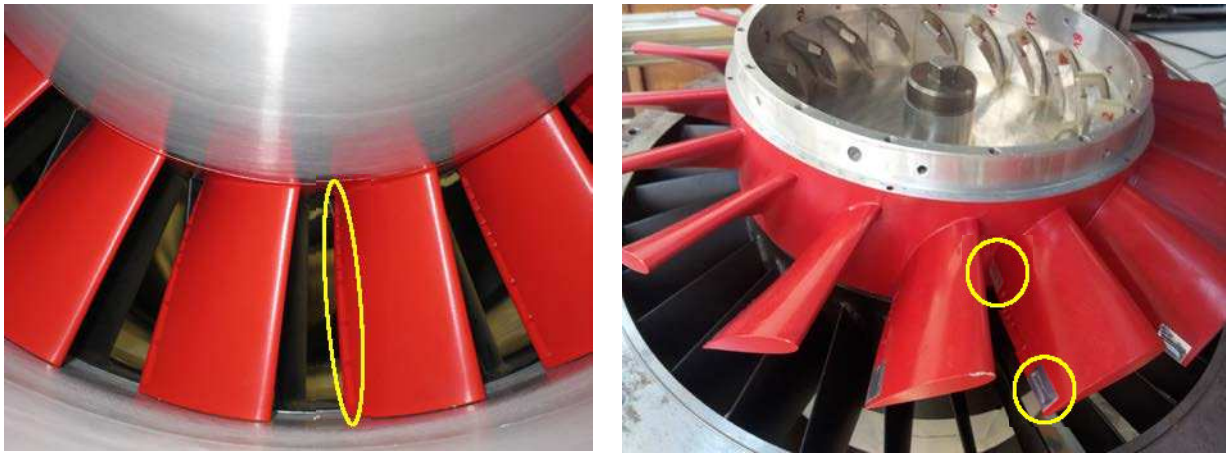

Fig. 1. Left: Rotor with 5 blowing orifices at the trailing edge. Right: Configuration 2 with blocked channels 1 and 5

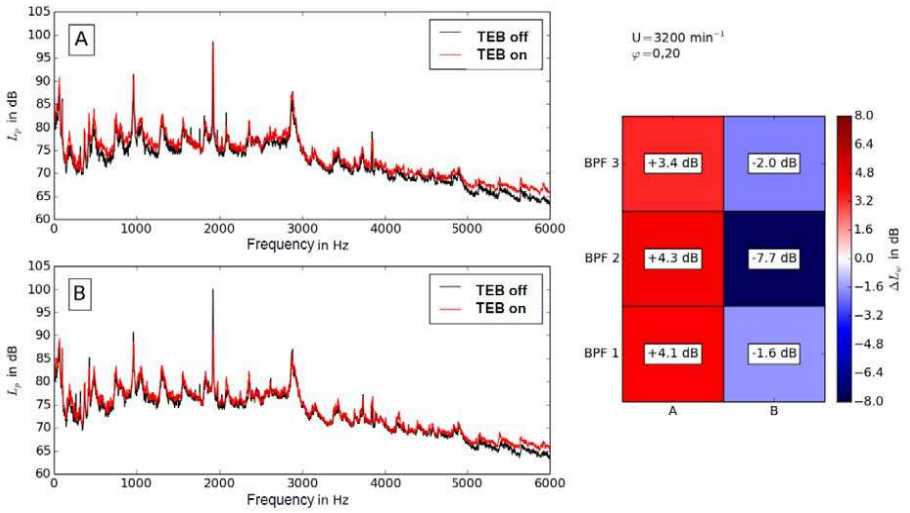

Fig. 2. Left: Averaged frequency spectra of the induct sound pressure in the inlet without TEB (in black) and with TEB switched on (in red). (A) shows conf. 1 utilizing all 5 internal blade channels, (B) shows conf. 2 using only the three inner blowing channels. Right: Comparison of the induct sound power level of the first three BPFs

The frequency spectra in Fig. 2 were averaged over 75 signals of wall-flush installed microphones in the inlet of the fan rig. The sound power difference of the BPF-tones depicted on the right hand side of Fig. 2 was calculated with the help of a complete radial mode decomposition of the induct sound field. The additional mass flow of pressurized air blown through the internal rotor channels was in the order of 2.4% of the overall mass flow of the fan stage. In the fan stage inlet, the sound power of the dominant fan BPF2 was reduced by roundabout 8dB, whereas the two neighbour tones (BPF1 und BPF3) were attenuated by about 2 dB in sound power. The talk will give a detailed description of the experimental setup, will provide more inside into the blade design, will show acoustic results of the TEB both for the inlet and the exhaust of the fan, and will furthermore present the results of hot-wire measurements in the inter-stage region of the fan rig.

Keywords: axial fan rig, trailing edge blowing, tonal noise attenuation.