

Title: Suppression of tonal noise in a centrifugal fan using guide vanes

Author/Authors: Kishokanna Paramasivam, S. Rajoo, Alessandro Romagnoli

Abstract: This paper presents the work aiming for tonal noise reduction in a centrifugal fan. In previous studies, it is well documented that tonal noise is the dominant noise source generated in centrifugal fans. Tonal noise is generated due to the aerodynamic interaction between the rotating impeller and stationary diffuser vanes. The generation of tonal noise is related to the pressure fluctuation at the leading edge of the stationary vane. The tonal noise is periodic in time which occurs at the blade passing frequency (BPF) and its harmonics. Much of previous studies, have shown that the stationary vane causes the tonal noise and generation of non-rotational turbulent noise. However, omitting stationary vanes will lead to the increase of non-rotational turbulent noise resulted from the high velocity of the flow leaving the impeller. Hence in order to reduce the tonal noise and the non-rotational noise, guide vanes were designed as part of this study to replace the diffuser vanes, which were originally used in the chosen centrifugal fan. The leading edge of the guide vane is tapered. This modification reduces the strength of pressure fluctuation resulting from the interaction between the impeller outflow and stationary vane. The sound pressure level at blade passing frequency (BPF) is reduced by 6.8 dB, the 2nd BPF is reduced by 4.1 dB and the 3rd BPF reduced by about 17.5 dB. The overall reduction was 0.9 dB. The centrifugal fan with tapered guide vanes radiates lower tonal noise compared to the existing diffuser vanes. These reductions are achieved without compromising the performance of the centrifugal fan. The behavior of the fluid flow was studied using computational fluid dynamics (CFD) tools and the acoustics characteristics were determined through experiments in an anechoic chamber.