

Grant AFC215-21

**Title:** Low noise efficient rim driven auxiliary ventilation fans

**Organization:** Virginia Polytechnic and State University

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**Focus Area:** Health and Safety Interventions

**Topical Area:** Machine Design and Ergonomics

**Problem Statement and Justification:** Physical hazardous agents that mine workers are exposed to on a daily basis include noise, vibration, temperature, dust, and so forth. Noise-induced hearing loss is a critical issue for a healthy mine workforce. There is still a need to reduce the exposure of miners to noise. If the Permissible Exposure Level (PEL) is exceeded, the mine operator is required to use all feasible engineering and/or administrative controls to reduce miner's exposure. There are many noise sources in a mine operation. Ventilation fans are one of the most dominant noise sources and thus a prime target for noise controls. In fact, ventilation fans are the second loudest noise source in coal mine operations (Cherniack et al., 2012). Ventilation systems must provide air to all places in an underground mine to maintain a safe level of oxygen, dilute and remove noxious gases, control airborne dust, control temperature and humidity in the working areas. The primary ventilation system for underground mines consists of a very large surface fan pumping air and distributing it through the mine. Temporarily mounted auxiliary ventilation fans are also used to supplement the air to specific working areas. These fans are much smaller than the primary one. However, these auxiliary fans are in close proximity to the miners and thus they have a more detrimental impact on the workers. This ventilation fan noise problem is not unique to the mine operations but is very common through many other industries.

**Impact of the Research:** This effort will significantly contribute to the improvement of the health of mine workers by reducing their exposure to high noise levels, i.e. preventing hearing loss. This is the primary goal of this project. A reduction of 15-20 dB relative to the current fan system used in the mines would imply that the fan will become one of the quietest sound sources in a mine operation.

**Objectives and Research Approach:** The main aim of this project is to experimentally demonstrate a new quiet portable ventilation fan that will improve the mine environment by preventing noise-induced hearing loss of the workers. The new quiet fan make use of technologies developed for other applications, primarily in the defense and aeronautic fields. The target is that this new advanced quiet fan will be 15 to 20 dB quieter than current commercially used fans while maintaining or improving aerodynamic performance. Given the current trend for rise in energy costs, it will also be shown that the energy consumption will be reduced using modern high efficiency brushless motors in the new quiet fan design. This is important since ventilation systems account for a significant proportion of the energy consumed in mines. The research approach is to design and built two prototype ventilation fan systems to demonstrate with actual hardware and measured data the technologies proposed here.