Assessing the Protection Factor of Firefighters' Respirators against Combustion Ultrafine Particles

James Dietrich (PI), Sergey Grinsphun

Department of Environmental Health, University of Cincinnati

First responders and first receivers are routinely exposed to ultrafine particles during emergency response activities. Firefighters are often exposed to high concentrations of toxic, primarily ultrafine particles aerosolized by combustion. Coronary heart disease is the main cause of death among US firefighters during fire suppression. Chronic inhalation of ultrafine particles has been associated with the onset of debilitating cardiovascular health effects (Baxter et al., 2010). Personal protection devices such as respirators are widely used to decrease the inhalation exposure. However, there is insufficient information pertaining to the protection level provided by these respirators against combustion aerosols during various activities, e.g., overhaul operations.

The present study aims at investigating the penetration of ultrafine particles originated by combustion of different materials into elastomeric half-mask respirators worn by firefighters in the field. The protection factor of firefighters' respirators against these particles will be assessed. The field data will be compared to the findings of a recently published laboratory investigation of a half-mask performance.

The present study deploys a novel aerosol measurement device, developed and made available to the project by NIOSH. This particle size selective instrument (expected to be commercially available from Kanomax, Inc., Japan) utilizes the condensation nuclei counter principle and is capable of real-time measuring of aerosol particles starting at or below 10 nm. The device is used to measure the particle concentration outside and inside the respirator. A total 12 to 25 firefighters in training are being currently recruited. During each exercise, participants are asked to perform activities relevant to emergency response situations. In addition, the workplace aerosol will be characterized as to its concentration and particle size distribution through real-time measurements conducted by Nano-ID (Particle Measuring Systems, Inc., USA)

The study design was completed in Spring 2013. Contact has been established with Chiefs Thomas Lakamp and Russ Kammer. Both fire departments have approved their participation in the field study. The data collection phase was scheduled to begin in July 2013. Several sessions were initiated at NIOSH at UC labs to familiarize the project team with the new instrument and ensure that the field study design and protocols are adequate. However, due to unforeseen circumstances (multiple problems with the Kanomax aerosol instrument prototype), the data collection phase has not been started yet. The prototype has been modified three times by NIOSH and Kanomax during the period of May through August 2013. According to the modified plan, the laboratory tests will begin this October (control burns have been scheduled).

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Corresponding Author*: James Dietrich at jamesdietrich26@gmail.com*

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