diesel exhaust from a portable air compressor. Each type of filter was divided into three groups for different exposure patterns: (1) a two-hour exposure; (2) an eight-hour exposure; or (3) two exposures on different days totaling approximately eight hours. After diesel exposure, penetration was retested using NIOSH test conditions. Mean laboratory penetration of Manufacturer A N95 filters increased to a high of 2.7% for the eight-hour exposure. N95 filters from Manufacturer C showed larger increases in mean penetration, reaching 19.7% for the intermittent exposure. Manufacturer A P95 filters remained far below 1% laboratory penetration for all exposures. Mean laboratory penetration for R95 filters from Manufacturer C increased with all exposures, up to 11% for the eight-hour exposure. Penetration of elemental and total carbon was determined for each group of filters using NIOSH Method 5040. Maximum mean penetration for the Manufacturer A P95 filters was 0.63%, significantly lower than the other filters. Manufacturer A N95 filters permitted a maximum mean penetration of 2.9%. The highest mean penetrations for Manufacturer C N95 and R95 filters were 8.9 and 5.8%, respectively. Because of design differences among N95 filters, they should not be used for diesel exposures. R and P95 filters should provide acceptable protection for workplaces, where exposure conditions are typically less harsh than these experimental conditions.

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PREDICTION OF AEROSOL FILTRATION EFFICIENCY UNDER CYCLIC FLOW BASED ON MEASURED CONSTANT FLOW EFFICIENCIES. A. Richardson, K. Hofacre, Battelle, Columbus, OH.

The National Institute for Occupational Safety and Health (NIOSH) currently certifies particulate respirator filters based on an inert aerosol test at constant flows ranging from 32 to 85 L/min. However, instantaneous peak inspiratory flows can well exceed 100 L/min during high work rates. Investigations assessing the effects of these high cyclic flow conditions on the performance of particulate filters for respirators are lacking. A preliminary study was undertaken to develop an approach to predict the filtration efficiency under cyclic flow conditions based on measured constant flow efficiencies. The filtration efficiencies of two NIOSH-approved filters (one N95 and one P95) were measured at constant flow rates ranging from 16 to 320 L/min using a challenge aerosol of 0.3 μm polystyrene latex spheres and a laser aerosol spectrometer. The measured filtration as a function of flow rate (or velocity) was then used to predict the efficiency for several cyclic flow conditions. Excellent agreement was obtained between the predicted cyclic flow efficiencies and those measured with minute volumes ranging from 32 to 130 L/min.

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EVALUATION OF A PROPOSED METHOD TO MEASURE N95 FILTER PENETRATION USING AMBIENT AEROSOLS. L. Janssen, M. Luinenburg, H. Mullins, 3M Company, St. Paul, MN; T. Nelson, NIHS Inc., Ardentown, DE.

It is theoretically possible to assess the fit or laboratory performance of N95 filtering facepiece respirators (FFR) by measuring total penetration of ambient aerosols. Since some ambient particles may penetrate N95 filters, this approach requires accurate measurement of that penetration. Subtracting filter penetration from total penetration should yield faceseal penetration. A study was conducted to evaluate the performance of a proposed method to make the filter penetration measurement. The proposed method was used to measure ambient aerosol penetration of two brands of N95 FFR on a test fixture. These measurements were compared with penetration measurements on the same FFR in a controlled submicrometer aerosol atmosphere and in an ambient atmosphere with test subjects breathing through them. Mean penetration values for the two brands of FFR using the proposed method were 10 and 52% lower in the controlled atmosphere than in the ambient atmosphere. Mean penetration values measured on people differed from the proposed method by 3 to 600%. In a second part of the study, test subjects wore elastomeric half facepieces sealed to their faces to minimize faceseal leakage. Ambient aerosol quantitative fit tests (QNFT) were performed with P100 and N95 filters without disturbing the facepiece. Penetration of the ambient aerosol through the N95 filters was then measured on a fixture using the proposed method. The measured filter penetration was subtracted from total penetration for the N95 QNFT. The remaining penetration was assumed to be faceseal leakage and was used to calculate a corrected fit factor for each subject. Mean corrected N95 fit factors were significantly different than the P100 fit factors. In addition, there was essentially no correlation between corrected N95 fit factors and P100 fit factors. It was concluded that the proposed penetration measurement method should not be used to assess any aspect of respirator performance.

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EFFICIENCY OF N95 FILTERING FACEPIECE RESPIRATORS AND SURGICAL MASKS AGAINST AIRBORNE PARTICLES OF VIRAL SIZE RANGE: TESTS WITH HUMAN SUBJECTS. S. Lee, S. Grinshpun, T. Reponen, University of Cincinnati, Cincinnati, OH.

Airborne viruses have drawn the world's attention after the outbreaks of SARS (Severe Acute Respiratory Syndrome) occurred in Asia. Some studies have shown that corona virus might have caused SARS since it was isolated from patients' body fluids and respiratory secretions. To prevent people from the airborne SARS infection, N95 filtering facepiece respirators and surgical masks have been recommended by the Centers for Disease Control and Prevention and the World Health Organization. At the same time, no sufficient information is available on the protection characteristics of these devices against aerosol particles of the viral size range. We have recently developed a personal sampling system for measuring the protection provided by respirators against airborne dust and microorganisms ranging from 0.7 to 10 μm in aerodynamic diameter. In this study, we have modified the system so that it can be utilized to conduct performance tests with stimulant particles of the viral size range, i.e., 0.02 to 0.3 μm. The experiments were carried out using this modified facility with six human subjects while the subjects were performing exercises following the OSHA fit testing protocol (29 CFR 1910.134). The results showed that there was no significant effect of human activity on the efficiency of these respirators against the viral simulants. The mean protection factors (34.5 ± 20.6) of N95 filtering facepiece respirators were four to eight times higher than those of surgical masks (6.0 ± 3.3). No particle size dependence of the protection factor provided by N95 filtering facepiece respirators and surgical masks was observed within the tested particle size range.

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FACIAL ANTHROPOMETRIC DIFFERENCES AMONG RACE/AGE GROUPS. Z. Zhuang, D. Viscusi, R. Shaffer, NIOSH, Pittsburgh, PA; L. Williams, CrystalView Technology Corp., Irvine, CA.

In a recent anthropometric survey by the National Institute for Occupational Safety and Health in 2003, a total of 3997 subjects (2542 male and 1455 female) were measured using traditional methods, and 1013 of them (713 male and 300 female) were also scanned using a 3D head scanner. The subjects were representative of the current U.S. civilian population of respirator wearers age 18 to 66. The subjects were classified into four race groups: White, African-American, Hispanic, and Others. Body mass index, height, weight, neck circumference, and 18 facial dimensions were measured. The objectives of this companion study were to (1) investigate the differences and variances in facial dimensions between gender, race, and age groups, and (2) identify typical face sizes/shapes for the development of test head forms. Statistical analyses generated 95% confidence limits for each variable, which allowed observational analysis of overlap between groups and the assignment of a significance indicator. African-Americans' menton-sellion length was on average 4.5 mm longer for males (n = 634) and 5.7 mm longer for females (n = 589) than the "Others" race group (n = 130 for males and 220 for females), which was mainly made up of Asian-Americans. Based on correlation analyses and relevance of some facial dimensions to respirator fit, a subset of 10 facial dimensions were identified for defining a

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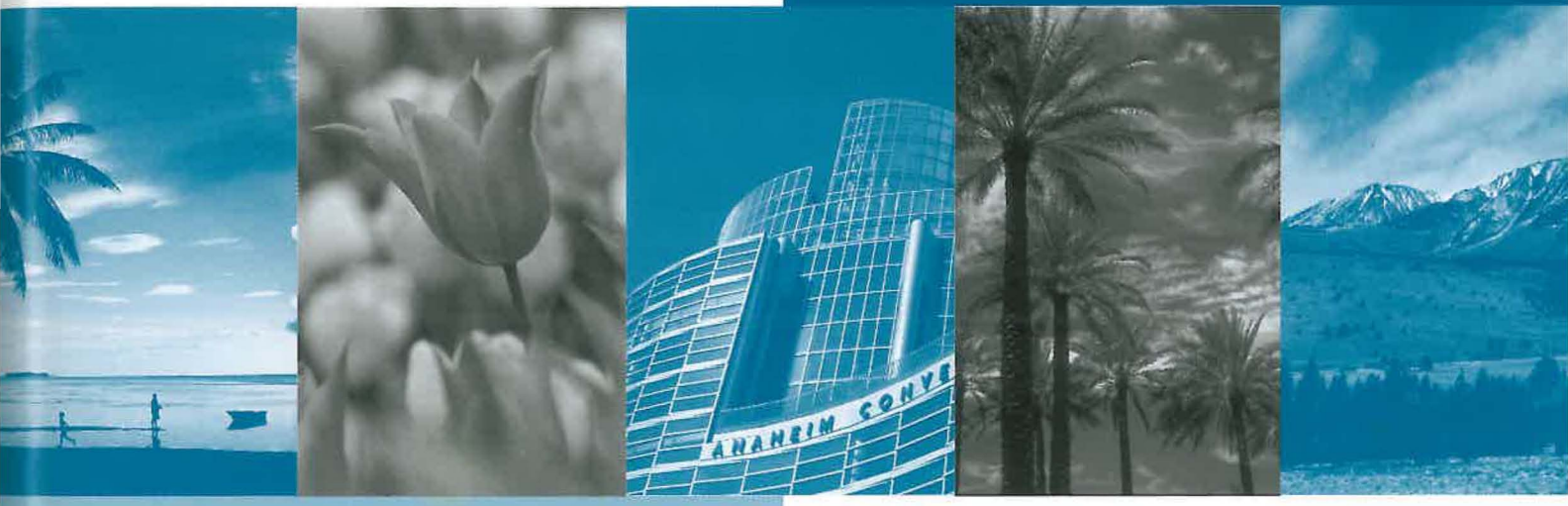

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