
Respirator Article Abstracts

We review the articles published in the American Industrial Hygiene Association Journal (AIHJ) and the Applied Occupational and Environmental Hygiene Journal for information that is applicable to the field of respiratory protection, and we publish the abstracts of these articles. We appreciate the cooperation of the American Industrial Hygiene Association and the American Conference of Governmental Hygienists in allowing us to do this.—Ed.

"A Feasibility Study of Quantitative Respirator Fit Testing by Controlled Negative Pressure," Clifton D. Crutchfield, Martin P. Eroh, Mark D. van Ert, *AIHJ*, April, 52(4): 172–176, 1991

The feasibility of using a direct measure of respirator leakage flow rate as a quantitative index of respirator face seal fit has been explored through the use of a new controlled negative-pressure method. The method is based on exhausting air from a temporarily sealed respirator facepiece at a rate sufficient to generate and then sustain a constant negative pressure inside the facepiece while the wearer holds his breath. The magnitude of the negative pressure is preselected to replicate the mean inspiratory pressure inside the mask during normal wear. With the air-purifying paths into the respirator temporarily blocked, measurement of the exhaust flow rate yields a synonymous measure of the leakage flow rate into the mask during inspiration under normal use conditions. The feasibility of using the new method to quantify respirator fit was assessed in a preliminary study that compared its performance with a quantitative fit-test method based on the use of dichlorodifluoromethane as a challenge agent. Study data exhibit a high degree of correlation ($r > 0.99$) and no significant difference between the two methods over a range of controlled mask-leakage rates. A major advantage of the new method is that a worker can be fit tested with his assigned respirator because the method does not require a destructive sampling probe. Other significant benefits compared to current methods used to quantify respirator fit appear to include (1) ease of test administration, (2) simplicity of test components, (3) lack of a potentially toxic challenge agent, (4) a straightforward calibration procedure, (5) multiple test capability, (6) immediacy of test results, and (7) field portability of the test system.

"The Physiological Cost of Wearing a Disposable Respirator," Jeffrey G. Jones, *AIHJ*, June, 52(4): 219–225, 1991

In order to gain an understanding of the physiological stresses imposed by the wearing of a single-use disposable respirator, a series of experiments was done to measure the cardiopulmonary effects of wearing the respirator (heart rate, respiratory rate, and blood pressure); resistance to breathing while wearing a respirator; and heat stress imposed by the use of a respirator (changes in inspired and expired air temperature). Ten men, ages 24 to 35, of varying fitness levels served as volunteers in the studies. All the men exercised on a treadmill both with and without 3M Model 8715 disposable respirators. Workloads corresponding to light, moderate, and heavy levels were calculated for each volunteer based on his maximal oxygen uptake. As work intensity increased, an increase in breathing resistance was found. Peak resistances were in the range of ± 2 cm water. Work-intensity level increases in respiratory rates were found with and without the respirators, but the respirator use trial had a significantly increased respiratory rate. Heart rate also showed a dose-related increase as work intensity increased and was significantly greater in the

respirator trials at heavy levels of work and during recovery. Systolic blood pressure showed a biphasic response to respirator use, being significantly lower at rest and higher at high levels of work. Diastolic blood pressure changes were less dramatic but were elevated in the respirator trials. Clinically important increases in blood pressure were found in two volunteers when respirators were worn. Air temperatures immediately anterior to the face were, on average, 7.5°C higher in the respirator trials. The use of a disposable respirator is associated with significant physiological costs especially at moderate and heavy work loads.

"A Review and Comparison of Adsorption Isotherm Equations Used to Correlate and Predict Organic Vapor Cartridge Capacities," Gerry O. Wood and Ernest S. Moyer, *AIHJ*, June, 52(4): 235–242, 1991

Four adsorption isotherm equations for describing measured capacities of organic vapor air-purifying cartridges were compared. Experimental breakthrough curves were measured for five organic vapors: ethanol, carbon tetrachloride, acetone chloroform, and hexane. Plots of service life at 1% breakthrough vs bed weight (stacked cartridges) yielded capacities over concentration ranges for three brands of cartridges. The Freundlich, Langmuir, Dubinin/Radushkevich, and HacsKaylo/LeVan isotherm equations fit the capacity vs vapor concentration data equally well, except in the case of ethanol. The ethanol fit was worse for the Freundlich equation. Other characteristics of these equations were related to their usefulness for correlating service life.

"The Influence of the Helmet Respirator on Peak Flow Rate in Aluminum Potroom," Johny Kongerud and Oivind Rambjør, *AIHJ*, June, 52(4): 243–248, 1991

The efficiency of the Racal Airstream helmet respirator in improving peak expiratory flow rates (PEFR) and symptoms (dyspnea, wheezing, and cough) in aluminum potroom workers with respiratory complaints was assessed in 19 workers. Peak expiratory flow readings and symptom recording from a two-week working period with use of the respirator were compared with a period when the 3M 9906 disposable mask was used. The study was designed as a randomized, parallel, cross-over study with five or six daily measurements of PEFR and daily symptom recording. A significant number of workers (15) had a higher mean peak flow in the helmet period than in the nonhelmet period ($p < 0.01$); symptoms did not improve significantly in the helmet period. Objective evidence of respiratory protection was observed for the group of workers as a whole, but the effect on symptoms as well as individual effect on peak flow was minor in the majority of the workers.

"A Comparison of Controlled Negative Pressure and Aerosol Quantitative Respirator Fit Test Systems by Using Fixed Leaks," Clifton D. Crutchfield, Robert W. Murphy, Mark D. van Ert, *AIHJ*, June, 52(4): 249–251, 1991

An automated version of a new method for quantitative respirator fit testing by controlled negative pressure was compared with a computerized aerosol fit test system. The controlled negative-pressure technique eliminates many of the problems associated with aerosol and pressure-decay fit-test methods. A series of fixed leaks was used to compare the leak measurement capabilities of the controlled negative-pressure system against a standard computerized aerosol fit-test system against a standard computerized aerosol fit-test system. Negative pressure and aerosol fit factors determined for a series of fixed leaks through hypodermic needles were highly correlated with each other ($r = 0.998$) and with the cross-sectional areas of the leak needles ($r > 0.995$).