

188.

A RECOMMENDATION FOR ACCEPTANCE CRITERIA FOR FIT TESTS.

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The American National Standard Institute (ANSI) standard on fit testing, Z88.10 includes a provision for the acceptance of new fit tests. The candidate test is compared to one of the accepted quantitative fit tests (QNFT) employed as a reference test. A minimum of 100 sequential paired tests from at least 25 different subjects must be conducted. At least 50 tests must have reference fit factors less than the required fit factor. A cumulative distribution plot or histogram is constructed to visually confirm that the fit factors obtained from the reference method brackets the required fit factor. A test is judged acceptable if the test sensitivity is 0.95 or greater.

A probability derived from binary logistic regression of typical fit test data demonstrates that the performance of a candidate test will depend heavily on the distribution of fit factors of the reference test. It is possible that a candidate fit test will show apparent differences with two different reference tests if the distribution of the fit factors for the reference tests are not equal. Four sets of data from OSHA accepted fit test methods are reviewed using this approach.

Rather than a simple sensitivity test, a criterion based on percent rejection by range of fit factors provides assurances that a new test effectively screens inadequately fitting respirators. It is proposed for a test to evaluate half facepiece respirators that the probability of passing with a fit factor of 50 should be ≤ 0.10 and at a fit factor of 100 the probability of passing should be ≤ 0.50 . These criteria are consistent with fit factor research on half facepiece respirators that show fit factors greater than 50 provide workplace performance higher than the assigned protection factor of ten.

189.

EVALUATION OF EXHALATION

VALVES. C. Chen, P. Lu, J. Liu, Huang, National Taiwan University, Taipei, Taiwan Republic of China; Y. Kuo, Chung Hwa College of Medical of Technology, Tainan, Taiwan Republic of China

Tests currently employed by NIOSH to certify respirators require that when tested with air at a constant suction head of 25 mmH₂O, the leakage into the facepiece from the exhalation valve(s) shall not exceed 30 mL/min. However, this test alone might not reflect the leakage rate under different levels of vacuum and the performance of the exhalation valve under cyclic motion over time. A leakage meter was built to measure the leakage rate from the exhalation valve. In addition, aerosol penetration test was conducted in a test chamber, to investigate the effect of possible aerosol deposition on the valve membrane or valve seat. A Palas powder disperser was used to generate monodisperse acrylic powders of var-

ious sizes. The aerosol number concentrations upstream and downstream of the exhalation valve were monitored by a condensation particle counter CPC3022 and a CPC3010, respectively. A homemade piston-cylinder breathing simulator was used to generate cyclic breathing patterns. Four different models (manufacturers) of exhalation valves were tested for leakage rate and the effect of particle loading on the valve membrane and valve seat. The results of leakage tests showed that the leakage rate could increase or decrease with increasing pressure drop inside the respirators, indicating that the current method of conducting leakage tests under one constant suction head of 25 mmH₂O does not guarantee better protection when the respirators were used under lower suction head. The leakage was mainly due to the fraud of valve seats. The results of aerosol loading tests showed that the aerosol penetration through the valve increased with time because of the aerosol deposition on either valve membrane or valve seat. The aerosol penetration became more significant when the exhalation valve exposed to higher wind speed, in particular when the cap of the valve was removed.

190.

PERFORMANCE OF SELF-CONTAINED SELF-RESCUERS DURING A MAN TEST 4 PROTOCOL FOR THE AUTOMATED BREATHING AND METABOLIC SIMULATOR.

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The Automated Breathing and Metabolic Simulator (ABMS) simulates human oxygen consumption, carbon dioxide production, minute ventilation, and breathing waveforms. Using metabolic data collected during a one-hour Man Test 4 performed by human subjects, two ABMS Man Test 4 protocols were developed: one simulating an 86 kg subject (MT4-50) and one simulating a 104 kg subject (MT4-95). NIOSH-approved 60-minute self-contained self-rescuer (SCSR) models A, B, C, and D (one compressed-oxygen, three chemical-oxygen models) were tested using MT4-50 (n=4) and MT4-95 (n=4). Test duration was determined using the following criteria: average inhaled O₂ (FIO₂) < 19.5%, average inhaled CO₂ (FICO₂) > 4%, minimum inhaled CO₂ (FICO₂min) > 1.5%, peak exhalation pressure (PE) > 350 mmH₂O, peak inhalation pressure (PI) < -350 mmH₂O, end-inhaled dry-bulb temperature (Tdb) > 56°C, and end-inhaled wet-bulb temperature (Twb) > 50°C. For MT4-50, duration was 65.5, 90.3, 66.3, and 75.5 min; and for MT4-95, duration was 45.3, 66.0, 50.3, and 63.8 min for models A, B, C, and D, respectively. During the sample period at minute 60 of MT4-50, FIO₂ was 80.8, 58.6, 82.8, and 86.3%; FICO₂ was 2.4, 0.6, 2.4, and 1.3%; FICO₂min was 0.2, 0.2, 0.0, and 0.0%; PE was 208, 42, 46, and 59 mmH₂O; PI was -190, -30, -52, and -46 mmH₂O; Tdb was 53.3, 43.0, 49.7, and 44.8°C; and Twb was 46.1, 43.1, 43.1, and

39.7°C for models A, B, C, and D, respectively. During the minute 60 sample period of MT4-95, FIO₂ was 35.1 and 74.9%; FICO₂ was 1.1 and 1.8%; FICO₂min was 0.6 and 0.0%; PE was 53 and 65 mmH₂O; PI was -49 and -67 mmH₂O; Tdb was 46.7 and 46.4°C; and Twb was 46.7 and 43.1°C for models B and D, respectively. These data demonstrate that the SCSR's performed as expected during the ABMS Man Test 4.

191.

ESTIMATING SERVICE LIVES OF ORGANIC VAPOR RESPIRATOR CARTRIDGES AT ALL RELATIVE HUMIDITIES.

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A widely-used equation model [Wood, AIHAJ 55:11-15 (1994)] for estimating service lives of organic vapor respirator cartridges has been updated with more recent research results and expanded to account for effects of high relative humidities. Adsorption capacity competition between water vapor and organic vapors is largely explained by mutual adsorption volume exclusion. The Dubinin/Radushkevich equation is used to describe the adsorption isotherms of both water and organic vapors. Effects of relative humidity on adsorption rates are described by an empirical correlation with breakthrough times. The dynamic natures of adsorption and competition are incorporated using an expanding zones model. The complete model has been implemented as both a spreadsheet and a Microsoft Visual Basic computer program. It has been tested and verified with published and unpublished data from many sources.

192.

THE EFFECT OF SULFUR DIOXIDE CO-ADSORPTION ON THE TOLUENE ADSORPTION PERFORMANCE OF ACTIVATED CARBON.

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Ordinary chemical cartridges are designed to prevent volatile organic vapors (VOC) to enter the respiratory tract of workers. For practical reasons, cartridges are tested against a limited number of VOCs and at concentration levels much higher than usually encountered. There is a lack of data describing the performance of chemical cartridges in environments where besides an organic vapor an inorganic gas is present. In this study, the dynamic adsorption of low concentration mixtures made up of toluene and sulfur dioxide onto activated carbon was investigated. First, the adsorption isotherm of toluene was obtained from breakthrough curves generated by continuously injecting toluene upstream of an activated carbon bed. The carbon samples were placed into a sealed copper adsorption cell submerged in a temperature controlled water bath. The upstream and downstream concentration was periodically monitored by on-line gas chromatography, and breakthrough curves were

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ABSTRACTS



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1.

RELATIONSHIPS BETWEEN WORK EXPOSURE AND RESPIRATORY OUTCOMES IN POULTRY WORKERS.

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A pilot study was conducted on 74 poultry barn workers in Western Canada during the winters of 1998-2000. General respiratory health, current, chronic and work related respiratory symptoms; general work duties, and work-site factors were ascertained, pre-exposure, by questionnaire. Personal airborne exposure levels and changes in symptoms and lung function were measured across the work-shift for all workers. Workers were classified according to the type of poultry operation (floor based, n=53; cage based, n=13) in which they worked. There was no significant difference in daily hours spent in the barn between those who worked with caged poultry (5.41±2.35 hours) and those who worked with floor-based poultry (4.42±2.48 hours). Age of birds was 47.10±58.36 days for floor based versus 155.91±63.01 days for cage based facilities.

There were no significant differences in personal environmental measurements between cage-based and floor-based facilities (ammonia 13.22±13.70 ppm, 17.34±16.35 ppm; total dust 5.74±4.85mg/m³, 10.01 ±8.84 mg/m³; endotoxin 6046±6089 EU/m³, 5457±5934 EU/m³ respectively). There were no significant differences in across work-shift change in pulmonary function indices between workers from cage and floor-based operations. For the entire sample total dust dose (work hours/day x total dust) significantly correlated with across-shift change in FEV₁, whereas endotoxin dose and ammonia dose did not. Stocking density was significantly correlated with average ammonia (ppm, p=0.002) and ammonia dose (ppm x work hours/day; p=0.004) in floor based operations and with total dust (particles/ml, p=0.002) in cage based populations. Stocking density was also significantly correlated with chronic cough (p=0.003) and across work-shift cough (p=0.05) and chest tightness (p=0.06) for workers from floor based operations; and with phlegm when working (p=0.018) and chest tightness across the work-shift (p=0.004) for workers from cage based operations. Type of poultry production operation and therefore type of work exposures appear to significantly impact symptoms experienced by workers exposed to these atmospheres.

2.

DUST GENERATION SYSTEM FOR AGRICULTURAL SOIL DUST. K. Lee, R. Domingo-Neumann, R. Southard, UC Davis, Davis, CA

Agricultural workers are prone to exposure to mixed dust of inorganic and organic compounds. Diverse working conditions and operations in agriculture make direct measurements of the mixed dust exposure difficult. This study was conducted to develop a new dust generation system to determine possible exposure potency indicators of soil samples. The dust generator consists of a blower, a rotating chamber and a settling chamber. The rotating chamber has inner baffles to provide sufficient agitation of the samples while the chamber is rotating. A blower provides air into the rotating chamber, and the suspended dust is moved to the settling chamber through a perforated pipe. A small fan inside the settling chamber helps maintain suspension of the dust. Various size fractions of dust are sampled on filters suspended in the chamber via outlet ports and attached pumps. Air pressure is released through a filter plate mounted on the wall of the settling chamber. Various operating conditions were evaluated: air intake from blower, speed of rotation, soil mass and sampling time. To evaluate the characteristics of dust from the system, we collected dust samples from agricultural fields while the soil was prepared for