

# Abstracts uit de Annals of Occupational Hygiene

## Manikin-Based Performance Evaluation of N95 Filtering-Facepiece Respirators Challenged with Nanoparticles

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Protection of the human respiratory system from exposure to nanoparticles is becoming an emerging issue in occupational hygiene. The potential adverse health effects associated with particles of 1–100 nm are probably greater than submicron or micron-sized particles. The performance of two models of N95 half-facepiece-filtering respirators against nano-sized particles was evaluated at two inhalation flow rates, 30 and 85 l min<sup>-1</sup>, following a manikin-based protocol. The aerosol concentration was measured outside and inside the facepiece using the Wide-Range Particle Spectrometer. Sodium chloride particles, conventionally used to certify N-series respirators under NIOSH 42 CFR 84 regulations, were utilized as the challenge aerosol. The targeted particle sizes ranged from 10 to 600 nm, although the standard certification tests are performed with particles of 300 nm, which is assumed to be the most penetrating size. The results indicate that the nanoparticle penetration through a face-sealed N95 respirator may be in excess of the 5% threshold, particularly at high respiratory flow rates. Thus, N95 respirators may not always provide the expected respiratory protection for workers. The highest penetration

values representing the poorest respirator protection conditions were observed in the particle diameter range of 30–70 nm. Based on the theoretical simulation, we have concluded that for respirators utilizing mechanical filters, the peak penetration indeed occurs at the particle diameter of 300 nm; however, for pre-charged fiber filters, which are commonly used for N95 respirators, the peak shifts toward nano-sizes. This study has confirmed that the neutralization of particles is a crucial element in evaluating the efficiency of a respirator. The variability of the respirator's performance was determined for both models and both flow rates. The analysis revealed that the coefficient of variation of the penetration ranged from 0.10 to 0.54 for particles of 20–100 nm in diameter. The fraction of N95 respirators for which the performance test at 85 l min<sup>-1</sup> demonstrated excessive (>5%) penetration of nanoparticles was as high as 9/10. The test results obtained in a relatively small (0.096 m<sup>3</sup>) test chamber and in a large (24.3 m<sup>3</sup>) walk-in chamber were found essentially the same, thus, suggesting that laboratory-based evaluations have a good potential to adequately represent the respirator field performance.

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## Comparing the Level of Dexterity offered by Latex and Nitrile SafeSkin Gloves

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An increase in the occurrence of latex allergy has been concurrent with the increasing use of latex gloves by laboratory and healthcare workers. In recent years nitrile gloves have been used to replace latex gloves to prevent latex allergy. Nitrile gloves offer a comparable level of protection against chemical and biological agents and are more puncture resistant. However, if manual dexterity is compromised by nitrile gloves to a greater degree than latex then this may increase the risk of sharps injuries. The Purdue pegboard test, which measures both gross and fine finger dexterity, was used to test the dexterity levels of two glove types used at HPA CEPR; Kimberly-Clark SafeSkin nitrile and latex laboratory gloves. There was a statistically significant 8.6% increase in fine finger dexterity provided by latex compared with nitrile SafeSkin laboratory gloves but no difference in gross dexterity between the glove types. There was no significant relationship between glove dexterity and age or gen-

der. The selection of glove size was influenced by the digit length of participants. Moreover, those with longer, thinner fingers appeared to have an advantage when using nitrile SafeSkin gloves. The level of dexterity provided by latex and nitrile SafeSkin gloves for tasks on a gross dexterity level are comparable and health workers will benefit from the non-allergenic properties of nitrile. For tasks requiring fine finger dexterity nitrile SafeSkin gloves may impede dexterity. Despite this, the degree of restriction appears to have a negligible impact on safety in this study when compared with the risk of latex sensitization and subsequent allergy. In addition to glove material, working practices must also take into account glove size, fit, grip and thickness, as these factors can all influence dexterity.

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# Sister Chromatid Exchange and Oxidative DNA Damage in Paving Workers exposed to PAHs

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Paving workers are exposed during road paving to several polycyclic aromatic hydrocarbons (PAHs) contained in asphalt fumes. In this study early genotoxic and oxidative effects of exposure to bitumen fumes were evaluated in 19 paving workers and 22 controls. Environmental and biological monitoring of exposure was carried out, measuring, on personal air samples from exposed workers collected during three working days, the concentration of 14 PAHs and urinary OH-pyrene at the end of each of the three working days. Genotoxic effect was evaluated analysing sister chromatid exchange (SCE) frequency and direct-oxidative DNA damage by formamido-pyrimidine-glycosylase (Fpg)-modified comet assay on lymphocytes. Tail moment values from Fpg-enzyme treated cells (TMenz) and from untreated cells (TM) were used as parameters of direct and oxidative DNA damage, respectively. For each subject, the TMenz/TM ratio >2.0 was used to indicate the presence of oxidative damage. DNA damage was also evaluated analysing comet percentage. Personal air samples showed low level of total PAHs (2.843 µg

m<sup>-3</sup>) with prevalence of 2–3 ring PAHs (2.693 µg m<sup>-3</sup>). Urinary OH-pyrene after work-shift of the three working days was significantly higher than that found at the beginning of the working week. SCE analysis did not show any difference between two groups while an oxidative DNA damage was found in 37% of exposed with respect to the absence in controls. Comet percentage was significantly higher (P = 0.000 ANOVA) in the exposed than in controls. The results demonstrate the high sensitivity of comet assay to assess early oxidative effects induced by exposure to bitumen fumes at low doses and confirm the suitability of urinary OH-pyrene as a biomarker of PAH exposure. In conclusion the study suggests the use of Fpg-modified comet test as a biomarker of early genotoxic effects and that of urinary OH-pyrene as a biomarker of PAH exposure to furnish indications in terms of characterization, prevention and management of risk in occupational exposure to mixtures of potentially carcinogenic substances.

Keywords: genotoxic effects • paving workers • polycyclic aromatic hydrocarbons • urinary 1-OH pyrene

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## Workplace Protection of Air-Fed Visors Used in Paint Spraying Operations

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Air-fed visors are commonly used for protection against exposure to airborne isocyanates during paint spraying. Protection levels for this class of equipment are theoretically adequate, yet isocyanate sensitization in this occupation still occurs. The work reported here set out to establish the level of respiratory protection that is achieved during real paint spraying activities when air-fed visors are used. The work also examined the effects of reduced air supply flow rates on this type of respiratory protection. The workplace study highlighted common problems that occur when attempting to measure protection factors, and process and interpret the collected data. Many of the environments included in this study did not exhibit challenge concentrations high enough to reliably measure the workplace protection factor of this class of device. When detection limits are taken into consideration,

the remaining field data suggest that an assigned protection factor in the region of 40 may be appropriate. When well maintained and used in accordance with the manufacturer's instructions, air-fed visors are capable of providing a good level of respiratory protection. The protection given by air-fed visors is strongly dependent on the air flow supplied to them. Laboratory measurements demonstrate that protection falls as the air supply falls. This is a gradual process and does not suddenly occur at any particular air supply flow. Observations made during the field tests indicate that there may be other activities associated with the spraying process that need to be taken into consideration when looking for sources of respiratory sensitization.

Keywords: workplace protection factor • assigned protection factor • air fed visor • paint spraying • isocyanate

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