

Letter to the Editor

Re: "Evaluation of Portacount for Determining Respirator Fit Factors, Part III: Human Subject Tests and Comparison with an Aerosol Photometer," by R. A. da Roza et al. (Fall 1991)

Mr. da Roza et al. conclude that, based upon a nonparametric statistical analysis, "at a fit factor of 100, the Portacount meets the ANSI Z88.10 criteria for validation of a new qualitative fit-test method; however, it does not meet the predictive value of a pass criteria at a fit factor of 1000." It seems that this finding was an important step towards conclusions stated in the Executive Summary as follows:

"We concluded that the Portacount can be used with ambient aerosols to confidently measure fit factors of 100. When used to measure fit factors of 1000 with ambient aerosols, several complications can occur that cause the measured fit factor to be low. Although this is undesirable, it errs on the side of safety and can be tolerated."

The above conclusions are based upon comparisons of photometer (validation standard) and Portacount (test) data collected by simultaneous measurements of in-mask aerosol concentrations while test subjects were in a generated aerosol chamber. Sequential ambient aerosol fit test data were also collected with the Portacount. The use of generated aerosol does not seem to be the proper basis for comparing the Portacount with the current standard photometer method since the Portacount is used almost exclusively with ambient aerosol in the field.

Using the same non-parametric statistical technique to compare the study's Portacount ambient aerosol data with its photometer data reveals that the Portacount failed to meet the ANSI validation criteria for both sensitivity to detect a failure and predictive value of a pass. The Portacount failures were consistent for both integrated and individual exercise fit factors at fit

factor levels of 100 as well as 1000. The direction of failures was not conservative in that, at both levels, the Portacount accepted a substantial number of fit tests that were rated as unacceptable by the photometer.

When the above failures are coupled with (1) the low correlations observed between photometer and Portacount ambient aerosol fit factors and (2) paired t-test results showing that average Portacount ambient aerosols fit test results were 4.68 times higher than photometer results, it is not clear that the conclusions reached in the paper are supported by the data.

Sincerely,

Clifton D. Crutchfield, PhD., CIH
Director, Industrial Hygiene
University of Arizona
Tucson, Arizona
USA

Robert A. da Roza replies:

Thank you for giving me an opportunity to respond to the letter from Mr. Crutchfield regarding Part III of our evaluation of the Portacount. Mr. Crutchfield is correct in his restatement of our major conclusion, "... the Portacount can be used with ambient aerosols to confidently measure fit factors of 100 ..." The two instruments were compared by use of a generated aerosol so that both could measure the same atmosphere. This is an essential requirement when comparing two measuring instruments. The photometer does not have the capability to measure fit factors for ambient aerosol—it does not produce a sufficiently large signal. However, the Portacount, which is a condensation nuclei counter, can count the particles in a generated aerosol, and thus measure fit factors. Any counting device does have an upper limit on its counting rate, but tests were performed to assure that we were below that rate. Therefore, it is

proper to use the *Portacount* under both aerosol conditions. Cautions about using the *Portacount* at very low aerosol concentrations are discussed both in our paper and the manufacturers instructions.

The problem with comparing the fit obtained by use of the *Portacount* with an ambient aerosol to the fit obtained by use of the photometer with a generated aerosol is that the measurements can not be taken simultaneously. You must have the human test subject in a small room (test chamber) that can be filled with aerosol for the photometer measurements, wait for the aerosol concentration to stabilize, have the subject perform the required eight exercises—during which the fit of the facepiece may change—then have the subject leave the test chamber and walk to a new location for the ambient aerosol/*Portacount* test. The subject then performs the same eight exercises. Now, the fit factor, or penetration if you prefer, can actually change from one exercise of the set to another. In fact, the normal breathing “exercise” which is performed as both the first and the eighth exercise rarely is the same both times. From observing hundreds of fit test records of penetration, one becomes convinced that the penetration does change as the human subject performs a series of exercises that simulate the motions that a worker might perform under actual use conditions. The data set from the photometer would have this variability as would also the *Portacount* data set. When these variabilities are combined with some unknown difference between two instruments being compared, the combined variability may prevent the data from meeting the proposed ANSI validation criteria. This should not be surprising.

If the photometer is compared to one of the experimental controlled negative pressure fit test instruments, the variability is only measured by one instrument—the photometer. The photometer measures the variations that occur with simulated work exercises, whereas the experimental controlled negative pressure fit test instruments can not make measurements while the human subject performs simulated work exercises. Thus, variability in fit is only measured by the photometer. Uncritically applying the statistical tests, one has a better chance of erroneously concluding that the experimental controlled negative pressure instrument meets the ANSI validation criteria when in fact it was measuring the leakage on an immobile face and not under simulated use conditions.

As the published studies on workplace protection factors have shown, we need test conditions that more accurately simulate work conditions. The experimental differential pressure instrument has not been shown to work while the subject is moving. Movement is necessary to simulate work conditions. The *Portacount* works well whether the subject is moving or not. In fact, being that the *Portacount* is portable and lightweight it has the potential of measuring protection factors under actual work conditions.

Robert A. da Roza

