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The Effect of Ambient Concentration and Exercise on PortaCount™ Quantitative Fit Factors

The PortaCount™ is a quantitative fit test method which uses ambient aerosols to determine the fit of a respirator. The current Occupational Safety and Health Administration (OSHA) regulations in the United States stipulate that eight exercises lasting one minute each are to be performed for this fit test. Ambient aerosol concentration levels vary greatly among workplaces, but OSHA does not stipulate a specific concentration. Due to the length of a fit test, considerable time and financial commitments must be made by employers to select a "best fitting" respirator for a given worker. Thus, the purposes of this study were to determine: (1) if PortaCount fit factors are affected by ambient concentration; (2) if any of the exercises are the most critical in determining the overall fit factor; and (3) if any exercise can be possibly eliminated. A data set of 20,974 PortaCount fit tests conducted at various workplaces was obtained. The data set was divided into two data sets: one consisting of half-mask (filtering-facepiece and elastomeric) and the other, full-facepiece respirators. The ambient concentrations were divided into five levels and Duncan's multiple range test was performed to determine if the fit factors vary among the five levels. The analyses of both data sets also involved determining the frequency of each exercise in having the lowest and highest fit factor. The fit factors for each exercise were also normalized to the highest fit factor among all exercises in each test and the mean ratio was determined for each exercise. Correlations between exercise fit factors were determined as well. Overall fit factors were found to be significantly dependent on the ambient concentration in both the half-mask and the full-facepiece data sets (p-value < 0.01). For overall fit factors greater than or equal to 100, the fit factor for "reading" or "the first normal breathing" was found to be the lowest fit factor among fit factors for each exercise for about 60% of the fit tests for half-mask respirators using six exercises; the normalized fit factors for these two exercises were also the smallest and second smallest. Fit factors for any exercise were found to be highly correlated with fit factors for other exercises. Fit factors for the first normal breathing were significantly smaller than those for the second normal breathing. Similar results were observed with the fit test data for full-facepiece respirators. The authors conclude that further study is needed to determine if the fit test pass/fail criterion should be adjusted for ambient concentration level. It is also postulated that controlled laboratory experiments may find that some exercises can be eliminated from the current fit test protocol without affecting the selection of a "best fitting" respirator for a given worker.