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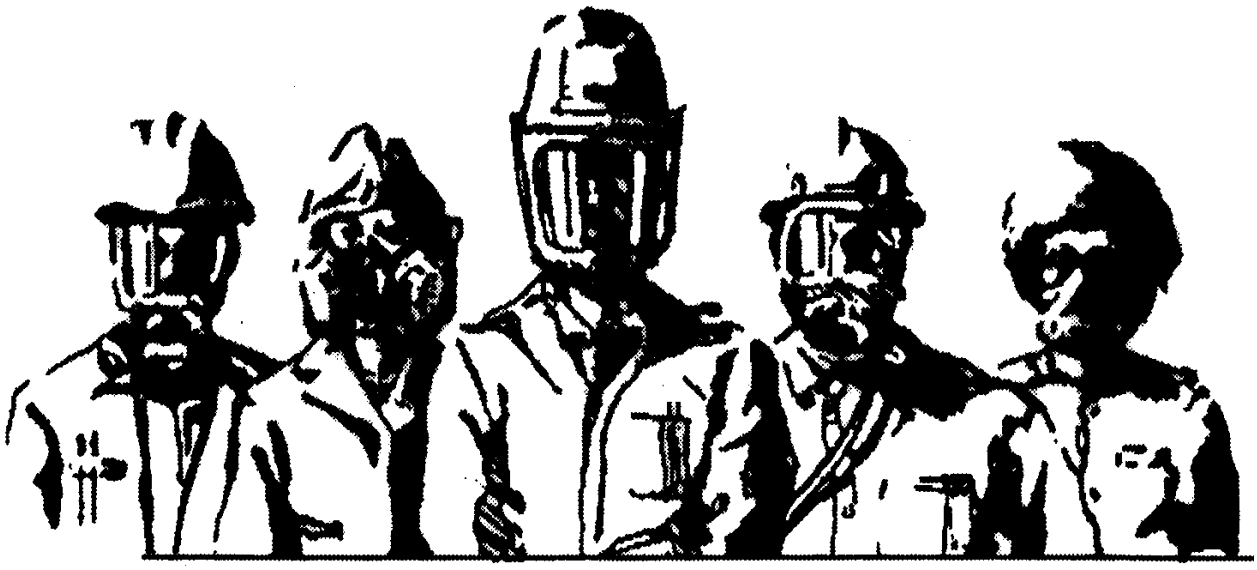

Extending the Perception of Speech Intelligibility in Respiratory Protection

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ABSTRACT

In the field of respiratory protection, speech intelligibility is perceived to be the quality of sound transmission through a respiratory interface. This paper aims to explore how speech intelligibility is a complex issue in part comprising of sound transmission, as well as other more subtle but no less important aspects, such as the visual cues gained from lip movement. The link has long been established as explained by P. Erber in the Journal of Speech and Hearing Disorders, where he states “Hearing-impaired persons usually perceive speech by watching the face of the talker”. The data and results gathered from this investigation of respiratory interfaces aims to demonstrate how the interaction between hearing and vision is perceived in speech intelligibility and how this phenomenon may be used to advantage by manufacturers of Respiratory Protective Device systems. With an understanding of this phenomenon, a manufacturer may create a respiratory interface that helps persons with impaired hearing who need to wear respiratory protection in their chosen occupation, be useful members of the workforce. It may also help completely able bodied people to communicate if their hearing is temporarily rendered obsolete by an unforeseen event. The methodology employed consists of using an adapted modified rhyme test (MRT). The test involves “listeners” being able to see the speakers’ lips through the respiratory interface as well as hearing them. The results of ‘seeing and listening’ are compared with ‘listening only’. A third scenario, where the listeners wear ear plugs but can see the speakers’ lips, is also examined. The results are analysed to show a marked improvement when able to see the speakers’ lips.

Keywords: speech intelligibility, respirator, modified rhyme test

Evaluation of a Faster Fit Testing Method for Elastomeric Half-Mask Respirators Based on the TSI PortaCount®

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ABSTRACT

In the United States, employees that wear tight-fitting respirators in the workplace are required to be fit tested annually using an Occupational Safety and Health Administration (OSHA)-accepted protocol. Given the large number of fit tests performed annually, industry would benefit if the time required to complete a fit test was reduced. TSI, Inc. (Shoreview, MN) has developed a method for elastomeric half-mask respirators that is a modification of the OSHA-accepted 'Ambient aerosol condensation nuclei counter (CNC) quantitative fit testing protocol' that reduces the test duration from about 7.2 min to 2.5 min. The objective of this study was to compare the fit factors measured with the TSI modified method to that of a reference method. The method comparison approach was based on American National Standards Institute (ANSI) Z88.10-2010 Annex A2, "Criteria for Evaluating New Fit Test Methods". Sequential, paired fit tests were performed on test participants with the modified (i.e., faster) method and a reference method during the same respirator donning. The fit factors for both methods were measured using the PortaCount® Model 8030, a CNC-based instrument. The exercises for the reference method were the standard OSHA exercise set without the grimace. The exercise set for the modified method included bending, jogging, head side-to-side, and head up-and-down. The results demonstrated that the new faster method can identify poorly fitting respirators as well as the reference method, as the test sensitivity of 0.96 was greater than the requirement (≥0.95) defined in ANSI Z88.10-2010. This new method also met the requirements for the predictive value of a pass, test specificity, predictive value of a fail, and the kappa statistic contained in the ANSI standard.

Keywords: respirator fit, quantitative fit test, elastomeric half-mask respirators

Recommended Requirements, Test Methods, and Pass/Fail Criteria for a "B95" Respirator for Healthcare Workers

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ABSTRACT

Project BREATHE (Better Respiratory Equipment using Advanced Technology for Healthcare Employees) seeks to improve respirator compliance for healthcare workers by promoting the development of more acceptable respirators. Previous work identified 28 idealized characteristics and suggested the need for development of a new voluntary standard ("B95" respirator). The goals of this manuscript are (1) to identify criteria for successful adoption of a voluntary B95 standard, (2) use these criteria to update Project BREATHE characteristics, and (3) to make preliminary recommendations for B95 requirements, test methods, and pass/fail criteria.

Criteria necessary for widespread adoption of a voluntary consensus standard were identified and used to provide recommendations for how the standards development process should proceed. After a reassessment process, only seven (25%) of the Project BREATHE characteristics remained a high priority and had a suitable test method available to reliably quantify performance. In the area of Safety & Effectiveness, one human subject test and one machine test were identified that address Project BREATHE characteristics related to respirator fit, reuse, and gauging fit. For Comfort & Tolerability, eight test methods – three machine and five involving human test subjects - were identified to address Project BREATHE characteristics related to breathing resistance, facial heat, air exchange, and moisture management. Pass/fail criteria were mostly identified using published data (where possible) from existing respirator models as the baseline. Overall, we feel that the proposed B95 respirator requirements, criteria, and test methods will provide a good starting point for deliberation and advancement through the consensus standards development process.

Keywords: respiratory protection, healthcare, infection control, comfort, fit, standards

Evaluation of a Faster Fit Testing Method for Filtering Facepiece Respirators Based on the TSI PortaCount®

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ABSTRACT

In the United States, employees that wear tight-fitting respirators in the workplace are required to be fit tested annually using an Occupational Safety and Health Administration (OSHA)-accepted protocol. Given the large number of fit tests performed annually, industry and the healthcare community would benefit if the time required to complete a fit test was reduced. TSI, Inc. (Shoreview, MN) has developed a method for filtering facepiece respirators that is a modification of the OSHA-accepted 'Ambient aerosol condensation nuclei counter (CNC) quantitative fit testing protocol' that reduces the test duration from about 7.2 min to 2.5 min. The objective of this study was to compare the fit factors measured with the TSI modified method to that of a reference method. The method comparison approach was based on American National Standards Institute (ANSI) Z88.10-2010 Annex A2, "Criteria for Evaluating New Fit Test Methods". Sequential, paired fit tests were performed on test participants with the modified (i.e., faster) method and a reference method during the same respirator donning. The fit factors for both methods were measured using a CNC-based instrument, the PortaCount® Pro+ Model 8038 operated in the optional N95 Mode (i.e., with the DMA active). The exercises for the reference method were the standard OSHA exercise set without the grimace. The exercise set for the modified method included bending, talking, head side-to-side, and head up-and-down. The results demonstrated that the new faster method can identify poorly fitting respirators as well as the reference method, as the test sensitivity of 1.0 was greater than the requirement (≥0.95) defined in ANSI Z88.10-2010. This new method also met the requirements for the predictive value of a pass, test specificity, predictive value of a fail, and the kappa statistic contained in the ANSI standard.

Keywords: respirator fit, quantitative fit test, filtering facepiece respirators

Fit of Filtering Facepiece Class 3 (FFP3) Respirators Part 1: A Comparison of Fit Test Methods

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ABSTRACT

To date there is no fit test method available which can give an absolute measure of fit for a Filtering Facepiece Class 3. Recommended fit test methods are based on different principles and use different assessment techniques and therefore may not give the same result. The aim of this study was to compare fit test methods when fit testing FFP3. 25 volunteers were recruited for a total of 130 test runs. Nine FFP3 models were identified for use in this study. From these, an FFP3 was selected for each individual at random, donned and worn, without disturbing the fit, whilst four different fit test methods were conducted: Bitrex, PortaCount, PortaCount-with-N95-Companion-technology, and the total inward leakage generated aerosol fit test method as a reference. The results from the individual fit tests within each test run were compared with the reference, and analysed according to the criteria given in the American National Standard for fit testing. No fit test method achieved all of the required, recommended and suggested criteria given in this Standard. Differences in the methodologies and the potential for bias in the results across these fit test methods are discussed. The results show that when conducted according to current HSE guidance, the PortaCount fit test method is more difficult to pass than the others. A reduction in the PortaCount pass criterion from the current 100 would lead to better overall agreement between the PortaCount fit test method and the reference method, (and the other fit test methods), whilst still being the only method achieving the test sensitivity criterion required by the Standard.

Keywords: Respiratory protective equipment (RPE), Bitrex, PortaCount, N95-Companion, RPE standards, Total inward leakage (TIL), Fit factor.