



STATEMENT OF
THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CENTER FOR DISEASE CONTROL
DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

AT THE
OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
U. S. DEPARTMENT OF LABOR
INFORMAL HEARING

ON
PROPOSED OCCUPATIONAL SAFETY AND HEALTH STANDARD FOR FIRE BRIGADES
AUGUST 28, 1979

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I am Richard M. Ronk, Chief of the Respirator Section at the National Institute for Occupational Safety and Health (NIOSH). Accompanying me is Mr. Nelson Leidel, Chief of the NIOSH Technical Evaluation and Review Branch.

We support OSHA's proposed requirement that interior structural fire fighters wear positive pressure self-contained breathing apparatus (SCBA). Our belief that such a requirement is essential to protect the lives of firefighters in such critical situations is based on our experience in testing approximately 1500 types of respirators. Our tests have shown that face seal leaks and regulator diaphragm malfunctions may cause SCBA wearers to breathe contaminants. The only way to safeguard the wearer adequately from this hazard is to maintain a slight positive pressure in the facepiece.

Since 1972, NIOSH has contracted with the Los Alamos Scientific Laboratory (LASL) for the development of performance criteria for quantitative respirator fit tests (1-5). The LASL approach was based on the selection of a stratified panel of 25 persons intended to represent nearly 95% of the adult working population. It involved testing selected respirators for face seal penetration and predicting the efficiency of classes of respirators based on the face sealing characteristics of these respirators. If the facepiece leakages for a certain proportion of panel members exceeded a critical value (e.g. 2% for full face respirators) the respirator was considered to be inadequate with respect to fit (6-7). Unfortunately, the small sample

number within each respirator/facial size combination does not allow one to predict face seal penetration with any reasonable confidence (8).

Based on an evaluation of the actual variance of penetration for all respirator/facial size combinations, we find that to be 95% confident that 95% of all trials would yield a face seal penetration equal to or less than a critical value, would require a minimum of 59 tests be conducted for each respirator/facial size combination (9-10). No current test protocol gives such levels of confidence for any face seal prediction, and even with the 59 tests, one would run the risk that 5 out of 100 uses of a respirator would allow significantly more face seal leakage than the critical value (10). To further complicate the matter, the LASL data represent only the idealized laboratory situation in which the respirators are fitted by skilled technicians, the strap tensions are normalized and a screening qualitative fit test is applied. None of these conditions occur under normal field use of respirators.

Other investigators have studied the face seal leakage problem and have found that field usage does result in a significantly higher variance in penetration than in strictly controlled laboratory tests (11-15). Research shows that even when 4 or 5 repetitive tests are made on the same individual it is not possible to adequately predict face seal efficiency because of large leakage variations. This is true even in a strictly controlled laboratory study where maximum effort is made to control the variables of strap tension, positioning facial contour change, and beard growth (16-17). To reiterate, there is no currently

available procedure to adequately predict the face seal penetration of a respirator/face combination.

NIOSH is attempting to develop a mathematical model which can be used to make valid predictions of face seal penetration with high levels of confidence (9). Until this technique is developed, prediction of face seal penetration cannot be made, except with massive numbers of tests.

Our experience with sources of respirator leakage other than around the face seal has been illustrated with the finding of a high prevalence of breached regulator diaphragms in open circuit SCBA's surveyed in fire departments around the country (18). While attention has been focused on a particular brand of SCBA, we have discovered that all open circuit SCBA's tested to date share to some extent the propensity to destroy their diaphragms in use (19). But diaphragm problems resulting from holes or tears are not restricted to open circuit SCBA's (20). In September of 1978 NIOSH was notified by a user that a significant hole had been found in the diaphragm of a Drager BG174A 4-hour negative pressure SCBA. Investigation of this problem led to a stop-sale and recall of the diaphragms for what the manufacturer stated was "... an inadequate bond where the yellow portion of the diaphragm is adhered to the outer black ring" (21). This resulted in the diaphragm coming unglued from its retaining ring with the possibility of inboard leakage.

Studies by NIOSH and others have conclusively demonstrated that in the presence of a break in respirator integrity, such as face seal or

diaphragm penetration, the maintenance of slight positive pressure prevents inhalation of contaminants (18).

Until we have a proven quantitative facepiece fitting system with adequate predictive capabilities and more rugged and reliable apparatus, we have no choice but to strongly recommend positive pressure apparatus for critical uses.

Nelson Leidel and I will be happy to answer any questions on our testimony. The relevant documents have been made a part of this proceeding.

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REPORT DOCUMENTATION PAGE		1. REPORT NO.	2.	PB91-153668  1979/08/28	
4. Title and Subtitle NIOSH Testimony on Fire Brigades by R. M. Ronk, August 28, 1979				6.	
7. Author(s) NIOSH				8. Performing Organization Rept. No.	
9. Performing Organization Name and Address NIOSH				10. Project/Task/Work Unit No.	
				11. Contract (C) or Grant(G) No. (C) (G)	
12. Sponsoring Organization Name and Address				13. Type of Report & Period Covered	
				14.	
15. Supplementary Notes					
16. Abstract (Limit: 200 words) This testimony concerns the views of NIOSH in support of OSHA's proposed requirement that interior structural fire fighters wear positive pressure self contained breathing apparatus. NIOSH views this requirement as essential to protecting the lives of firefighters in such critical situations, based on their experience in testing approximately 1500 types of respirators. The only way to safeguard the wearer adequately is to maintain a slight positive pressure in the facepiece. Various investigators have examined the face seal leakage problem and have found that field usage does result in a significantly higher variance in penetration than in strictly controlled laboratory tests. NIOSH is attempting to develop a mathematical model which can be used to make valid predictions of face seal penetration with high levels of confidence. Until a proven quantitative facepiece fitting system is devised, it is imperative that positive pressure apparatus be used for critical situations.					
17. Document Analysis a. Descriptors					
b. Identifiers/Open-Ended Terms NIOSH-Publication, NIOSH-Author, NIOSH-Testimony, Ronk-R-M, Safety-practices, Safety-equipment, Firemen, Personal-protective-equipment, Respirators					
c. COSATI Field/Group					
18. Availability Statement		REPRODUCED BY U.S. DEPARTMENT OF COMMERCE NATIONAL TECHNICAL INFORMATION SERVICE SPRINGFIELD, VA 22161		19. Security Class (This Report)	21. No. of Pages 9
				22. Security Class (This Page)	22. Price

