

ATTACHMENT 6

Nina Turner et al, *Evaluation of Proposed Methods to Update Human Testing of SCBA*, 56 AIHA J 1195 (1995)

COMMENTS TO PROPOSED RULE ON APPROVAL TESTS AND STANDARDS FOR CLOSED-CIRCUIT ESCAPE RESPIRATORS

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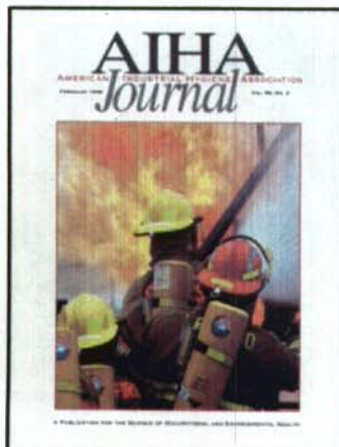
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Evaluation of Proposed Methods to Update Human Testing of Self-Contained Breathing Apparatus

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The current Man Test protocols used by the National Institute for Occupational Safety and Health for the certification testing of self-contained breathing apparatus (SCBA) do not provide continuous real-time information on the performance of these devices during actual use. In addition, current protocols do not test human subjects at the same absolute work rates but at rates that vary according to the subjects' body weights. This study was conducted to evaluate revised "Use Test" protocols proposed by the U.S. Bureau of Mines, which are normalized to subjects' body weights. No differences in duration were observed among the three body weight categories for the multiple work rate Use Test 2. It was concluded that the proposed Use Test protocols could form the basis for eventual recommendations to revise the current Man Tests for SCBA performance evaluation.

The purpose of this study is to demonstrate the feasibility of using updated test methods and protocols for the human testing of self-contained breathing apparatus (SCBA). There is general agreement among respirator researchers, users, and manufacturers that the current Man Tests described in 30 CFR, Part 11,⁽¹⁾ are in need of revision.⁽²⁻⁷⁾ The stated purposes of the current Man Tests are to (1) familiarize the wearer with the apparatus during use, (2) provide for a gradual increase in activity, (3) evaluate the apparatus under different types of work and physical orientation, and (4) provide information on the operating and breathing characteristics of the apparatus during actual use.⁽¹⁾

The current protocols for Man Tests 1-4 do not adequately fulfill purposes 3 and 4. Real-time monitoring was not technically feasible when these standards were written; consequently, monitoring currently occurs only during specified 2-min periods of inactivity. During these periods of inactivity, all the measured physiological variables (respiration rate, mouth pressure, temperature, and inspired CO₂ concentration) decrease significantly. Research by Bernard et al.⁽³⁾ indicates that within 30 sec of termination of moderate-in-

tensity exercise, minute ventilation decreases 30% and pressure at the mouth drops 50%. Therefore, the continuous monitoring technique used in this study was of benefit to the participants, by monitoring their safety, and to the investigators, by providing continuous real-time information on respirator performance.

In addition to a lack of continuous monitoring, current Man Test protocols do not consistently test subjects at the same absolute work loads. The proposed Use Test protocols prescribe different treadmill settings for several ranges of body weights, providing for consistent absolute work loads regardless of body weight.

A previous literature review⁽⁸⁾ omitted several recent experimental and demographic studies⁽⁹⁻¹²⁾ that are relevant to the currently proposed Use Test protocols. These studies fall into two distinct categories: physical characteristics of SCBA users and metabolic rates of SCBA users. Each is discussed separately.

PHYSICAL CHARACTERISTICS OF SCBA USERS

Metabolic rate, as measured by oxygen consumption ($\dot{V}O_2$), has been shown by Kamon et al.⁽²⁾ to vary by as much as 30% between 50th and 95th percentile miners. It is apparent that SCBA performance during the

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