

POF022: General platform presentation

Comparison of ISO work of breathing and NIOSH air flow resistance test methods.

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Abstract

Work of breathing (WOB) was identified by Silverman as a basis for breathing resistance limits for respiratory protective devices (RPDs). Used for underwater breathing apparatus since the 1970s, WOB was recently incorporated into new ISO standards for RPDs. National Institute of Occupational Safety and Health (NIOSH) methods and requirements for breathing resistance, specified in 42CFR Part 84, currently do not include WOB. The aims of this study were to measure and characterize WOB for current RPDs and compare the ISO method, results and requirements to those used at NIOSH.

WOB was determined as in ISO-16900-12:2016, with equipment as in ISO-16900-5:2016 using a medium ISO head form. WOB measured at eight work rates was compared with results from NIOSH tests. Fifty-four models were tested, including air-purifying (APR) and supplied-air respirators (SAR): 17 filtering facepiece, 7 full-facepiece (with a chemical, biological, radiological and nuclear canister), 12 elastomeric half-mask, and 3 tight-fitting powered air-purifying (PAPR), 6 loose-fitting PAPR, 3 self-contained breathing apparatus, 4 constant-flow airline, and 2 pressure-demand airline.

53/54(98%) met NIOSH breathing resistance requirements. All RPD at work rate 1 (35LPM) and 50/54(93%) at work rate 2 (65 LPM) met proposed WOB limits (ISO 17420-1, ISO 17420-2). For non-powered APR, NIOSH inhalation resistance correlated significantly (P -value<0.05) (at work rates 1 and 2) with WOB_{inhalation} (R^2 =0.90), minimum pressure (R^2 =0.80). Exhalation resistance likewise correlated moderately with WOB_{exhalation} (R^2 =0.73) and maximum pressures (R^2 =0.63).

This study found that NIOSH breathing resistance and ISO WOB can be predicted from the other. The probability of exceeding the NIOSH exhalation resistance requirement was appreciably greater than for NIOSH inhalation resistance, ISO WOB or peak pressures. Results from PAPR and SAR designs had a comparable but less statistically-significant relationship.