Title: Comparison of current versus proposed SCSR regulations

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Current Regulations

Specify activities
Monitor stressors only during rest periods
Stop testing at rated durations
Classify apparatus by duration
Comfortable stressor level limits
Evaluate apparatus components

Proposed Regulations

Specify work rates
Monitor stressors continuously
Stop testing when empty
Classify apparatus by capacity (quantity of usable oxygen)
Physiologically tolerable stressor level limits
Evaluate entire apparatus

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Reasoning for proposed changes

1) **Two people of different body weights walking at the same speed will have different oxygen consumption rates. The heavier person will use more oxygen than a lighter person. A breathing apparatus being tested with heavier human subjects will be stressed more than an apparatus being tested with lighter human subjects. Certification tests should test all apparatus at the same work load.**
2) **The current testing regimen monitors stressor levels (CO_2, O_2, and temperature) only while the test subject is standing still. The proposed testing regimen will monitor stressor levels (CO_2, O_2, temperature, and breathing pressures) continuously, including during high-work load periods.**
3) **Current certification tests are for specific durations. Testing stops at 60 minutes, for example, for 1-hour-rated SCSRs. If there is more oxygen left in the apparatus, how the apparatus behaves if the user continues to breathe on the apparatus after 60 minutes is unknown. If CO_2 rises to high levels, the user may find himself unable to continue wearing the apparatus. The proposed regulations will continue testing until the apparatus is empty, requiring that all stressors remain at safe levels.**
4) **Current regulations classify apparatus by duration even though the duration is inversely proportional to O_2 use rate. The faster you use up the O_2, the lower the duration. The proposed regulations classify apparatus by capacity – quantity of usable O_2. Capacity is much less affected by use rate. Auto gas mileage is a similar concept. It is understood that how long a tank of gas will last depends on car speed.**
5) **The current stressor level limits are comfortable. The proposed limits are based on human physiological tolerance in order to enable smaller and lighter breathing apparatus that may be less comfortable, but still safe, to wear.**
6) **The current regulations include testing components of breathing apparatus. The proposed regulations evaluate the performance of the entire breathing apparatus in actual use. For example, the demand valve of compressed-oxygen apparatus is required to "…provide at least 30 liters of oxygen per minute when in the fully open position." The pressure required to activate the demand valve, however, is not specified. This resulted in approval of an apparatus with a very stiff demand valve (Ocenco EBA 6.5) which caused users in an actual escape (Greenwich Colliery, 1984) to breathe around the mouth, remove their nose clips, or remove the mouth piece during high work rates. And the current test for breathing resistance evaluates the apparatus performance with dry air and no CO_2 in the breathing gas. In actual use, however, the breathing resistance of KO_2 apparatus increases with moisture and CO_2. There are no breathing resistance limits in the man tests. Both of these problems are eliminated in the proposed tests with continuous monitoring. (Ocenco has replaced the stiff demand valve.)**

Performance Test results of currently approved SCSRs

CSE SR-100
Duration, empty: 47 min
Quantity of delivered O_2: 89 L (92 L in Capacity test)
Failure mode: >4% average inhaled CO_2 at 33 min.

Drager OXY K Plus
Duration, empty: 48 min
Quantity of delivered O_2: 91 L (118 L in Capacity test)
Failure mode: None

Ocenco EBA 6.5
Duration, empty: 75 min
Quantity of delivered O_2: 135 L (144 L in Capacity test)
Failure mode: <15% O_2 immediately; >50°C at 33 min; >4% CO_2 at 61 min

Ocenco M-20
Duration, empty: 10 min
Quantity of delivered O_2: 25 L (26 L in Capacity test)
Failure mode: <15% O_2 immediately; >50°C at 3 min; >4% CO_2 at 3 min

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