# COMPARISON OF PROPOSED CONCEPT POWERED, AIR-PURIFYING RESPIRATOR (PAPR) STANDARDS FOR INDUSTRIAL, WMD, AND CBRN CLASSIFICATIONS

5/30/05

| PAPR STANDARD | INDUSTRIAL | WMD (name to change) | CBRN |
|---|---|---|---|
| PAPR types | Respiratory inlet covering:<br>(Tight fit or loose fit) @ 3 flow rates:<br>Low, Moderate, High | Tight fit or loose fit @ 2 flow rates<br>(Low and Moderate) | Tight fit only @ 2 flow rates (Moderate and High) |
| Approval types | Approved per :<br>Protections as requested<br>+ inlet covering (Tight or loose fit)<br>+ IDLH w. $O_2$, , non-IDLH escapes<br>+ Flow rates (Low, Med, High) | Approved Per :<br>Single protection- CBRN<br>+ Tight or loose fit<br>+ NOT for IDLH escape<br>+ Flow rates (Low, Med) | Approved Per :<br>Single protection- CBRN<br>+ Tight fit only<br>+ IDLH w. $O_2$ , non-IDLH escapes<br>+ Flow rates (Med, High) |
| Environments | TIGHT FIT<br>Entry in characterized<br>Escape from characterized or uncharacterized with sufficient O2<br><br>LOOSE FIT<br>Entry in characterized<br>Escape with only from characterized-unit must be removed | TIGHT FIT<br>Entry in characterized<br>Escape only from characterized<br><br>LOOSE FIT (same as TIGHT)<br>Entry in characterized<br>Escape only from characterized | TIGHT FIT<br>Entry in characterized<br>Escape from characterized or uncharacterized with sufficient O2<br><br>No LOOSE FIT |
| Pressure type | Positive or non-positive pressure | Positive or non-positive pressure | Positive pressure only |
| General test condition | Test at max flow | Same | Same |
| Filter type | Hi efficiency filter (PAPR 100)<br>Base filter (PAPR 95) | PAPR 100 only | PAPR 100 only |
| Cartridge/canister usage | Cartridges, canisters, or filters sealed in original packaging until | Same | Same |

| | | | |
|---|---|---|---|
| | used | | |
| Agent exposure | Not Applicable<br>Not approved for any agent exposure | Not designed for liquid agent expose<br>If exposure occurs, dispose of immediately | If liquid agent exposed- disposed of after use |
| Gas/vapor approval categories | Approved for gas families via TRAs (Test Representative Agents) + additional industrial chemicals | Approved for gas families via TRAs (Test Representative Agents) only | Approved for gas families via TRAs (Test Representative Agents) only |
| Part 84 requirements | General provisions Subparts A, B, C (fees), D, E, F, G unless specified | Same except subpart C<br>Fees specified separately | Same except subpart C<br>Fees specified separately |
| Containers/packaging conditioning | No environmental conditioning | No environmental conditioning | Environmental conditioning in min packaging |
| Rough handling | No rough handling requirement | Canister rough handling since uses CBRN canister | Canister rough handling |
| Labeling | Label- Battery part number on battery pack AND other suitable location if not visible<br>+ list battery service life (run time) | Same | Same |
| Labeling- additional | Label- Additional C&L's as required | Same | Same |
| Battery life use time | Battery life in 60 min increments | Same | Same |
| Battery indicators | Battery life indicator- may be passive | Same | Same |
| Battery life | None | None | Battery- expiration date |
| Battery alert | Low Battery- 15 min low battery life alert- Must readily detectable without manipulation of the respirator | Same | Same |
| Battery operation time | Continue to perform properly 15 minutes after rated time at min. specified op. temp. | Same | Same |
| Low air flow or low pressure indicator | Must readily detectable without manipulation of the respirator<br>Test at min specified op temp & 25C | Same | Same |
| System flow – minimum flow requirements | CONSTANT FLOW<br>Light flow (work) rating<br>Tight fit >= 85lpm???? | Low and Moderate only | Moderate and High only |

| | | | |
|---|---|---|---|
| Test performed on most restrictive cartridge/canister/filter configuration | Loose fit>= 115 lpm????<br>to be determined<br>Moderate flow rating<br>Tight fit >= 115 lpm<br>Loose fit>= 170 lpm<br>High flow rating<br>Tight fit >= 261 lpm for final 10 minutes of specified operation time<br>Loose fit >= 350 lpm for final 10 minutes of specified operation time<br><br>BREATH RESPONSE<br>(tight fit only)<br>Low flow rating<br>>=14.5 res./min @ 10.5 L/min. vol.<br>Moderate flow rating<br>>=24res./min.@ 40 L/min<br>High flow rating<br>>= 30 res./min. @ 86 LPM + 30 res./min @ 103 L/min for final 10 minutes of specified operation time | | |
| Non-powered system resistance | No requirement: FMEA Failure Modes and Effects Analysis used | Same | Same |
| Vision | Field of View<br>Score >=90 on med. Size | Same | Same |
| Vision- haze | Haze <= 3% | Same | Same |
| Vision- luminous trans | Luminous Trans >= 88% | Same | Same |
| Abrasion | Optional: Abrasion res-<br>haze increase <=4% | Optional: Abrasion res-<br>haze increase <=4% | Required |
| CO2 testing- Machine | CO2- Machine test<br>Inhaled <= 1%<br>14.5 res.p.m. | Same | Same |

| | | | |
|---|---|---|---|
| | 10.5L 5%<br>CO2 inhaled. | | |
| CO2 and O2- Human subject | CO2 & O2 Human Subject<br><=2%<br>O2 >= 19.5%<br>@ 3.5 mph walk | Same | Same |
| Hydration devices (optional) | Hydration (if present)<br>75mm H2O suction<br>Leakage <= 30 mL/min | Same | Same |
| Sound | Noise <= 80 dBA | Same | Same |
| Gas/vapor testing concentration:<br>per system<br><br>Testing per cartridge or canister performed at highest flow rate of respirator system on which cartridges or canisters will be used divided by number or cartridges or canisters<br><br>Concentration calculation:<br>Test concentration= PEL X APF of 50 X safety factor of 10.<br><br>Breakthrough = PEL.<br>Ethylene Oxide calculated at 10 X concentration and 10X | Gas/Vapor Test ppm Break Through ppm<br>-<br><br>Ammonia 2500 25<br>Cyanogen Chl. 300 1<br>Cyclohexane 2600 10<br>Formaldehyde 500 1<br>Hyd. Cyanide 940 4.7<br>Hyd Sulfide 1000 10<br>Nitrogen Dio 200 1NO2, 25 NO<br>Phosgene 250 1.25<br>Phosphine 300 0.3<br>Sulfur Dio 1500 5<br>---<br>INDUSTRIAL ONLY<br>Carbon Mon. 18000 35<br>Ethylene Oxi. 5000 1<br>Methyl Amine 5000 10<br><br>NOTE: Industrial may choose any combinations of protections. | Same Except for<br>Carbon Mon.<br>Ethylene Oxide<br>Methyl Amine<br><br>NOTE: CBRN must be approved for all protections above dashed line shown in industrial column | Same Except for<br>Carbon Mon.<br>Ethylene Oxide<br>Methyl Amine<br><br>NOTE: CBRN must be approved for all protections above dashed line shown in industrial column |

| | | | |
|---|---|---|---|
| breakthrough for laboratory purposes. | | | |
| Gas/vapor test conditions | Gas/Vapor Test conditions<br>Not preconditioned<br>Tested at 25% & 85% RH | Same | Same |
| Gas/vapor test time | Test concentration X rated minutes (in 60 min intervals) | Gas/Vapor Test Time:<br>60 min | Gas/Vapor Test Time:<br>Test concentration X rated minutes (in 15 min intervals) |
| Gas/vapor test flows | Performed on cartridge or canister at max flow rate of system on which it will be used divided by number of cartridges or canisters | Performed at max flow rate of system on which it will be used | Gas/Vapor Test Flow<br>(canister system)<br>Constant , Moderate 100 lpm<br>Constant, High 261 lpm<br>Demand, Moderate 115 lpm<br>Demand ,High 300 lpm |
| Particulate testing concentration:<br>per system | Particulate PAPR 95 & PAPR 100<br>PAPR 95- DOP –initial penetration<br>PAPR 100- DOP- 200 mg loading<br>20 canisters tested<br>95.0% or 99.97% efficiency<br>+6 after cyclohexane if used in conjunction with OV protection | Particulate<br>DOP- 200 mg<br>20 canisters<br>99.97% eff.<br>after cond.<br>+6 after cyclohexane | Particulate<br>PAPR 100 only plus<br>+6 after cyclohexane |
| Particulate test conditioning | Tested as received | Test following environmental conditioning | Test following environmental conditioning |
| Particulate test time | PAPR 95- DOP -instantaneous<br>PAPR 100- DOP- 200 mg loading then test until no further degradation | PAPR 100- Same | PAPR 100- Same |
| Particulate test flows | Performed at max flow rate of system on which it will be used | Same | Same |
| Crisis Provision | Not required | Not required | Panic demand - Canister<br>Hi flow :5 min @ 100-135 lpm (note: would be the same as constant moderate w. |

| | | | 1-canister PAPR<br>-OR-<br>Br. Machine @ 114 lpm & peak flow rate @ 360 lpm |
|---|---|---|---|
| Resistance of Cartridge/canister/filter | Resistance in parallel: +-10% | Same | Same |
| Canister uniformity system service test | None | System service<br>Test w. cyclo., SO2, Cyan. Chl. & Phos. On manifold | System service<br>Test w. cyclo., SO2, Cyan. Chl. & Phos. On manifold |
| Fogging | Fogging- low temp<br>VAS >= 75 at min temp specified by applicant | Same except at -21C | Same except at -21C |
| Communications | None required | Communications:<br>>=70% | Communications:<br>>=70% |
| Agent testing | None required | LAT (same) | LAT |
| Fit testing | LRPL value of 10,000 proposed | Same but value may be revised | Same but value may be revised |
| Environmental conditioning | None | None | Durability<br>Hot, cold, vibration, drop |
| QA | QA per 42 CFR 84 | Same | Same |
| Practical Performance | Determined as part of LRPL | Same | Same |
| Electronic component analysis | FMEA (Failure Modes and Effects Analysis) | Same | Same |
| Intrinsic safety (optional) | Intrinsic safety- Part 18 or recognized independent lab | Same | Same |
| ESLI (optional) | ESLI- per present requirement | Not applicable | Not applicable |
| Shelf life (optional) | Mfr. may list shelf life of components | Same | Same |
| Valve leakage | Per Part 84 existing requirements | Same | Same |
| Total system leakage | Determined via LRPL | Same | Same |