N95 Replacement Proof of Concept Testing. Location: Gage building UofT, Dala Lana School of Public Health.

APIL Lab Team: William Ng, Andrew Syrett, Vahid Anwari. Note: These preliminary test results are for internal use only, not meant to be conclusive evidence for proof of concept testing or official results.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Parameter  Resistance (Inches H2O). | Expected | Total particles passing through #/cm^3 | Flow | Material | Conclusion |
| 1st seal test room air  -Entire mask sealed with aluminum tape | -5.3 | - 1000 or infinitely negative | 12x10^3 (Ideal: <20) | 30 L/min | NIH medium mask, Dragon skin 30 (blue) silicon, Filter material: 2 ply N95 filter (56 mm x 56 mm | Leakage + smaller particles passing through at high velocity due to low surface area |
| 2nd seal test room air. Mask sealed except at area of filter | -3.98 | Same as above | Similar to above | 30 L/min | Same as above | Same as above |
| 3rd seal test - entire surface area sealed with aluminum tape | -9.94 | Same as above | Similar to above | 30 L/min | NIH medium mask, Dragon skin 30 (blue) silicon, Filter material: 3 ply N95 filter (56 mm x 56 mm |  |
| Matt’s mask around mannequin head – Sealed with aluminum tape | * -17 | Same as above | **≈** 270 | 30 L/min | Sewn Halyard 400 | Better than above – higher surface area. Still suffers from leakage at sewn area of the head bands on each side. Has potential, improve with heat treated seams, and retest. |
| Roxon – attached to hose | -3.96 | Same as above |  | 30 L/min | Lots of leakage, low resistance | Low surface area, not enough filter material |
| Woodbridge 5 ply Taped over mouth of mannequin with aluminum tape | -14.6 | Same as above | 142 (Reference <20 ideal). Best N95 = o particles with perfect seal. Median sized particle: 50 nm | 30 L/min | Woodbridge 5 ply. Velocity of particles near mask = 0.2 m/s | Low surface area, inconclusive. |
| N95 filter (3 ply) roughly < 1.5”x1.5” attached to mannequin head with aluminum tape | -9.2 | Same as above | 173, median size 76 nm | Flow 30L/min | 3M 5N11 N95, 3 ply. | Low surface area reduces filter effectiveness at high flow rates of 30 L/min |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

**Overall Conclusions**: Problems with leakage with the NIH model despite thorough taping with aluminum tape. The 5.7 cm x 5.7 cm filter area reduces surface area during inspiration, allowing smaller particles with higher velocities to pass through even the 3 ply N95. Nylon cage of the NIH mask does not stick well to the aluminum tape and makes it difficult to seal. The mannequin head is not to proportion compared to an ideal facial shape. Significant leakage issues and the low surface area for filtering in NIH model and the “montana” and its derivative models renders **these designs non testable for NIOSH level testing with NaCl.**

**Future directions**: Increased SURFACE AREA of filter area is mandatory – particles detectable by the test was 10 nm – 500 nm. Good level filters prevent the passing of particles >20 nm, 3M N95 masks with excellent seal perform with 0 particles passing through, has high surface area.

Nylon filament and other 3D printed masks not recommended due to poor sealing and very low surface area.

|  |  |  |
| --- | --- | --- |
| A picture containing indoor, open, sitting, stove  Description automatically generated | NIH medium mask, Dragon skin 30 (blue) silicon, Filter material: 3 ply N95 filter (56 mm x 56 mm |  |
| A picture containing indoor, table, sitting, black  Description automatically generated | Woodbridge filter taped with aluminum tape over mannequin head testing resistance |  |
| A picture containing indoor, sitting, table, bowl  Description automatically generated | Resistance testing the Roxon filter |  |
|  |  |  |