30 March 2020

Dear Valued Customer:

Thank you for your recent inquiry with respect to the Neptune 3 Rover and Compact Smoke Evacuator, specifically regarding their filtration capability.

How efficient are Neptune and Compact filters? Do they capture coronavirus?

The Neptune 3 Waste Management System is compatible with two filters:

1. HEPA (High Efficiency Particulate Air) filter, PN 0702-034-000
2. ULPA (Ultra-Low Penetration Air) filter, PN 0702-040-000

The Compact Smoke Evacuator is compatible with an ULPA filter sold in various markets under one of these part numbers:

- 0703-040-000
- SFR-FIL-C-L

Our HEPA filter is designed to remove particles and odors from air pulled through the Rover's internal 4L and 20L fluid suction canisters. An independent lab verified that it meets HEPA efficiency performance[1], defined as particle collection efficiency of at least 99.97% per IEST-RP-CC001[2].

Our Neptune and Compact ULPA filters are designed to remove particles and odors from air pulled through smoke evacuator disposable tubing and accessories. An independent lab verified that they meet ULPA efficiency performance[3,4], defined as particle collection efficiency of at least 99.999% per IEST-RP-CC007[5].

Furthermore, all three filters have typical viral and bacterial filtration efficiency of at least 99.99%, as verified by another independent lab[6]. Their protocol leveraged viral and bacterial media used in ASTM F2101, ASTM F2101, and EN 14683 for surgical face masks[7], but then dramatically increased the concentration to challenge entire filter assemblies. However, Stryker does not have testing with a coronavirus.

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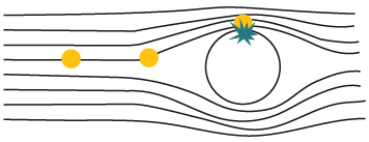
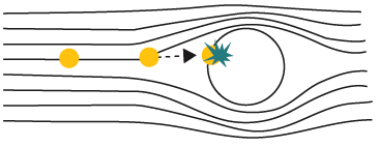
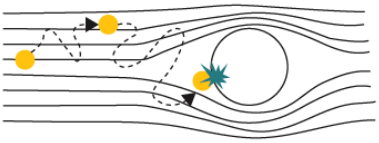
[1] Stryker internal test reports S1756.070333, S1756.070771, S1756.070817, S1756.070840
[2] IEST-RP-CC001 requires testing at 0.3-µm mass median diameter particle size
[3] Stryker internal test reports S1756.071362, S1756.071444, S1756.071469, S1756.071450, S1988.150724
[4] Stryker internal test reports D0000018642, Design.zip, DVerR-021A-08 AT-1 to Design Verification Report - Filter verification rev. 1.pdf
[5] IEST-RP-CC007 requires testing at the most penetrating particle size (MPPS)
[6] Stryker internal test report X9999.190249, Neptune HEPA and ULPA filters tested to 150 LPM, Compact filter tested to 100 LPM.
[7] Challenge organisms were staphylococcus aureus and bacteriophage phiX174.

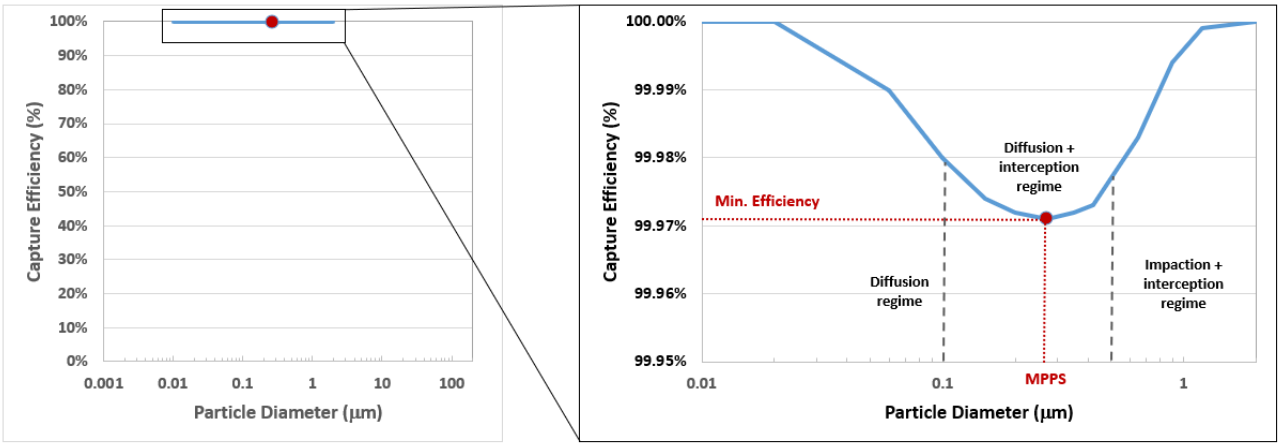
What size particles do your filters capture?

Contrary to popular belief, aerosol filters are more than a sieve which only captures particles above a certain size. Aerosol filters capture particles of all sizes, but the capture efficiency rate is not the same for all particle sizes. The reason for this behavior is that there are five basic mechanisms simultaneously at work as aerosol travels through a filter[8]:

1	Interception	Particle motion follows gas streamline and touches a fiber (includes sieving)	
2	Impaction	Particle can't follow streamline due to inertia, leading to fiber collision	
3	Diffusion	Particle erratic path due to Brownian motion leads to fiber collision	
4	Settling	Particle downward motion due to gravity leads to fiber collision	Usually insignificant
5	Electrostatic	Particle charge attracts toward fiber leading to collision	Very difficult to quantify

When you combine these mechanisms into a HEPA-grade filter (or better), a typical filtration efficiency curve might look like the figure below[9]. Note that there is a valley defining the minimum filter efficiency at the most penetrating particle size (MPPS). This valley occurs in the regime where interception has a reduced effect as particles get smaller, and where diffusion has a reduced effect as particles get bigger. All particles, both larger *and smaller than the MPPS*, are collected with greater capture efficiency[10].

[8] Hinds, William. *Aerosol Technology*. 2nd ed., Wiley-Interscience, 1999, pp. 182, 191-195.
[9] K. W. Lee & B. Y. H. Liu (1980) On the Minimum Efficiency and the Most Penetrating Particle Size for Fibrous Filters, Journal of the Air Pollution Control Association, 30:4, 377-381, DOI: 10.1080/00022470.1980.10464592
[10] Hinds, p. 187.



Due to this well-known behavior studied in aerosol research over the past several decades, international standard filtration performance test methods focus their measurements in the 0.1 to 0.5 µm particle diameter range. IEST-RP-CC001, for example, requires HEPA filters to be at least 99.97% efficiency at 0.3 µm diameter, under the assumption that this is at, or very near, the MPPS[11]. For ULPA filters, IEST-RP-CC007 requires at least 99.999% efficiency at the most penetrating particle size between 0.1 and 0.7 µm.

In summary, Stryker's HEPA and ULPA filters provide excellent filtration efficiency, even for viruses. As always, here at Stryker, we stand ready to answer any questions our customers may have concerning our products. If you have any questions pertaining to the contents of this letter, please contact us immediately.

Yours Sincerely,

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[11] Hinds, p. 198