

### Section III: Results

#### Statistical Tests

The statistical test I used for this test was a T-test. I calculated the mean filtration efficiency for the surgical mask for PM 1.0, PM 2.5, and PM 10.0. Then, the mean filtration efficiency for the designed mask will be compared and used in a T-test to find if there is statistical significance that the efficiency of the designed mask is greater than the surgical mask.

#### *Student's T Test*

3 different T-tests were performed to show that there was statistical significance that the designed mask has a higher filtration efficiency than the surgical mask. As seen in Table 2 and Table 4, the filtration efficiencies for both masks were recorded over 30 trials. The average filtration rate for the designed mask for PM 1.0, PM 2.5, and PM 10.0 was 95.6%, 96.02%, and 96.68%, respectively. The average filtration rates for the surgical mask for PM 1.0, PM 2.5, and PM 10.0 are 93.19%, 95.58%, and 96.14%, respectively. For each T-test, the null hypothesis was equal to the average filtration efficiency for each PM size for the surgical mask. Additionally, the sample mean was equal to the corresponding PM size filtration percentage for the designed mask. The alternative hypothesis was set greater than the null hypothesis. The sample size for all tests was 30. The T-test for comparing the PM 1.0 filtration efficiencies yielded a p-value of  $4.18 \times 10^{-8}$ , 0.15447 for PM 2.5, and 0.001488 for PM 10.0. All 3 p-values are below the significance level of 5%.

First, the average amount of PM 1.0, PM 2.5, and PM 10.0 particles dispersed by the diffuser was recorded. The values for PM 1.0, 2.5, and 10.0 were 711, 1402, and 2091 particles, respectively. After 30 trials, the number of particles that penetrated through the designed mask for each size in each trial was recorded.

Table 1: The number of particles of PM 1.0, 2.5, 10.0 that were quantified penetrated through the mask over the span of 30 trials for the designed mask.

	T1	T2	T3	T4	T5	T6	T7	T8	T9
PM 1.0	39	38	17	24	23	32	13	38	19

PM 2.5	74	71	34	40	57	73	41	79	30
PM 10.0	87	89	44	50	82	99	71	92	36

	T10	T11	T12	T13	T14	T15	T16	T17	T18
PM 1.0	26	21	23	36	41	37	21	39	26
PM 2.5	41	34	35	65	78	65	33	69	42
PM 10.0	53	40	42	84	98	80	40	89	56

	T19	T20	T21	T22	T23	T24	T25	T26	T27
PM 1.0	34	36	31	30	31	40	41	40	35
PM 2.5	65	64	54	48	50	66	66	70	61
PM 10.0	85	84	58	63	63	71	81	83	79

	T28	T29	T30
PM 1.0	37	29	32
PM 2.5	60	61	49
PM 10.0	65	70	51

Using these values, a table was created to represent the filtration percentages of the mask in each trial.

Table 2: The percentage (in decimal form) of particles that were filtered out by the designed mask in each trial

	T1	T2	T3	T4	T5	T6	T7	T8	T9
PM 1.0	0.945	0.947	0.976	0.966	0.968	0.955	0.982	0.947	0.973
PM 2.5	0.947	0.949	0.976	0.971	0.959	0.948	0.971	0.944	0.979
PM 10.0	0.958	0.957	0.979	0.976	0.961	0.953	0.966	0.956	0.983

	T10	T11	T12	T13	T14	T15	T16	T17	T18
PM 1.0	0.963	0.97	0.968	0.949	0.942	0.948	0.97	0.945	0.963
PM 2.5	0.971	0.976	0.975	0.954	0.944	0.954	0.976	0.951	0.97
PM 10.0	0.975	0.981	0.98	0.96	0.953	0.962	0.981	0.957	0.973

	T19	T20	T21	T22	T23	T24	T25	T26	T27
PM 1.0	0.952	0.949	0.956	0.958	0.956	0.944	0.942	0.944	0.951
PM 2.5	0.954	0.954	0.961	0.966	0.964	0.953	0.953	0.95	0.956
PM 10.0	0.959	0.96	0.972	0.97	0.97	0.966	0.961	0.96	0.962

	T28	T29	T30
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PM 1.0	0.948	0.959	0.955
PM 2.5	0.957	0.956	0.965
PM 10.0	0.969	0.967	0.976

Then, the same set-up was used for the surgical mask. The number of particles penetrating through the surgical mask was recorded.

Table 3: The number of particles of PM 1.0, 2.5, 10.0 that were quantified penetrated through the surgical mask over the span of 30 trials

	T1	T2	T3	T4	T5	T6	T7	T8	T9
PM 1.0	59	61	38	39	49	40	39	44	30
PM 2.5	89	83	79	74	82	61	55	70	65
PM 10.0	99	81	86	82	91	80	85	64	79

	T10	T11	T12	T13	T14	T15	T16	T17	T18
PM 1.0	49	59	31	55	37	57	65	62	59
PM 2.5	61	76	63	59	49	66	67	69	59
PM 10.0	89	90	92	75	73	69	83	89	85

	T19	T20	T21	T22	T23	T24	T25	T26	T27
PM 1.0	40	45	32	54	48	51	54	43	52
PM 2.5	43	49	39	59	61	60	56	45	55
PM 10.0	78	69	72	65	79	88	90	82	81

	T28	T29	T30
PM 1.0	48	55	59
PM 2.5	49	58	60
PM 10.0	77	73	70

Using these values, a table was created to represent the filtration percentages of the surgical mask in each trial.

Table 4: The percentage (in decimal form) of particles that were filtered out by the surgical mask in each trial

	T1	T2	T3	T4	T5	T6	T7	T8	T9
PM 1.0	0.917	0.914	0.947	0.945	0.931	0.944	0.945	0.938	0.958

PM 2.5	0.937	0.941	0.944	0.947	0.942	0.956	0.961	0.95	0.954
PM 10.0	0.953	0.961	0.959	0.961	0.956	0.962	0.959	0.969	0.962

	T10	T11	T12	T13	T14	T15	T16	T17	T18
PM 1.0	0.931	0.917	0.956	0.923	0.948	0.92	0.909	0.913	0.917
PM 2.5	0.956	0.946	0.955	0.958	0.965	0.953	0.952	0.951	0.958
PM 10.0	0.957	0.957	0.956	0.964	0.965	0.967	0.96	0.957	0.959

	T19	T20	T21	T22	T23	T24	T25	T26	T27
PM 1.0	0.944	0.937	0.955	0.924	0.932	0.928	0.924	0.94	0.927
PM 2.5	0.969	0.965	0.972	0.958	0.956	0.957	0.96	0.968	0.961
PM 10.0	0.963	0.967	0.966	0.969	0.962	0.958	0.957	0.961	0.961

	T28	T29	T30
PM 1.0	0.932	0.923	0.917
PM 2.5	0.965	0.959	0.957
PM 10.0	0.963	0.965	0.967

Using the data from Table 2 and Table 4, the filtration efficiencies of both masks can be graphed. The average filtration rate for the designed mask for PM 1.0, PM 2.5, and PM 10.0 was 95.6%, 96.02%, and 96.68%, respectively. The designed mask standard deviation for PM 1.0, PM 2.5, and PM 10.0 was 0.0112, 0.0106, and 0.009, respectively. The average filtration rate for the surgical mask for PM 1.0, PM 2.5, and PM 10.0 are 93.19%, 95.58%, and 96.14%, respectively. The surgical mask standard deviation for PM 1.0, PM 2.5, and PM 10.0 was 0.0137, 0.0084, and 0.0041, respectively.

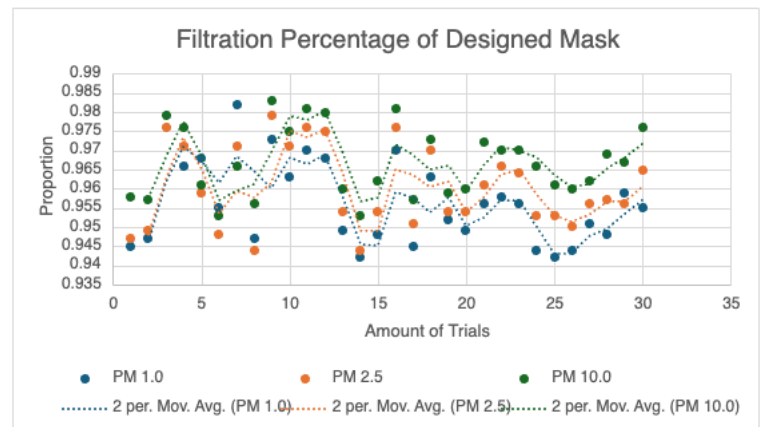


Figure 5: A graph of the proportion of the filtration efficiency for the designed mask. PM 1.0 (Blue), PM 2.5 (Orange), PM 10.0 (Green). Moving averages are provided over 30 trials.

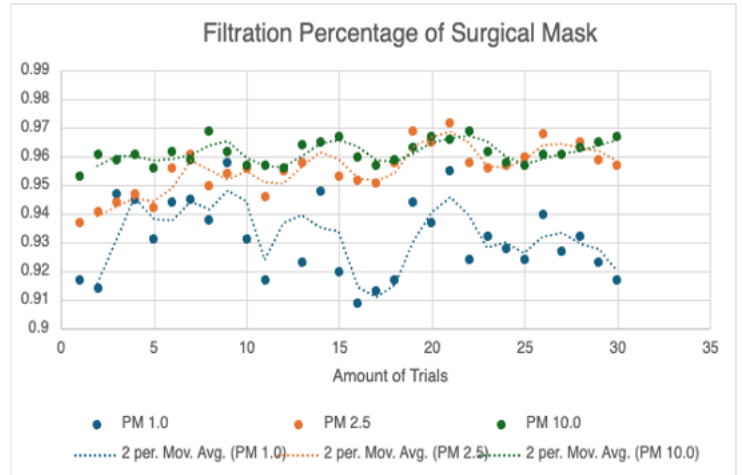


Figure 6: A graph of the proportion of the filtration efficiency for the surgical mask. PM 1.0 (Blue), PM 2.5 (Orange), PM 10.0 (Green). Moving averages are provided over 30 trials.