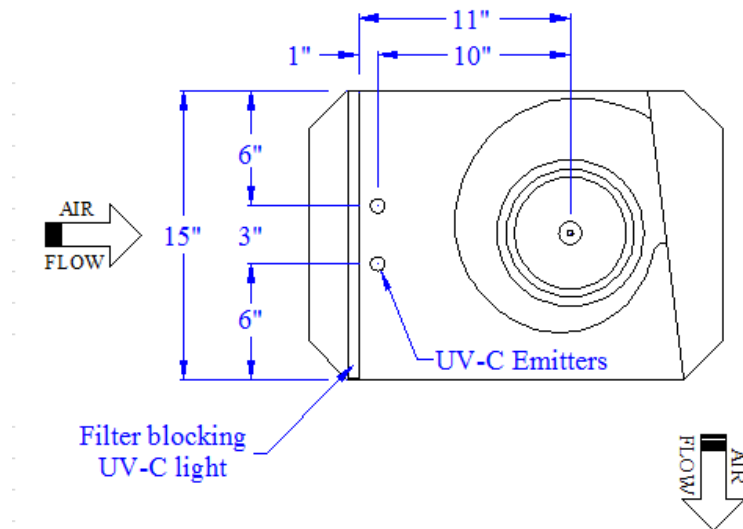


Sample Calculation for UVC-1-36

A certain dose of UVC is required to inactivate a particular pathogen. The dose is determined by multiplying the intensity of the UVC emitters by the exposure time of the air. The calculation of the intensity of the emitters at certain distances is determined by software. The time is determined by the physical dimensions of the air curtain and the speed of the air. Once the dose is known, it can be used to calculate the kill rate of a particular pathogen.

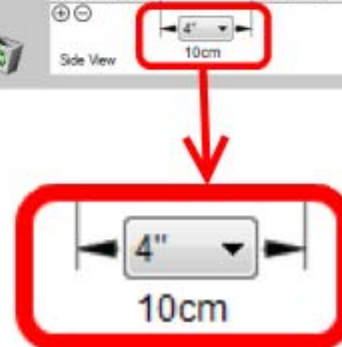
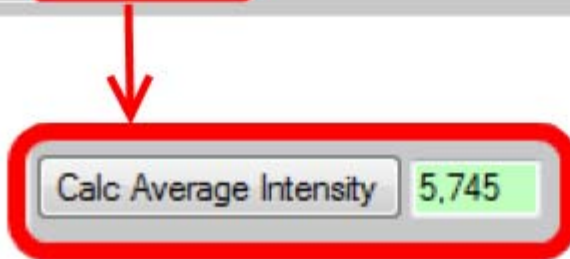
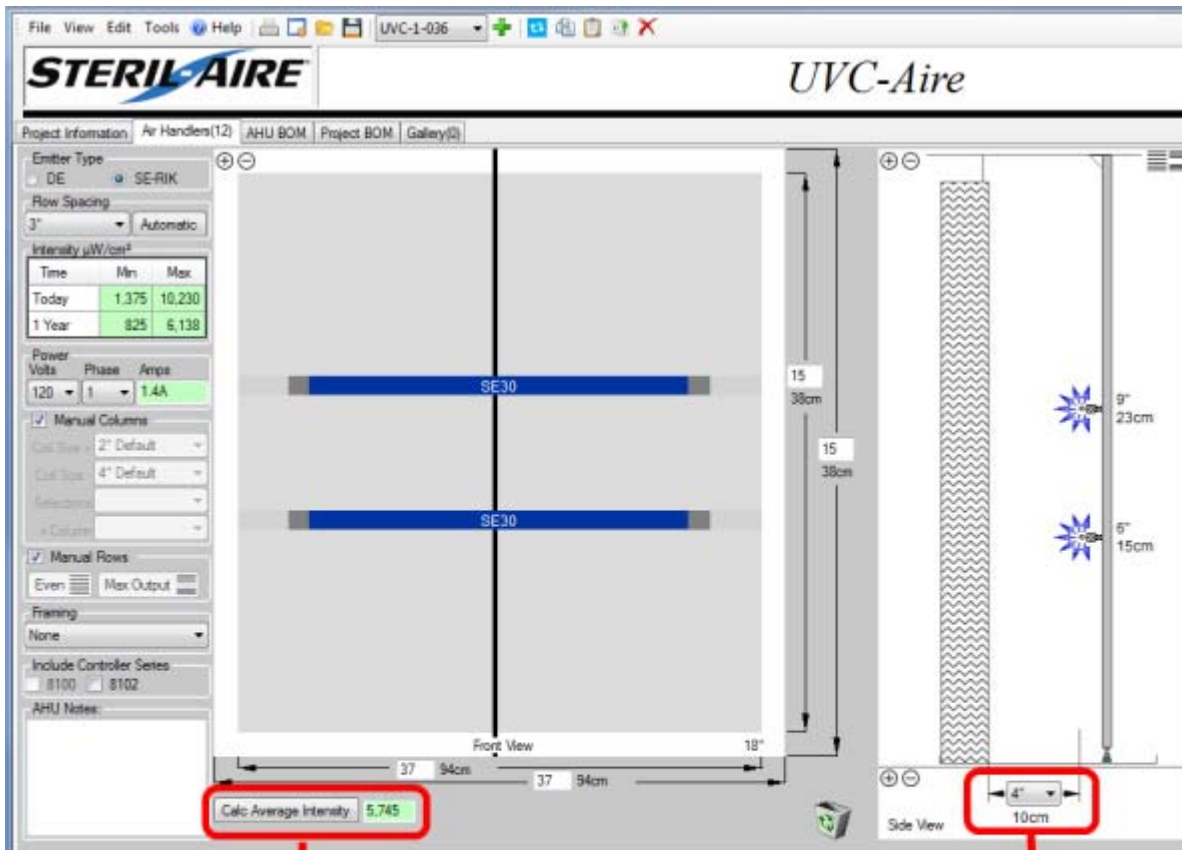
Calculating the UVC Intensity

Below is a drawing of the profile of the UVC-Aire air curtain showing the dimensions and layout of the emitters in relation to the airflow. The air is exposed to the emitters for 11" with a height of 15". Of the 11", 1" is before the emitters and 10" are after.



The Smart Tools Selector software from Steril-Aire is used to calculate the average intensity of the emitters on a plane a certain distance away from the emitters. For our air curtain, the 11" of air travel is broken down into 1" sections. After the dimensions and emitter setup is entered into the software, it is used to determine the average intensity at various distances from the emitters.

Below is a screenshot of the software calculating the average intensity of the UVC-1-36 air curtain 4" away from the emitters.



Below are the intensities read from the software with the value from the example above shown in red.

Distance away from emitter (in)	Avg intensity from Smart Tool software ($\mu\text{W}/\text{cm}^2$)
1	11,848
1	11,848
2	8,722
3	6,952
4	5,745
5	4,856
6	4,170
7	3,626
8	3,184
9	2,820
10	2,516

Calculating the time

The time is determined by first calculating the velocity when in sterilization mode. In sterilization mode, the motors will run at 50% of their maximum speed. The velocity is found by dividing the CFM for high speed taken from the catalog by 2, then dividing by the area of the intake. Once the velocity is found, the time it takes the air to travel 1” can be determined.

Model	UVC-1-36
Catalog CFM on high speed	1401
CFM at 50% in sterilization mode	700.5
Height (in)	15
Width (in)	37
Average face velocity (FPM)	181.75
Seconds per Inch	0.0275

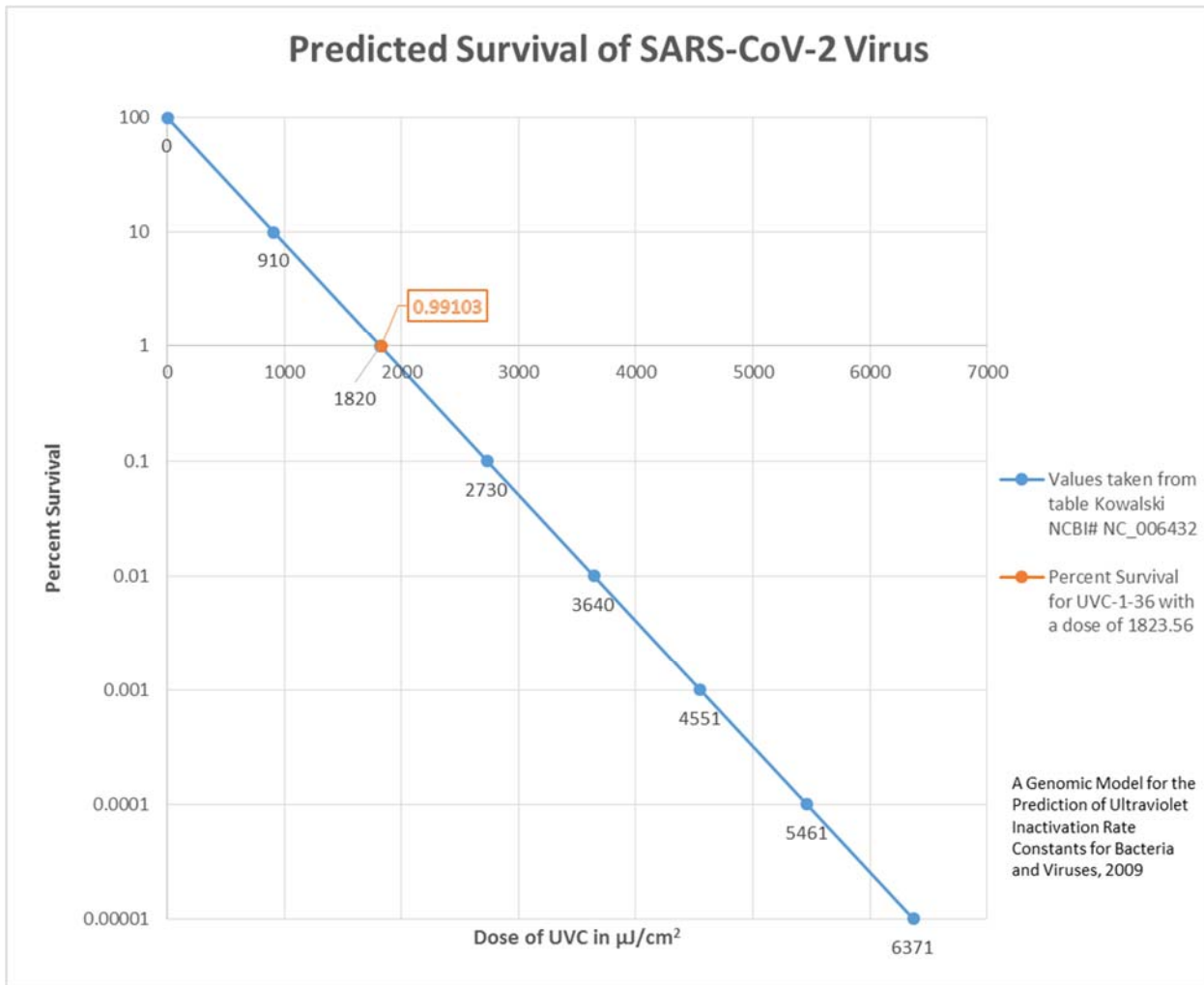
Calculating the Dose

The dose is determined by multiplying the intensity for each inch the air travels (determined above) by the time it takes for the air to travel one inch. The doses for each inch are then added up to get the total dose for the entire 11 inches.

Distance away from emitter for commercial case (in)	Avg intensity from Smart Tool software ($\mu\text{W}/\text{cm}^2$)	Time (s)	Dose = Intensity x Time ($\mu\text{J}/\text{cm}^2$)	
1	11848	0.0275	325.94	
1	11848	0.0275	325.94	
2	8722	0.0275	239.94	
3	6952	0.0275	191.25	
4	5745	0.0275	158.05	
5	4856	0.0275	133.59	
6	4170	0.0275	114.72	
7	3626	0.0275	99.75	
8	3184	0.0275	87.59	
9	2820	0.0275	77.58	
10	2516	0.0275	69.22	
			1823.56	Total Dose

Calculating the Airborne Inactivation Rate for SARS-CoV-2

Once the dose is known, the inactivation rate for a specific pathogen can be determined. For inactivation rates specific to SARS-CoV-2 which causes COVID-19, the chart below is used. The survival rate of the virus for various doses is shown as a blue line. This line is based on values from previous independent studies and the point calculated in this example is overlaid on the line shown in orange.



This can be determined mathematically using the following semi-logarithmic straight line equations.

Equation for line: $Y = k \cdot 10^{mx}$ where k is the y-intercept and m is the slope

Slope: $m = (\log(y_1) - \log(y_2)) / (x_1 - x_2)$

Two known points on the line can be used to get the slope of the line and y intercept. Then the equation for the line can be used to determine the percent survival rating based on the dose.

Dose ($\mu\text{J}/\text{cm}^2$) =	1823.56
slope m =	-0.001098901
y intercept =	100
% survival =	0.99103

The percentage of pathogens inactivated is 100% minus the survival percentage.

Airborne Inactivation Rate of SARS-CoV-2 for the UVC-1-36 = 100% - 0.99103% = 99.00897%

SARS-CoV-2 Inactivation Rates for Other UVC-Aire Models

This method can be automated using a spreadsheet. Using the spreadsheet and the method above, below are the SARS-CoV-2 inactivation rate calculations for other UVC-Aire models.

Model	UVC-1-36	UVC-1-42	UVC-1-48	UVC-1-60	UVC-2-72	UVC-2-84	UVC-2-96	UVC-3-108	UVC-3-120	UVC-3-132	UVC-4-144
CFM (high speed)	1401	1678	1757	2007	2802	3356	3514	4203	4757	4809	5604
CFM (50%)	700.5	839	878.5	1003.5	1401	1678	1757	2101.5	2378.5	2404.5	2802
Height (in)	15	15	15	15	15	15	15	15	15	15	15
Width (in)	37	43	49	61	73	85	97	109	119	134	146
Avg velocity (FPM)	181.75	187.31	172.11	157.93	184.24	189.52	173.89	185.09	191.88	172.26	184.24
Seconds per Inch	0.0275	0.0267	0.0291	0.0317	0.0271	0.0264	0.0288	0.0270	0.0261	0.0290	0.0271
Dist. (in)	Avg Intensity ($\mu\text{W}/\text{cm}^2$)										
1	11,848	12,515	13,020	12,700	13,075	12,770	13,249	14,210	14,516	12,979	13,140
1	11,848	12,515	13,020	12,700	13,075	12,770	13,249	14,210	14,516	12,979	13,140
2	8,722	9,232	9,620	9,418	9,753	9,492	9,857	10,572	10,827	9,679	9,825
3	6,952	7,377	7,701	7,569	7,851	7,631	7,932	8,509	8,718	7,811	7,931
4	5,745	6,113	6,395	6,313	6,561	6,368	6,627	7,112	7,290	6,546	6,650
5	4,856	5,183	5,434	5,389	5,612	5,441	5,669	6,087	6,243	5,618	5,709
6	4,170	4,465	4,693	4,676	4,881	4,728	4,933	5,300	5,439	4,904	4,987
7	3,626	3,896	4,105	4,110	4,300	4,162	4,349	4,676	4,802	4,337	4,413
8	3,184	3,434	3,628	3,649	3,827	3,703	3,875	4,170	4,286	3,877	3,947
9	2,820	3,052	3,233	3,267	3,436	3,324	3,483	3,752	3,859	3,497	3,562
10	2,516	2,733	2,903	2,946	3,107	3,006	3,255	3,402	3,502	3,177	3,239
Dist. (in)	Dose ($\mu\text{J}/\text{cm}^2$)										
1	325.9	334.1	378.2	402.1	354.8	336.9	381.0	383.9	378.3	376.7	356.6
1	325.9	334.1	378.2	402.1	354.8	336.9	381.0	383.9	378.3	376.7	356.6
2	239.9	246.4	279.5	298.2	264.7	250.4	283.4	285.6	282.1	280.9	266.6
3	191.3	196.9	223.7	239.6	213.1	201.3	228.1	229.9	227.2	226.7	215.2
4	158.0	163.2	185.8	199.9	178.1	168.0	190.6	192.1	190.0	190.0	180.5
5	133.6	138.4	157.9	170.6	152.3	143.6	163.0	164.4	162.7	163.1	154.9
6	114.7	119.2	136.3	148.0	132.5	124.7	141.8	143.2	141.7	142.3	135.3
7	99.8	104.0	119.3	130.1	116.7	109.8	125.1	126.3	125.1	125.9	119.8
8	87.6	91.7	105.4	115.5	103.9	97.7	111.4	112.7	111.7	112.5	107.1
9	77.6	81.5	93.9	103.4	93.2	87.7	100.2	101.4	100.6	101.5	96.7
10	<u>69.2</u>	<u>73.0</u>	<u>84.3</u>	<u>93.3</u>	<u>84.3</u>	<u>79.3</u>	<u>93.6</u>	<u>91.9</u>	<u>91.3</u>	<u>92.2</u>	<u>87.9</u>
Total	1823.6	1882.3	2142.5	2302.9	2048.3	1936.4	2199.1	2215.2	2188.8	2188.6	2077.3
Kill Rate =	99.01%	99.15%	99.56%	99.71%	99.44%	99.26%	99.62%	99.63%	99.61%	99.61%	99.48%