



AIR PURIFICATION

October, 2023

For Clean Air Force of Central Texas

ALLEN[®]

- Alen is an Austin-based manufacturer of trusted, top-rated True HEPA air purification products
- We believe we can improve quality of life for all; by reducing illnesses and absenteeism from airborne pathogens, harmful pollutants and irritating allergens
- Alen is a leader in indoor air quality. Air purification is our sole focus; we aren't making vacuum cleaners, humidifiers, or AI robots. We take air care seriously.
- Technology is foundational to all we do, from advanced sensors to our Alen Air app and tech platform
- We've earned over 27,000 5-star customer reviews and top industry rankings and we're dedicated to a best-in-class customer experience



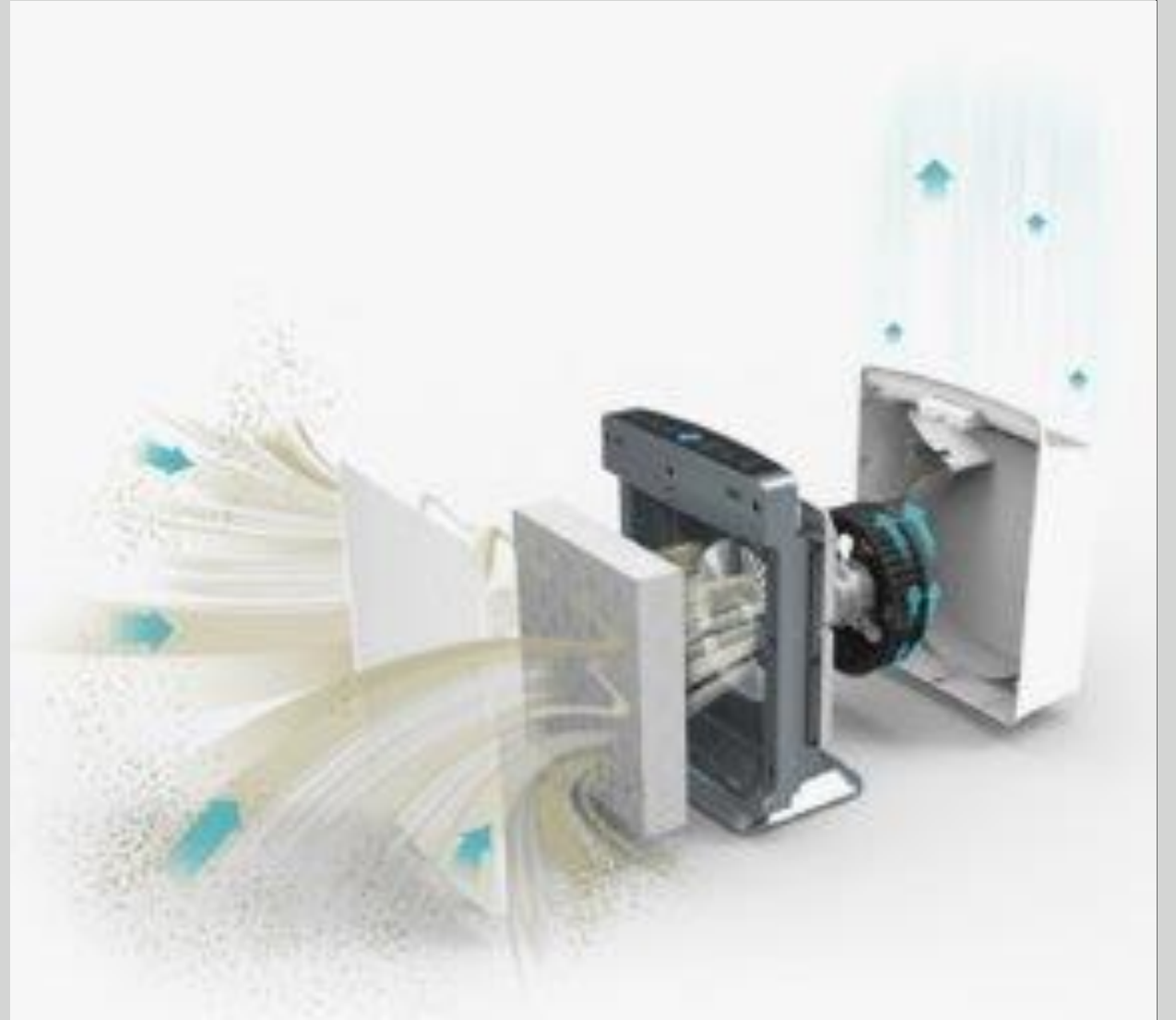


AIR PURIFICATION BASICS

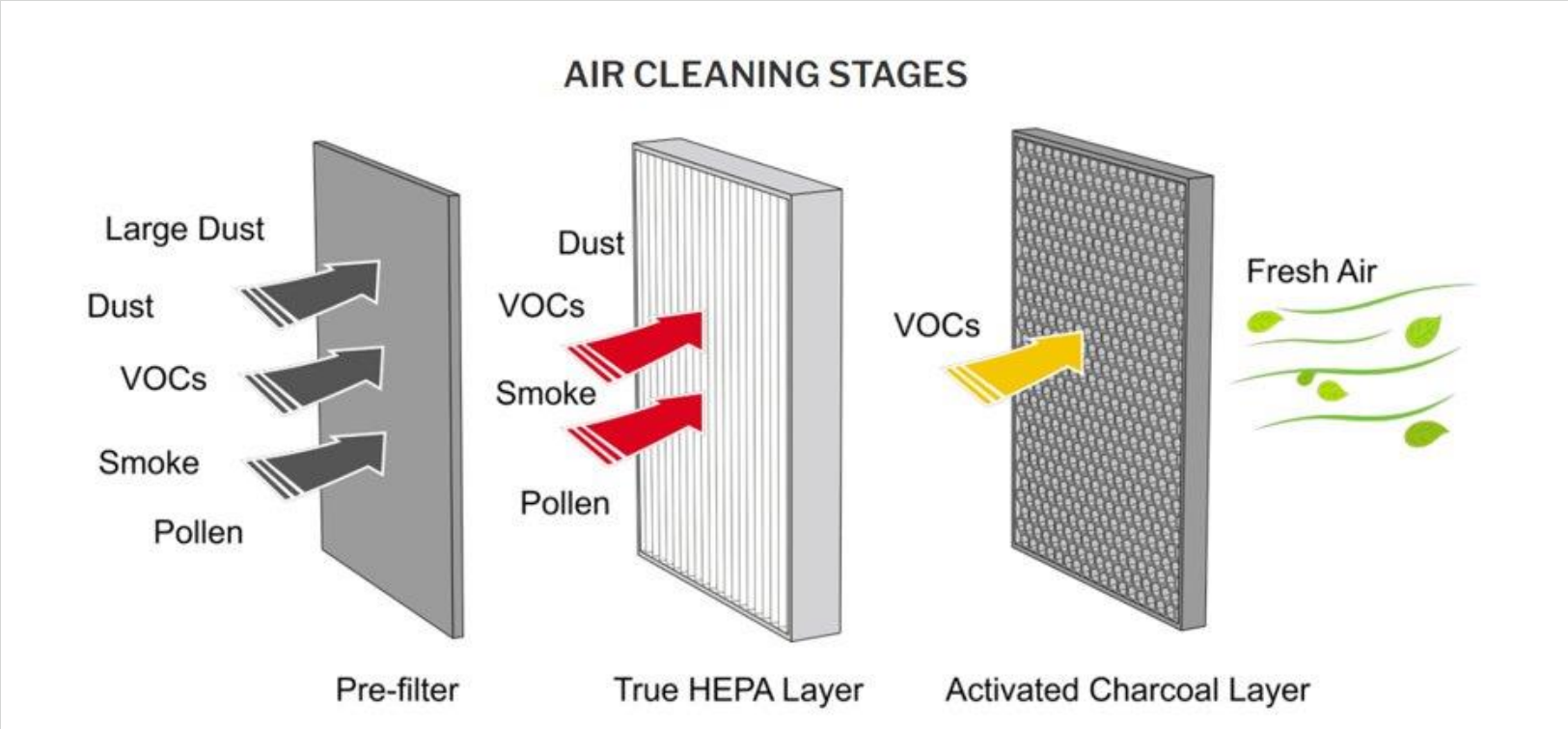
The purifier

Seems so simple...

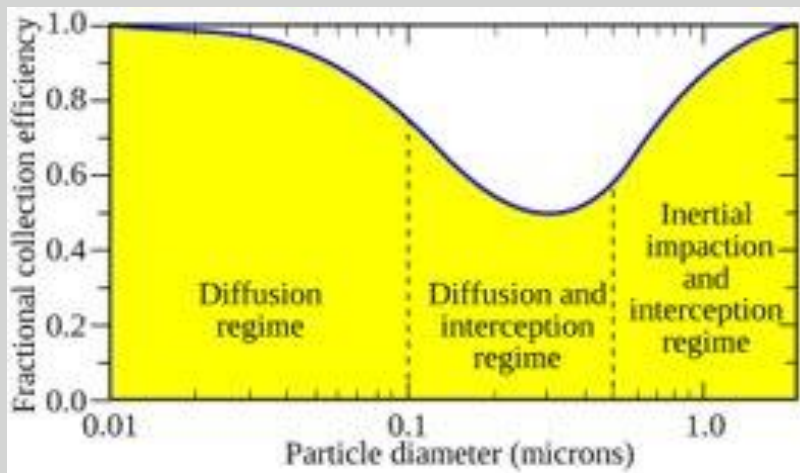
- What makes a good one?



Air Purifier Filtration Basics



HEPA vs. MERV



MERV Rating	Air Filter will trap Air Particles size .3 to 1.0 microns	Air Filter will trap Air Particles size 1.0 to 3.0 microns	Air Filter will trap Air Particles size 3 to 10 microns	Filter Type ~ Removes These Particles
MERV 1	< 20%	< 20%	< 20%	Fiberglass & Aluminum Mesh
MERV 2	< 20%	< 20%	< 20%	~
MERV 3	< 20%	< 20%	< 20%	Pollen, Dust Mites, Spray Paint,
MERV 4	< 20%	< 20%	< 20%	Carpet Fibres
MERV 5	< 20%	< 20%	20% - 34%	Cheap Disposable Filters
MERV 6	< 20%	< 20%	35% - 49%	~
MERV 7	< 20%	< 20%	50% - 69%	Mold Spores, Cooking Dusts,
MERV 8	< 20%	< 20%	70% - 85%	Hair Spray, Furniture Polish
MERV 9	< 20%	Less than 50%	85% or Better	Better Home Box Filters
MERV10	< 20%	50% to 64%	85% or Better	~
MERV 11	< 20%	65% - 79%	85% or Better	Lead Dust, Flour, Auto Fumes, Welding Fumes
MERV 12	< 20%	80% - 90%	90% or Better	Superior Commercial Filters
MERV 13	Less than 75%	90% or Better	90% or Better	~
MERV 14	75% - 84%	90% or Better	90% or Better	Bacteria, Smoke, Sneezes
MERV 15	85% - 94%	95% or Better	90% or Better	
MERV 16	95% or Better	95% or Better	90% or Better	
MERV 17	99.97%	99% or Better	99% or Better	HEPA & ULPA
MERV 18	99.997%	99% or Better	99% or Better	~
MERV 19	99.9997%	99% or Better	99% or Better	Viruses, Carbon Dust, <.30 pm
MERV 20	99.99997%	99% or Better	99% or Better	

Illustration Provided by LakeAir / www.lakeair.com

Merv = "minimum efficiency reporting value"

HEPA – high efficiency particulate filters

True HEPA = 99.97%
efficiency at .3
micron particle size

H13 = 99.95%
minimum
efficiency, or
efficiency at MPPS

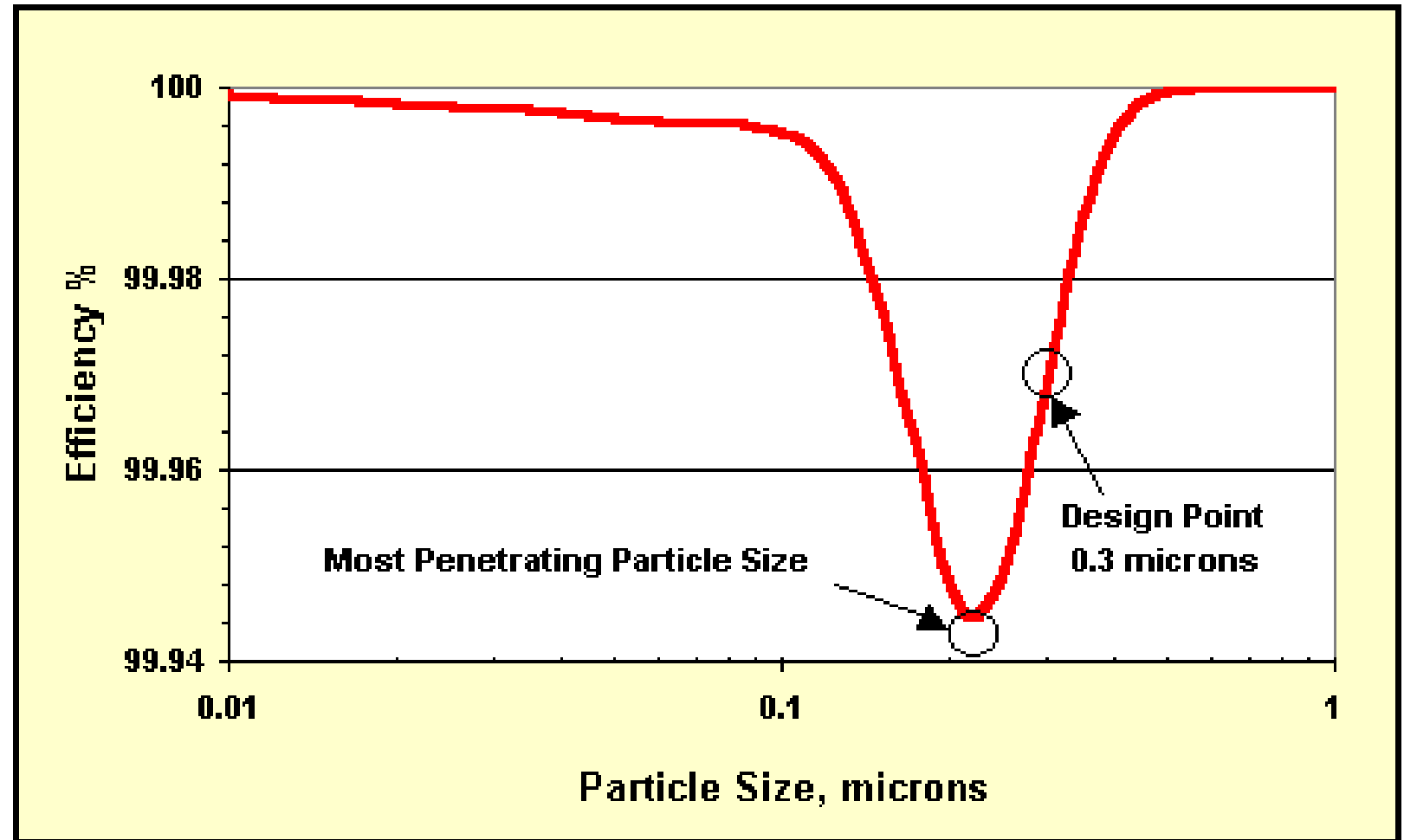
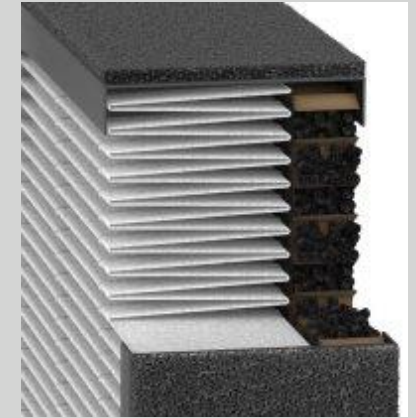


Figure 1: Typical Performance of a HEPA 99.97% Filter.

Air Purifier Filtration Technologies



Air Concern Category	Filter Technology
Allergens	HEPA
Dust	HEPA
Dust Mites	HEPA
Pet Dander	HEPA
Virus/COVID	HEPA
Bacteria	HEPA + Antimicrobial
Mold	HEPA + Antimicrobial
Household Odors	HEPA + Activated Carbon
Pet Odors	HEPA + Activated Carbon
Chemical Vapors/VOCs	HEPA + Activated Carbon
Baby/Teen Odor	HEPA + Activated Carbon



DEFINITIONS

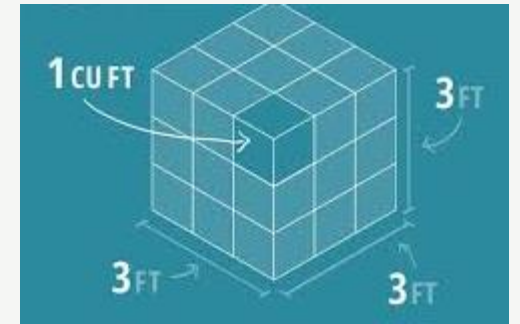
Contaminant Size

Chart Source:
[Wikipedia](https://en.wikipedia.org/wiki/Particulate_matter)



CFM, ACH, and CADR Definitions

- **CFM** = Cubic Feet per Minute
- **ACH** = Air Changes per Hour (used to determine coverage)
- **CADR** = Clean Air Delivery Rate
 - Measures relative reduction of particulate matter suspended in the air in a specified 1,008 cubic foot test chamber.
 - Association of Home Appliance Manufacturers. [AHAM AC-1](#) Standardized 20-minute performance measuring procedure for air cleaners
 - CFM of air that has had all the particles of a given size distribution removed from the air, over and above the rate at which the particles are naturally falling out of the air.
 - Smoke .09-1.0 μm
 - Dust .5-3 μm
 - Pollen 5-11 μm



$$\text{ACH} = \frac{(\text{Air Purifier CADR in CFM} \times 60)}{(\text{Room SqFt} \times \text{Ceiling Height})}$$

The formula to calculate Air Changes per Hour

[CADR - Wikipedia](#)

[AHAM- AC-1 Protocol](#)

Note: 1 CFM = ~1.7 m³h

<https://alen.com/blogs/articles/why-ventilation-filtration-are-the-keys-to-combating-covid>



CASE STUDY

Alen Coffee Shop Study, Excerpt

Coffee Shop Air Quality Testing

Rationale/Hypothesis:

- **Experimental Rationale**

- To understand impact of running an Alen Air Purifier in a small business when additional contaminants are introduced into the environment

- **Hypothesis:**

- When a contaminant is added to the space by cough, sneeze, or by other means, an air purifier cleans the air back to normal, safe levels faster than if an air purifier is not used. Our tests used party smoke as a surrogate for more harmful contaminants such as viruses.

Coffee Shop Testing: Executive Summary

- When purifiers are used, in normal ceiling height space, ambient particulate levels (PM 1) were shown to be 30% lower than when no air purifier's were used.
- When a contaminant is added, air purifiers clean the air back to normal ambient levels 25% faster than if no air purifier is used.
- High ceilings and high air flow (from ceiling fans/HVAC) help reduce the concentration of pollutants faster, and in those situations adding air purifiers does not provide significant improvement in particulate reduction time.

>>More study would be needed to quantify this effect.



Coffee Shop Air Quality Testing

Test materials/methodology

- **Test Equipment:**

- Smoke Machine (700w), UltraTec fire and safety long-lasting smoke liquid, Halo Smart Air Quality Monitors (8 monitors set to measure PM1.0 and below), Alen BreatheSmart 75i's with B7-Pure filter, phone used as timer, PC with Microsoft Excel table for data entry/collection.

- **Methodology:**

- Test Method: Natural Decay Rate (NDR)
 1. Measure the Ambient room particulate level PM1.0 (Ambient Level)
 2. Using the smoke machine – introduce extra contaminants into the room
 3. Take initial reading after smoke and then at each subsequent one-minute interval (PM1.0)
 4. Stop taking readings when air quality reverts to ambient level
- Test Method: Purifier assisted Decay Rate (PDR)
 5. Turn on Air Purifier(s)
 6. Repeat testing 2-4 with one purifier, two purifiers and so on



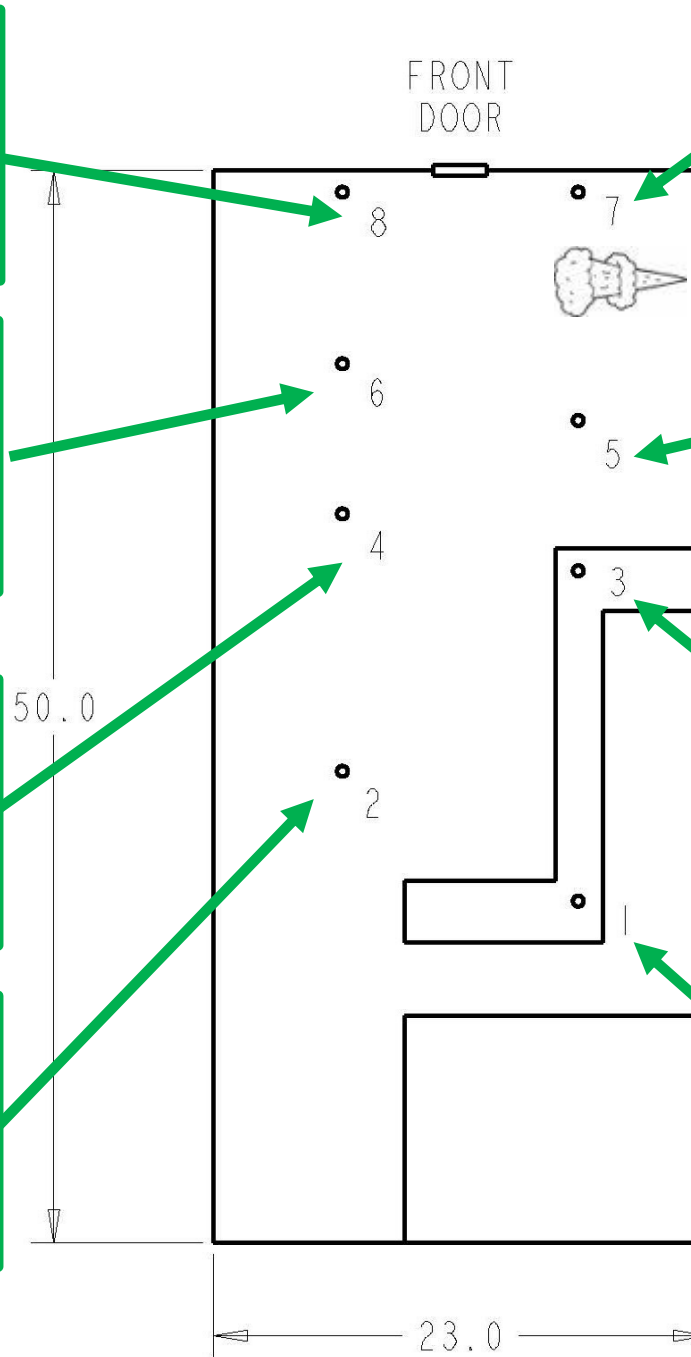
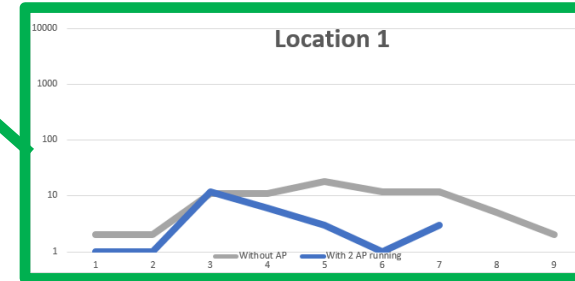
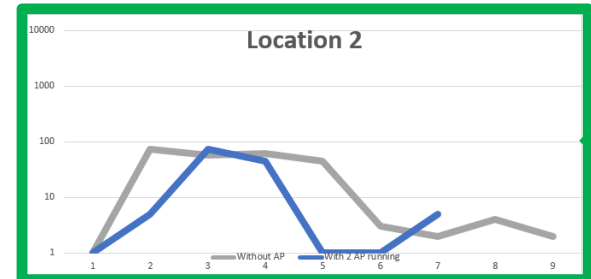
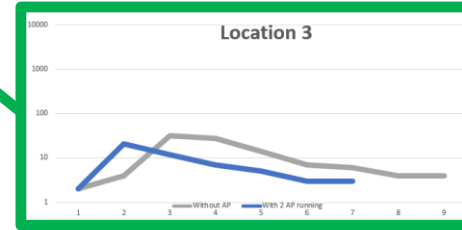
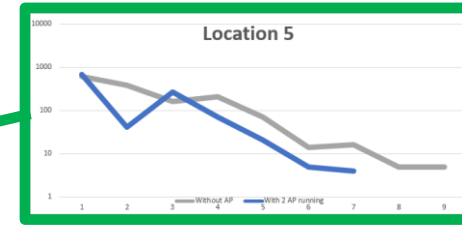
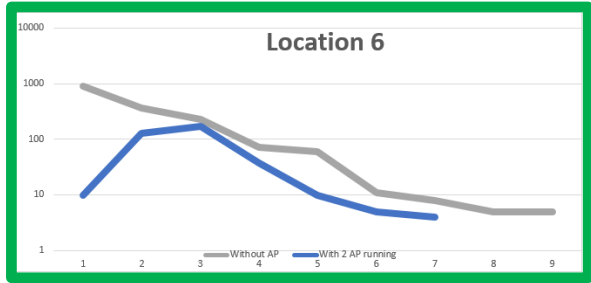
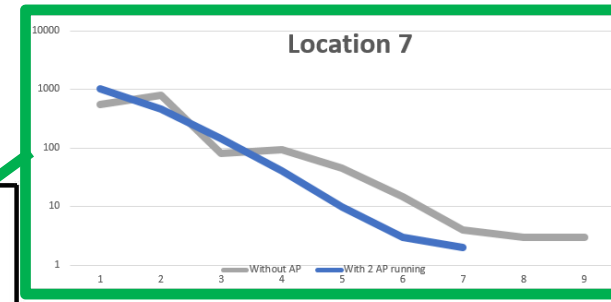
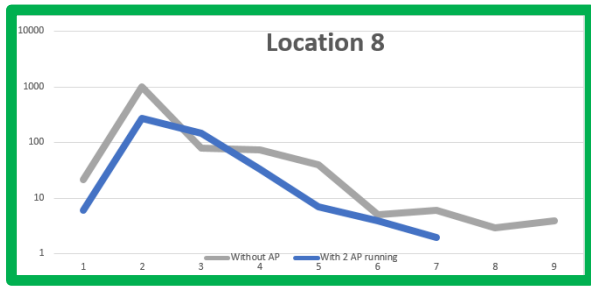
Particle Sensor

Alen BreatheSmart 75i

Coffee Shop Air Quality Testing – Summer Moon, Burnet Rd. Location, approx. 1,150sqft

SUMMARY OBSERVATIONS, all particulate measurements in terms of PM1.0

1. Overall, 14% improvement in ambient particle levels, with addition of air purifiers
2. Most significant improvement at sensor 4 (near the door) where ambient particulate level was consistently worse to begin with, improvement was 34% with addition of air purifiers.
3. When smoke was introduced, particle decay to baseline levels was 38% faster with air purifiers, ~5 minutes vs. 8 min. on average.
4. Coverage area depends on room *volume* because of variable height ceilings. In addition to the air purifiers, particulate level and particulate distribution is influenced by the HVAC system and ceiling fans.
 - Air quality in this small, well-ventilated shop (strong HVAC flow observed) was generally good to begin with. Readings averaged 2.4 without air purifiers running and 2.1 with.
5. Two BS75i's, run on Turbo, generate approximately 3.6 additional air exchanges per hour
>75i = one air exchange in 2,600 sqft space x two = 5,200/(1,150 x 1.25 for partial taller ceilings) = 3.6 exchanges



Summer Moon Coffee Shop
Burnet Rd.
Aug 20, 2020

- Smoke test with purifier (blue line) and without (gray line)
- 8 Sensors spaced evenly throughout the shop

Coffee Shop Air Quality Testing

Summer Moon, Burnet Rd. Location



Coffee Shop Air Quality Testing

Summer Moon, Avery Ranch Location



Coffee Shop Air Quality Testing

Summer Moon, Cedar Park Location





ADDENDUM

Extra Slides – If time permits

Calculating Room Coverage

Formula:
 $(CFM \times 60) / \text{Ceiling Height} / \text{ACH}$

Four different scenarios:

- 75i on speed 3, 8ft ceilings, ACH of 2 (Alen) = ?
- 75i on turbo, 12ft ceilings, ACH 4 = ?
- FLEX on speed 3, 9 ft ceilings ACH 5 (~AHAM) = ?
- FLEX on speed 3, 9 ft ceilings ACH 2 (Alen) = ?

Air Purifier Speed	BS 75i	Rough Room Coverage	BreatheSmart	Rough Room Coverage	Fit50	Rough Room Coverage	45i	Rough Room Coverage	Flex	Rough Room Coverage	T500	Rough Room Coverage
Speed 1	95 CFM	350	150 CFM	550	110 CFM	400	70	250	53 CFM	200	48 CFM	180
Speed 2	170 CFM	650	185 CFM	700	142 CFM	550	135	500	135 CFM	500	83 CFM	300
Speed 3	240 CFM	900	225 CFM	850	192 CFM	700	175	650	147 CFM	560	145 CFM	500
Speed 4	280 CFM	1000	300 CFM	1100	231 CFM	900	245	800	225 CFM	700		
Speed 5	350 CFM	1300										

[Room Coverage Calculator - Excel](#)



IoT

Networked air purification benefits

Enterprise benefits for IoT

- Dashboard – air quality and filter life status at a glance
 - Troubleshooting of air quality – quick analysis
 - Purifier & AQM status – idle/fan speed
 - Reporting
- Bulk controls – control numerous connected devices with one tap
 - Power on/off
 - Lock/unlock devices
 - Set up multiple locations/buildings
- Notifications – alerts for air quality issues/ filter life replacement

