Airport Guide to Air Filtration

Pollutants of concern in an airport setting are similar to those in industrial areas and near freeways. Airports have aditional pollutants from unburned hydrocarbons generated from jet exhaust, as illustrated in the chart on the right.

Effective airport filtration requires a combination of standard ASHRAE grade filtration along with a carbon adsorbant. The adsorbant will be used to remove the VOC's, hydrocarbons, ozone, nitrogen dioxide and sulfur dioxide. The ASHRAE grade filters remove coarse particulates to extend the life of and increase the efficiency of the carbon adsorbant. Filtration design in the airport setting should:

- ♦ Remove jet fume odors from outdoor ventilation air.
- ♦ Bring the quality of outdoor ventilation air to NAAQS (National Ambient Air Quality Standard).
- ♦ As a minimum, bring the concentration of internally generated contaminants down to the level equivalent of 20 cfm/person clean outdoor air (ASHRAE 62-89).

Carbon monoxide concentration levels can generally be eliminated with adequate ventilation and need not be addressed for chemical filtration.

Contaminants in airports

Contaminants:	Standard/guidline	Sources
Volatile Organic Compounds Odor @ ppm levels	Sensory irritation occurs @ 0.2-1 ppm Human	Jet fumes Building materials
Nitrogen dioxide	0.055 ppm-1 year (NAAQS)	Jet fumes Ambient Air
Sulfur dioxide	0.03 ppm - 1 yr. (NAAQS)	Jet fumes Ambient air
Ozone	0.12 ppm -1 hr. (NAAQS)	Ambient air
Carbon monoxide	35 ppm - 1 hr (NAAQS)	Jet fumes
PM10 (particles less than 10 μm)	50 ug/m^3 - 1 year (NAAQS)	Ambient air
Submicron particulates	Respirables, some of which are carcinogenic (e.g. PAH) capable of adsorbing and desorbing VOCs	Jet fumes

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Filtration combination

Because of the heavy concentration of jet fumes in the airport environment, gas phase filtration is called for, in combination with standard ASHRAE grade filtration. The chart on the front of this brochure shows the types of gaseous contaminants contributed by jet fumes. The chart below shows a recommended filter configuration to deal with these contaminants as well as coarse particulates

Recommended Airport Filter Combination

Type of filter	Purpose	Relative Location	Precisionaire Models
ASHRAE 30% filter	Remove coarse particles to extend service life of high efficiency filter	Pre filter	Pre Pleat 40 Pre Pleat 65
ASHRAE 95% filter	Remove submicron particles to protect carbon filter from particulate contamination.	Downstream of prefilter and upstream of AC	Superflow V Rigi Pleat PrecisionCell PrecisionCell II
Heavy duty carbon filter	Remove VOC's, sulfur diioxide nitrogen dioxide and ozone	Downstream of 95% filter and upstream of AC	Superflow V with Activated Carbon

What type of gas phase filter is recommended?

Because it is the most effective adsorbent for VOC's which are the primary contaminants in airport environments, activated carbon is recommended. Activated carbon is also effective in removing other contaminants of concern:

Rating of adsorbents on scale of 0-10 with 10 being the best

Gas Vapor	Activate Carbon	Caustic impregnated carbon	Alumina oxide impregnated with pot. permanganate
VOC's (50-100) compounds	9	6-7	2-3
Nitrogen Dioxide	8	9	5
Sulfur Dioxide	7	9	8
Ozone	10	10	7
Carbon	0	0	0

What is an ideal carbon for HVAC applications?

- Higher micropore volume (means higher VOC adsorption capacity) - coconut shell carbon with 60% carbon tetrachloride activity (ASTM D-3467)
- Large particle size (to better retain the adsorbed VOCs) - 4x6 or 4x8 mesh
- Less affected by relative humidity - toluene test at high RH
- Less attrition - > 97% hardness (ASTM D-3802)

Typical efficiencies of heavy duty carbon filters

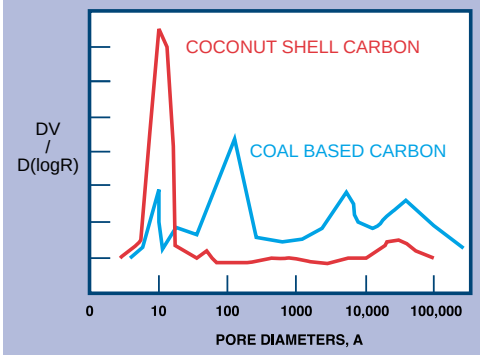
VOCs (toluene)	85%
Ozone:	95%
Nitrogen Dioxide:	80-85%
Sulfur Dioxide:	80%

* Except ozone, the efficiencies are referred to time averaged efficiency

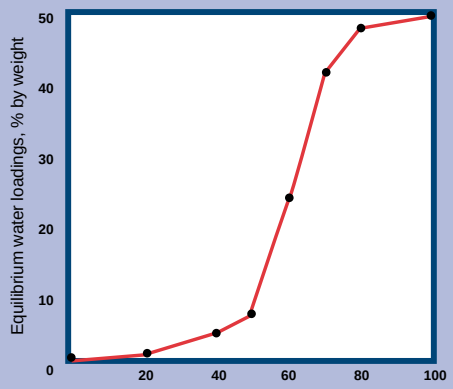
** Ozone efficiency remains constant with time.

*** The efficiencies are rated at 500 fpm, 75º F and 50% Relative Humidity

"Heavy duty carbon filter" in this example refers to 12 panels (21"x24") in zig-zag configuration within a housing. Carbon is 90 lbs of 4x8 mesh coconut shell carbon, with a bed depth of 1 inch. Residence time: 0.1 seconds at 500 fpm.



Coconut shell activated carbon rated at 60% carbon tetrachloride activity.



Adsorption isotherm of water vapor

Recommended specification for activated carbon:

Type: Virgin coconut shell activated carbon with 60-65% carbon tetrachloride activity (ASTM D-3467)

Mesh size: 4x8 mesh

Hardness: >97% (ASTM D-3802)

Toluene test: A minimum of 75% efficiency after 5 hours adsorption time

Test condition:

Bed depth: 1 inch
Flow velocity: 50 fpm (0.1 second residence time)
Toluene challenge concentration: 100 ppm
Relative humidity: 75%
Temperature: 75º F
Carbon pre-conditioning: 2 hours at 150º C in an inert (nitrogen) atmosphere

To determine system removal efficiency for outdoor VOCs (hydrocarbons from jet fume)

Step 1: Enter the X axis at the point of 20% (outdoor air)

Step 2: Trace vertically to the curve corresponding to 85% single pass efficiency

Step 3 Draw a line parallel to the X axis on the point of the Y axis. This determines the system efficiency.

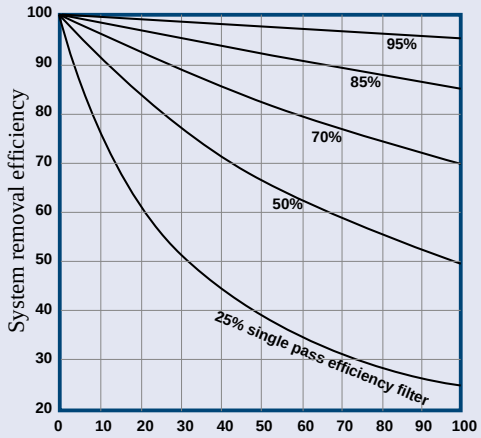
Example: If

(a) single pass VOC efficiency of the adsorbent is 85% and

(b) outdoor air used is 20%, then

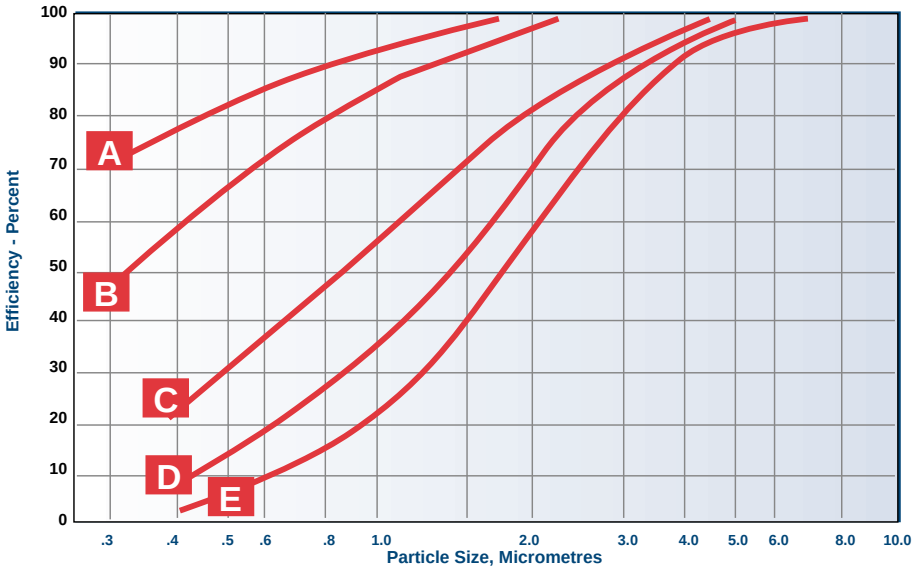
system removal efficiency is 96.6%.

So if your outdoor VOC concentration is 1ppm, then the indoor VOC level is .034 ppm or 34ppb.



Outdoor Air Cleaning Chart

Approximate Efficiency vs. Particle Size for Typical Air Filters

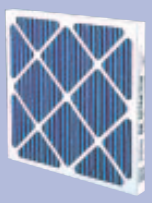


A	90-95% Efficiency:	Superflow V, Rigi Pleat, Precisionocell, Precisioncell 2
B	80-85% Efficiency:	Superflow V, Rigi Pleat, Precisionocell, Precisioncell 2
C	60-65% Efficiency:	Superflow V, Rigi Pleat, Precisionocell, Precisioncell 2
D	40-45% Efficiency:	PrecisionPak, Rigi Pleat
E	25-30% Efficiency:	Pre Pleat

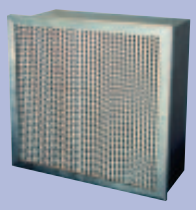
ASHRAE Grade filtration increases longevity and efficiency of your adsorbant.

Well planned use of ASHRAE grade filtration as described on page 2 of this brochure will help your adsorbant filters to work better and last longer. The chart above shows the relative efficiencies of the various Precisionaire filters on different particle sizes.

Pre Pleat

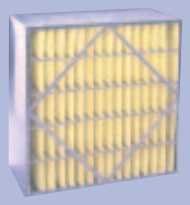


PrecisionCell

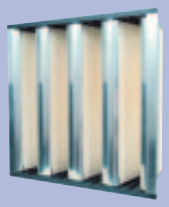


PrecisionCell 2

Rigi Pleat

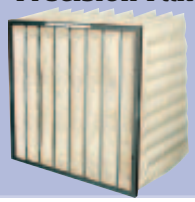


Superflow V



Superflow V Carbon

Precision Pak



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