GUIDE TO AIR SCRUBBING

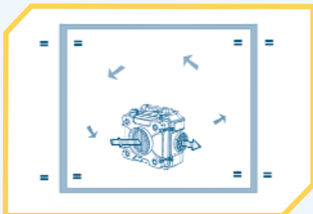
DRI-EAZ®

FIRST IN DRYING SOLUTIONS

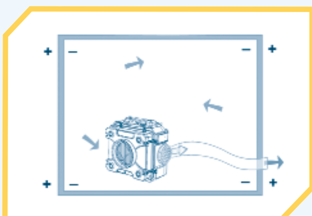
WHAT IS AN AIR SCRUBBER?

In the simplest terms, an air scrubber is a portable filtration system. It draws in air from the surrounding environment and passes it through a series of filters. These filters efficiently remove particles from the air to help improve indoor air quality.

Air scrubber or negative air machine?
Often the terms "air scrubber" and "negative air machine" are used interchangeably. However, the two terms refer to very different applications.



regular air scrubber



negative air machine

An air scrubber stands alone in the center of a room without any ducting attached. The air it filters is recirculated to the surrounding area. An air scrubber application helps improve the general air quality of the jobsite.

A negative air machine uses ducting to remove contaminated air from a sealed containment area. The filtered air is exhausted outside of the containment. This creates negative air pressure (a slight vacuum effect) inside the containment relative to surrounding areas. A negative air machine application helps limit the spread of contaminants to other areas inside the structure.

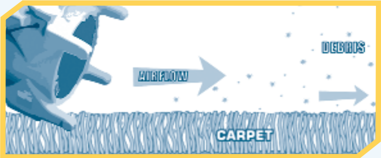
Many air scrubbers can also be used as a negative air machine, but this requires additional features:

- ductable in and ductable out
- sealed housing
- precise airflow adjustment
- a blower motor with variable speed to maintain containment

WHY SHOULD I USE AN AIR SCRUBBER?

The goal of every restoration job is to safely and efficiently return the indoor environment to pre-loss condition for the customer. Part of this responsibility is to address the quality of the air inside the structure.

Any job that involves cleanup of sewage, mold, and/or fire damage will generate significant amounts of particulates and odiferous (smelly) gases. These contaminants are a direct result of the damage itself, as well as the necessary process of treating and cleaning damaged materials. This includes not only damage in the occupied space, but also contaminants in wall or ceiling cavities that may be disturbed and unknowingly introduced into the occupied space. These contaminants can settle on carpet, upholstery, furnishings, and be drawn into the HVAC system.



Even clean-water losses are susceptible to compromised indoor air quality. The high-velocity airflow necessary for effective drying does more than evaporate moisture into the air—it also stirs up millions of microscopic particles that have been trapped in the carpet or have settled on structural materials.

Some of these particles, such as human skin cells, animal hair, and dirt, are nearly always present but are innocuous to occupant health. Chemical agents such as soot particles, hydrogen sulfide gas, and mercaptans (organic sulfur-containing chemicals generated by sewage-borne bacteria) can create unwanted visual damage and noxious odors. Potential human allergens such as cat or dog dander or dust mites may be released in large concentrations from damaged carpets and furniture. Most importantly, readily aerosolized biological agents such as sewage-born bacteria or mold spores (and spore by-products) are likely to be introduced into the air in large amounts during the drying restoration process—and these agents can cause adverse human health effects when inhaled.

Ultimately, if these pre-existing or newly introduced contaminants are not removed effectively they will impact the indoor air quality (IAQ) of the worksite and compromise the quality of the entire restoration job. Some contaminants can even create a potential indoor health hazard.

An air scrubber helps prevent these undesirable—and potentially harmful—particles and gases from remaining in the indoor environment or lodging in your equipment. By greatly reducing the types and quantity of airborne particles, an air scrubber also reduces the chances that occupants or technicians will inhale contaminants or gases. Removing contaminants safely, efficiently, and cost-effectively with an air scrubber is a great benefit to your business, your employees, and your customers.

For your occupants
An air scrubber helps create a cleaner, safer indoor environment for occupants both during the restoration work and after it is done. Occupants who are able to re-enter a previously damaged building without visual, odor, or health complaints are likely to be satisfied with your work. Using an air scrubber on a job is a cost-effective way to increase the quality and value of the service you offer to your customers.

For your technicians
Using an air scrubber on the job also reduces the risk for those working on the job. In many cases, an air scrubber may be much more effective, comfortable, and less expensive than requiring the use of respirators. An air scrubber is a short-term and long-term investment in the health and productivity of the people who do the work of restoration.

Legal implications
An air scrubber not only addresses indoor air quality concerns while the work is being performed, it can also help limit your legal exposure long after the job is done. This is especially true with water damage and mold contamination. Sometimes a restored structure develops a problem with IAQ due to a pre-existing condition or subsequent damage that is beyond the scope of your company's responsibility. By using an air scrubber on every job, you are taking an extra step to minimize unintended liability and complications that affect indoor air quality and occupant health.

Increase safety and productivity
Improving IAQ also benefits equipment performance and quality of work. For instance, in water damage restoration an air scrubber captures dirt, dust, and debris that might otherwise coat dehumidifier coils (thereby decreasing water removal efficiency) and/or clog airmover intake vents (thereby reducing airflow). An air scrubber helps keep your equipment clean so that it can perform at its best.

WHAT'S IN THE AIR?

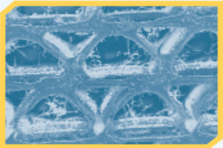
Pollutants of concern
Air is composed of much more than nitrogen, oxygen, and carbon dioxide. Even the relatively "clean" air of a normal (non-smoking) household or office environment contains a variety of microscopic particles, allergens, and organic chemicals.

Most of these commonly occurring agents are the result of normal human and animal activity, plants, insects, cleaning products, and personal hygiene products. The normal introduction of dirt and certain soil- and plant-borne mold spores into the indoor environment occurs through open windows, doors, and foot traffic. These particulates comprise most of what is found in normal indoor dust, both on surfaces (such as carpets) and in the air.

A normal indoor environment also includes trace quantities of volatile organic chemicals (VOCs). These VOCs are the result of evaporation or off-gassing from carpeting, furniture, and certain household or other chemical products. Most of these substances are either harmless or, in a few cases, represent potential allergens to a small number of genetically susceptible individuals.

These normally occurring indoor substances can be distinguished from actual indoor "contaminants" or "pollutants." The latter substances have the potential to cause adverse health effects, both short-term (acute) and long-term (chronic). The Environmental Protection Agency (EPA)[1] and American Lung Association[2] have both published articles listing pollutants of concern. These pollutants can be classified into two types: particulate and gaseous.

Particulate Pollutants
These very small solid or liquid particles are light enough to float around in the air. They may include organic (i.e. carbon-containing) or inorganic compounds and both dormant and living organisms. Of primary concern are:


depth loading particles captured in filter

1) non-visible respirable particles that can penetrate deep into the lungs where they may stay a long time and cause acute or chronic health effects; and

2) larger particles—such as pollen, animal dander, or dust—that do not penetrate as deeply, but may cause an allergic reaction.

WDR FILTRATION STUDY[3]

Particles found on Standard Water Damage Jobs

- Debris
- Fibers
- Ascospore
- Aspergillus ochraceus
- Aspergillus versicolor
- Bacillus sp. 1
- Bacillus sp. 2
- Bacillus sp. 3
- Chactomium sp.
- Cladosporium spp.
- Epithelial cells
- Hyphae
- Pollen
- Insect parts
- Micrococcus sp.1
- Micrococcus sp. 2
- Nigrospora spp.
- Paecilomyces sp.
- Penicillium sp.1
- Stachybotrys - like
- Taeniolella spp.
- Torula spp.
- Trichoderma sp.
- D. Pteronysisinus (Der p I) (dust mite)
- D. Farinae (Der f I) (dust mite)
- Cat allergen (Fel d I)

Gaseous Pollutants
These include combustion gases and organic chemicals that are not associated with particles. With the development of increasingly sophisticated measurement equipment, hundreds of different gaseous chemical pollutants have been detected in indoor air. Sources include combustion appliances, cigarette smoking, vehicle exhaust, building materials, furnishings, paints, adhesives, dyes, solvents, cleaners, deodorizers, personal hygiene products, pesticides, and even the cooking of food or the metabolic processes of humans, animals or plants.

Health effects depend on the type and concentrations of gaseous pollutants, frequency and duration of exposure, and in the case of allergenic substances, individual sensitivity. Some of these chemicals are simply transient irritants, capable of causing short-lived reactions such as watering or burning of the eyes or nose, cough, or other adverse reactions related to their unpleasant odor. For all but a few specific agents, the long-term health effects (at relatively low concentrations found in typical indoor environments) are unknown and/or not studied.

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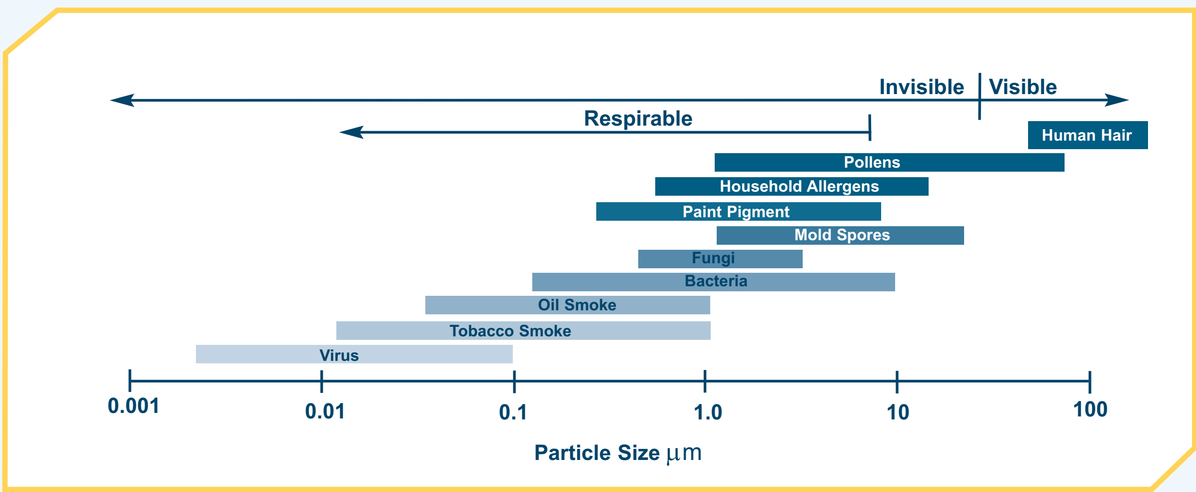
[1]United States Environmental Protection Agency and the United States Consumer Product Safety Commission Office of Radiation and Indoor Air, The Inside Story: A Guide to Indoor Air Quality - EPA Document #402-K-93-007, 19 June 2003 <http://www.epa.gov/iaq/pubs/insidest.html>.
[2]American Lung Association, Residential Air Cleaning Devices: Types, Effectiveness, and Health Impact, 19 June 2003 <http://www.lungusa.org/pub/cleaners/air_clean_toc.html>.
[3]Information presented by Dri-Eaz and 3M at the 2003 Dri-Eaz Restorative Drying Symposium

Because many of these particulate or gaseous agents are reasonably well tolerated by most individuals in otherwise "normal" indoor environments, their role as actual "pollutants" in buildings that sustain water, fire, or sewage damage is probably minimal. However, substances of concern to restoration professionals—mold, bacteria and their odor-causing chemicals, and combustion products—may nevertheless be difficult to identify by sight or smell from these many common background substances. For this reason, in at least some restorations for water damage, fire, mold, or sewage, sampling of the indoor air and dust for specific biological (and less often, chemical) contaminants is necessary prior to starting the restoration work.

Measured in microns
Most airborne particles of concern to human health are not visible to the naked eye. The size of these particles is measured in microns. A micron, short for micrometer and abbreviated µm, is one millionth (1/1,000,000) of a meter. A particle of 1 micron in diameter is far smaller than the period that ends this sentence. The following chart compares the average sizes of some common airborne particles and gas molecules.

PARTICLE SIZE SPECTRUM



Settling of particles
The smallest particles are light enough to be suspended in the air indefinitely. However, most indoor airborne particles are gravimetric. That is, they will eventually settle to the ground or onto surfaces like furnishings, counter tops, and windowsills.

In the turbulent environment of water damage restoration—or wherever else high-velocity airflow is employed—even the heaviest particles can remain airborne where they may be inhaled. Restoration procedures often disturb particulate matter in such a way that the indoor air, if not sufficiently filtered, can become contaminated.

Depending on size and other physical properties, as well as environmental conditions, some particles can take quite a long time to settle. In the case of very small mold spores arising from water-damaged building materials, they are often able to "latch on" to larger particles and remain in the settled dust for long periods of time.

The following chart shows the relative time it takes for particle sizes to settle one meter under still (non-turbulent) indoor air conditions.

APPROXIMATE PARTICLE SIZES AND TIME TO SETTLE 1 METER[3]

Particle type	Diameter (µm)	Time
Human hair	100-150	5 seconds
Skin flakes	20-40	
Visible dust	> 10	
Common pollens	15-25	
Mite allergens	10-20	5 minutes
Fungal spores	2-10	
Bacteria	1-5	
Cat dander	0.5-1.5	10 hours
Tobacco smoke	0.1-1.0	
Metal and organic fumes	< 0.1-1.0	
Cell debris	0.01-1.0	
Viruses	< 0.1	10 days

[3]Spengler, John D, Ph. D., Harvard School of Public Health, Boston, MA; referenced in Residential Air Cleaning Devices: Types, Effectiveness, and Health Impact (American Lung Association), 19 June 2003, Appendix 1: Table - Approximate Particle Settling Time <http://www.lungusa.org/pub/cleaners/fig2.html>.

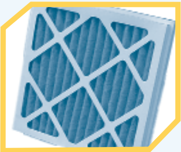
HOW AN AIR SCRUBBER WORKS

In order to remove airborne particles from the surrounding environment, an air scrubber draws the air through a series of filters. Each filter stage operates with progressively higher efficiency. The net effect is to produce the cleanest air possible at the highest rate of airflow through the entire filter system.

Pre-filters

The first stage of filtration is known as the "pre-filter" stage. Pre-filters capture the majority of "larger" particles that may range from visible down to 10 µm. This is accomplished by arranging several pre-filters in order of increasing efficiency.

pre-filter



By capturing these larger particles, a set of relatively inexpensive pre-filters actually extend the service life of a more expensive primary filter. Without pre-filters, the high-efficiency primary filter would load with particles earlier, thereby causing the airflow rate and filtration efficiency to decrease. Removing these relatively larger particles with pre-filters helps the entire unit maintain high airflow, better filtration efficiency, and process more cubic feet per minute (CFM). Depending on the duration of the job, pre-filters may be replaced several times during the lifetime of one high-efficiency primary filter.

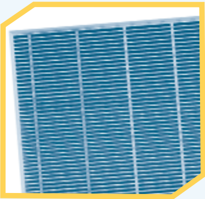
Optional carbon filters

Most air scrubbers include space in the pre-filter stage for an optional carbon filter. The carbon filter captures the gas- and vapor-phase molecules that the human nose detects as odors. This is accomplished through a process called adsorption, where the gaseous molecules are physically attracted to the surface of the carbon.

The greater the surface area of the carbon, the more effective the filter is at adsorbing odor-causing molecules. Activated carbon is the preferred material for odor removal because it has a very large surface area. Just one gram of activated carbon may have as many as 2,000 square meters of surface area to adsorb gaseous odor molecules.

The service life of a carbon filter depends on the type and concentration of the odor. Your sense of smell will let you know when it's time to replace the carbon filter.

primary HEPA filter



Primary filter

The final stage of filtration in an air scrubber is the primary filter. The primary filter completes the filtration process by removing the tiniest particles from the air. These particles may be as small as 0.3 microns in diameter.

An effective primary filter should be constructed of HEPA filter media. HEPA media is laboratory-tested to capture at least 99.97% of all 0.3-micron particles that pass through the filter media at a predetermined rate of airflow.

It is important to recognize that not all HEPA-media filters provide the same level of performance on the jobsite that they provide in the laboratory. We'll address this issue in the section titled, "The HEPA Facts."

The primary filter should be changed during a job when it becomes loaded with particulate and performance begins to suffer. To avoid cross-contamination, the primary filter should be changed between every job.

Blower

No matter how effective the filter system is, an air scrubber needs a dependable and versatile blower. The blower pulls the air through the filters and exhausts the filtered air out of the unit. If the unit is to be used as a negative air machine, the blower should be powerful enough to provide sufficient static pressure for maintaining constant negative air pressure in the contained area.

It is important that the blower's power complements the efficiency of the installed filter system. A blower that is too powerful (that is, it pulls too many CFM) may overwhelm a mismatched filter system and actually decrease the system's efficiency.

Some air scrubbers offer the added benefit of variable speed operation. This feature allows the operator to adjust the blower speed to better filter small rooms and containment areas.

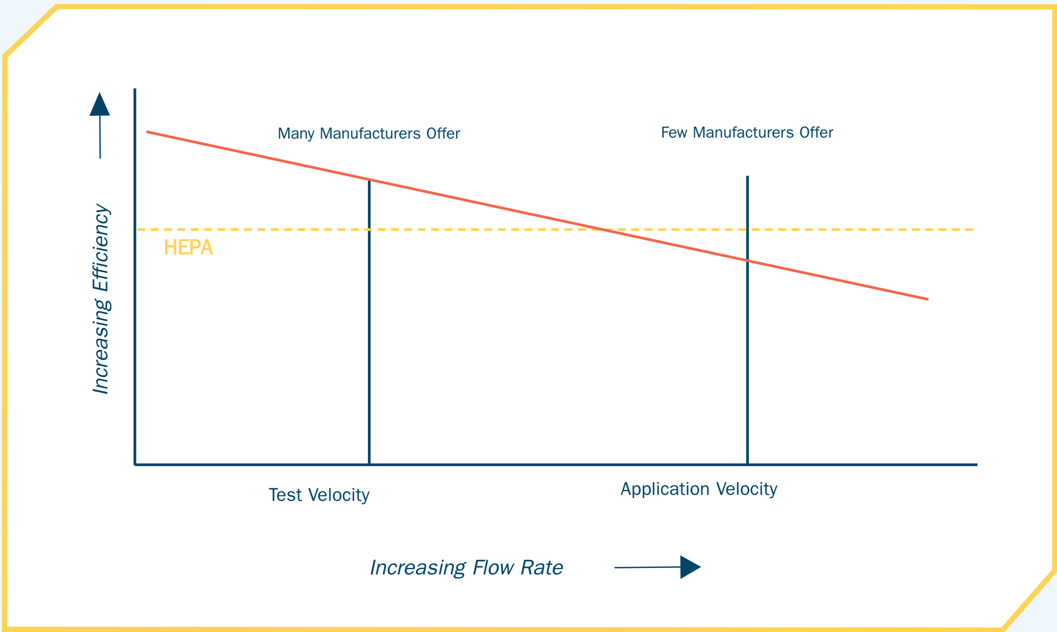
THE HEPA FACTS

The most common buzzword surrounding air scrubbers is HEPA, which stands for High Efficiency Particulate Air in reference to filter performance. It seems that nearly every manufacturer of high-efficiency filters or air-cleaning devices claims to be HEPA or have a rating of 99.97%. But what does this HEPA rating actually mean?

The history of HEPA
In order to discover what sort of difference a HEPA filter actually makes in real world applications, let's look back at the origins of HEPA filtration.

The first HEPA filters were developed in the 1940s by the research and development firm Arthur D. Little as part of the Manhattan Project, a classified U.S. government project that developed the atomic bomb. The researchers needed a way to control the spread of very small, radioactive particles. They identified the 0.3-micron particle as the most penetrating particle into the human lung and focused their testing of filter performance around this particle size. The initial filters were so effective that they were referred to as "absolute filters." The generic term "HEPA" came into use in the 1950s after the absolute filter was commercialized.

FILTRATION PRODUCTS



The 99.97% standard

The modern day standard for HEPA performance is very similar to the original tests performed for the Manhattan Project nearly 60 years ago. Though not regulated by any government agency, HEPA filter manufacturers conform to the recommended procedures set by the Institute for Environmental Sciences and Technology (IEST). IEST-RP-CC021.1 and IEST-RP-CC001.3 are the most cited recommended practices for determining whether or not a filter meets true HEPA standards.

IEST-RP-CC021.1 specifies that, in order to qualify as HEPA ***media***, the filter media must be 99.97% efficient against 0.3-micron oily aerosol particles traveling at a specified rate of 5.3 centimeters (cm) per second. This test focuses on the material out of which a filter is constructed.

IEST-RP-CC001.3 specifies that, in order to qualify as a HEPA ***filter***, the entire filter must be 99.97% efficient against 0.3-micron oily aerosol particles at the application flow rate. This test focuses on the entire filter in its final constructed form.

Though these brief descriptions do not even begin to describe the tests in complete detail, they raise issues that are important to a discussion of HEPA filtration. Note that each test addresses three separate factors: particle type, particle size, and ***particle flow rate***, or the speed at which particles encounter the filter. These are all critical to establishing whether a filter meets HEPA standards of 99.97% efficiency.

HEPA and application rates

The particle flow rate at which a filter is tested has a significant effect on its efficiency rating. The slower the rate, the longer the dwell time for particles within the filter and the easier they are to capture. A slow particle flow rate results in a higher efficiency rating.

In the previous section we noted that both IEST-RP-CC021.1 and IEST-RP-CC001.3 account for particle flow rates as part of the testing procedure. When testing the media alone (IEST-RP-CC021.1), this rate is defined as 5.3 cm/second. But when testing the entire filter (IEST-RP-CC001.3), this rate is left open to interpretation as the "application rate," meaning the rate at which the filter will be used when performing the intended work.

In order to qualify as HEPA according to the IEST, many air scrubber filters are tested at slower application rates. The actual particle flow rate (velocity in cm/second) may vary according to the size of the filter but translates to processed volumes of air as low as 150 to 200 CFM or less. This is in sharp contrast to the stated capacity of a typical air scrubber that may process 500-2000 CFM (or more) in real-world operating conditions.

Thus, a filter that is merely designed to pass a test for HEPA efficiency in the laboratory may be overwhelmed at normal operating airflow on the job. It might provide good filtration, but it will not necessarily be HEPA.

It's important to look at more than just claims of HEPA efficiency when selecting an air scrubber for your needs. Make certain that the filtration system is designed for high volumes of airflow. You should also look for a filter system that will help to minimize the build-up of pressure on the filters (also known as "pressure drop").

Pressure drop
By design, every filter system creates some resistance to airflow. As the blower pulls air through an air scrubber's filter system, any resistance to airflow will create a drop in pressure (a decrease in airflow) behind the filters. The greater this resistance to airflow, the greater the pressure drop and the fewer useable CFM for the job.

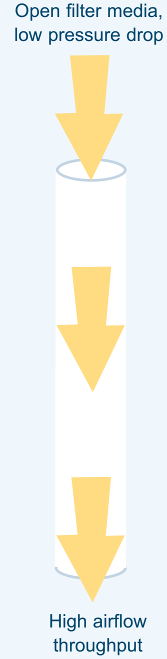
Optimal filter systems minimize this resistance (i.e. they have a low pressure drop) to help maximize filtration efficiency. Lower quality filter systems create high resistance (i.e. high pressure drop) that decreases filter performance.

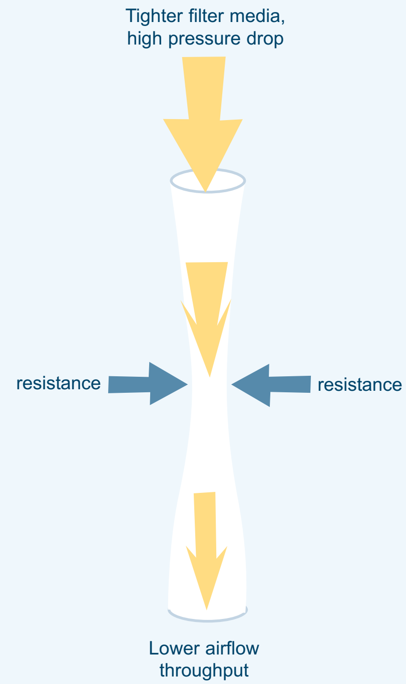
An air scrubber with low pressure drop will be able to process higher volumes of air with less strain on the motor. The ideal filtration system combines high filtration efficiency, high volumes of airflow, and low pressure drop for the best real-world performance.

Loading capacity
How a HEPA filter collects particles is another important point to consider. A filter design that collects particles mostly on the surface (like a lint trap on a dryer) will load quickly, causing an increase in pressure drop, a decrease in airflow and a decrease in filtration efficiency. On the other hand, a filter design that can utilize its entire depth to capture particles, not just the surface, will maintain a lower pressure drop, higher airflow, higher filtration efficiency, and provide a longer service life. This performance feature is often called "depth loading," and is advantageous to the restorer for the reasons outlined above.

Durability of HEPA filters
The durability of HEPA filter media plays a critical role in the quality of an air scrubber's performance in the real world. A filter may perform perfectly well in the laboratory, but should it be damaged through shipping or handling, it will suffer a permanent loss of filtration efficiency. Fragile media can be crushed or torn, leaving gaps and holes that allow particles to pass through unfiltered and negating the benefits of a HEPA rating.

Make certain that the filter media in the air scrubber you select is designed to withstand the rigors of restoration work. It should be resilient enough to withstand the bumps and drops common to being transported as freight (before the purchase) and installed in the unit (on the jobsite).





CLEAN AIR DELIVERY RATE (CADR)

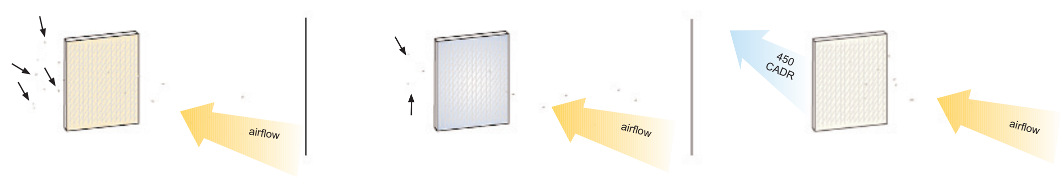
Clearly, airflow is a critical element in the efficiency of a filtration system. As emphasized earlier, a filter that meets the HEPA standard when tested in the laboratory at 150 CFM may not provide HEPA-quality filtration at 500 CFM. Even though a CFM rating—or air changes per hour—tells you little about the quality of filtration, this is the way the restoration community has compared air scrubber performance.

The Association of Home Appliance Manufacturers (AHAM) has a rating system that's been used to compare performance filtration equipment for years: Clean Air Delivery Rate (CADR). CADR is a measure of the actual volume of cleaner air delivered per minute. It factors in how the filtration system and the entire machine work together, at the airflow rate you're using. The highest CADR numbers belong to air scrubbers that combine high filtration efficiency, high airflow, and low pressure drop. Selecting the proper filter media can optimize CADR.

The CADR system is unique because it indicates how efficiently a machine removes particles from the air—not just the number of CFM or the type of filtration. The restoration/remediation market is beginning to use the CADR system because it represents a better way of comparing performance between units. CADR is a step forward for the industry because it tells you how much cleaner the air really is, when processed by a particular machine at a particular flow rate.

CADR: VOLUME OF CLEANER AIR DELIVERED PER MINUTE

The highest CADR numbers belong to air scrubbers that combine high filtration efficiency, high airflow, and low pressure drop.



Airflow: 450 CFM
Filtration Efficiency: 0%
CADR: 0 CFM

Airflow: 450 CFM
Filtration Efficiency: 80%
(low pressure drop)
CADR: 360 CFM

Airflow: 450 CFM
Filtration Eff: 99.97% (True HEPA)
(low pressure drop)
CADR: 450 CFM

HOW TO USE AN AIR SCRUBBER

Preparation

Before using an air scrubber, be certain that you start with a clean unit with new filters. The best practice is to thoroughly clean the unit and replace both the pre-filters and the primary filter after every job. This extra step eliminates the possibility of cross-contaminating a clean space as fungal spores and other microbes can grow through any filter over time. The cost of filters should be considered part of the cost of restoration.

During the job, change filters as soon as the pressure drop increases to the point where filtration efficiency begins to suffer. Higher quality air scrubbers are able to monitor pressure drop and alert you when filters need changing.

Placement for water damage

For water damage restoration, an air scrubber should be placed in the center of the affected area. The air scrubber will draw in the surrounding air and return the filtered air back into the same environment. To operate the air scrubber, simply turn the unit on. It will immediately begin drawing in air through the filter system and capturing airborne particles. When working in large areas or spaces that are divided by walls, doorways, or hallways, you may need to place several air scrubbers at strategic locations. For more information, see the next section "Maximizing circulation."

Maximizing circulation — 500 CFM or 2000 CFM?

Contaminants in the air may not be evenly dispersed throughout a room or structure. It is possible for "stale" pockets of air to remain out of an air scrubber's reach. These stale pockets may be in corners, closets, hallways, through doorways, or in any area that is isolated or blocked from the air scrubber.

Remember, dirty air will not move to clean air. The only way to truly filter an indoor structure is to place air scrubbers in several strategic locations. The goal is to eliminate stale pockets: several 500 CFM units will provide a better environment than one 1500-2000 CFM unit.

If conditions allow you may consider placing airmovers in a room or structure to specifically improve circulation of the indoor air for better filtration. You may also wish to duct the process air from the air scrubber to another part of the structure to increase air circulation between rooms. More likely, you may need to place more than one air scrubber throughout a structure to minimize stale pockets of air.

Determining ACH

ACH stands for air changes per hour. An air scrubber accomplishes one "air change" when it filters a volume of air equivalent to the size of the room (known as "equivalent volume"). For instance, a room with 500 square feet and 8-foot ceilings has 4,000 cubic feet. In this situation, an air scrubber would achieve one air change after filtering the room's equivalent volume, or 4,000 cubic feet of air. Of course this figure will vary depending on the size of the structure or area.

Currently there are no standards for the minimum number of ACH on water damage restoration. All standards for ACH come from other industries such as asbestos remediation, mold remediation, or hospital sterilization. The standards vary widely depending on application and jurisdiction. For example, the IICRC's S520 mold guidelines (Sec. 10.3.1) recommend that "a minimum of four air changes per hour be maintained for ventilation and contaminant dilution" when using pressure differentials.

As a general rule you should achieve a minimum of 6 ACH. This means that an air scrubber must complete six air changes every hour, or one every 10 minutes. If you can increase the ACH, do so.

You can determine the CFM needed to achieve 6 ACH with a simple 3-step formula:

1 Calculate the room's volume in cubic feet. To do this, multiply the square footage by the ceiling height. In the example above, the floor has an area of 500 square feet (multiple length by width) and 8-foot ceilings.

500 x 8 = 4,000 cubic feet of volume.

2 Multiply the room's volume (in cubic feet) by 6 to find the total cubic feet of filtration needed per hour

4,000 cubic feet x 6 = 24,000 cubic feet per hour

3 Divide the total cubic feet per hour by 60 to convert to cubic feet per minute (CFM)

24,000 cubic feet per hour / 60 minutes = 400 CFM

You can see that you would need an air scrubber with 400 CFM to maintain 6 ACH in a 4,000 cubic foot space. You can apply this formula to any closed environment and determine the CFM required to achieve 6 ACH.

New to the industry is CADR, or Clean Air Delivery Rate. This is a more effective way at matching an air scrubber to the volume of a space.

WHEN TO USE AN AIR SCRUBBER

Water damage restoration
One of the most practical and necessary places to use an air scrubber is on every water damage restoration job. The immense amount of airflow necessary for the evaporation of moisture from carpet, pad, drywall and other damaged materials also stirs up a vast amount of debris into the air from carpet, furniture, and ductwork. These airborne particles can range from allergens normally found indoors (like pet dander) to potentially hazardous contaminants that may be a result of water damage (like mold spores).

Use an air scrubber on water damage to drastically reduce the number of these airborne particles and improve the quality of indoor air.

Fire damage restoration
Use an air scrubber on fire damage to not only reduce particle counts, but to reduce odors. Supplement the pre-filter stages with an optional carbon filter to effectively capture gas molecules that cause odors in addition to airborne debris stirred up by the restoration and reconstruction process.

Dust control
An air scrubber is a valuable tool in any environment where dust is undesirable for reasons of safety, comfort, or precision. Situations may include workshops, construction sites, or factory production lines.

Odor Control
With an optional carbon filter placed in the pre-filter stage, an air scrubber can remove odor-causing gas molecules from the air in addition to microscopic particles. Applications include cleanup for fire, sewage, mold contamination, and even standard carpet cleaning jobs.

Sewage remediation
Use an air scrubber with an optional carbon filter to help control odor and reduce the number of gaseous pollutants while remediating sewage damage.

Negative air machine for mold remediation
Certain air scrubbers can also be used as negative air machines for containment purposes. In order to function effectively as a negative air machine, an air scrubber must include these features:

- ductable in and ductable out capability
- sealed housing
- precise airflow adjustment

For mold remediation, an air scrubber/negative air machine should be placed outside the containment. It will draw air from the contained area through ducting and exhaust filtered air outside the containment area. Use the variable speed operation to control the pressure differential of the containment area and thereby avoid collapsing the containment barrier because of too much vacuum pressure from the air scrubber/negative air machine.

Achieving true HEPA filtration efficiency of 99.97% (as described earlier in this guide) is especially critical when using an air scrubber as a negative air machine, because the air scrubber (and filter) will only process the air one time, as it's ducted out. According the IICRC's S520 mold guidelines (Sec. 10.3), "If pressure differentials are used, it is highly recommended that they be created using HEPA air filtration devices set up as negative or positive air machines."

An air scrubber/negative air machine helps prevent contaminants from escaping from a properly constructed containment area.

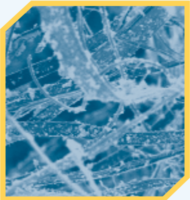
AIR SCRUBBER SAFETY

What an air scrubber does not do
Though an air scrubber is a powerful and versatile tool when properly applied, there are inherent limits to its abilities. The most significant limitation is implied by its name—an air scrubber helps clean the air but it does not help clean surfaces. An air scrubber is effective only against airborne particles (and gaseous pollutants) that pass through the filter system. Particles that settle on furniture, countertops, or other surfaces, or which are drawn in to the HVAC system, are beyond an air scrubber's reach.

The use of an air scrubber is not a guarantee that the air will be decontaminated at the conclusion of the job. The design of any building will have spaces of "dead air" that resist circulation. It is possible that an air scrubber will miss certain groups of airborne particles because that air will never pass through the filter system.

An air scrubber will not capture every single particle or gas molecule that passes through the filter system. Even the most efficient air scrubber filter systems are only rated 99.97% effective against particles 0.3 microns in diameter or larger. Some particles in this size range and smaller will be able to pass through the filter without being captured.

Changing filters and cleaning
To help prevent cross-contamination between jobs, limit your liability, and to optimize the performance of your air scrubber, you should perform a basic maintenance routine between every use: decontaminate the entire unit inside and out, (Milgo QGC works great for this) and replace the entire filter system (both pre-filters and primary) before placing the unit on a new job.



Loaded filter

During a job, filters should be changed when they become so loaded with particles that they begin to reduce airflow and increase pressure drop. Overly loaded filters not only restrict CFM, they can result in a loss of filtration efficiency. You may need to monitor the exhaust airflow with a manometer at selected intervals to determine pressure drop. Some air scrubbers include on-board pressure sensors that automatically alert you when the filters need changing.

Use appropriate PPE
An air scrubber captures particles that can be hazardous to human health. During the process of changing filters, decontamination, or performing maintenance, large concentrations of captured particles can become airborne in the immediate area. For these reasons, air scrubber operators should wear appropriate personal protection equipment (PPE) when performing any type of service on an air scrubber. A NIOSH-approved respirator is always essential for these tasks. If you've used the air scrubber for mold remediation or in another environment with known contaminants, you should also consider wearing gloves, eye protection, and coveralls.

Disposal of filters
The particles captured by a filter can cause adverse human health effects should they be re-released into the air. For this reason, you should dispose of used filters with care. You should place used filters in a plastic bag and seal the top before disposing. Always follow local regulations when disposing of used filters.

Classes and education
This guide to air scrubbing is a great place to begin your education in the uses, features, and advantages of air scrubbers. Now you understand more about how an air scrubber can help to improve indoor air quality for various types of restoration jobs and what features to look for when you purchase.

But this publication should not be the end of your education on air scrubbing and jobsite air filtration. There are currently a number of classes available that comprehensively address building investigation, restoration methods, and indoor air quality. As the restoration and construction industries continue to learn about the importance of jobsite filtration there will be even more opportunities to learn. An investment in your education will ultimately benefit your customers and employees, and in so doing, increase the quality, reputation, and longevity of your business.