# Gas-Phase Filtration Solutions

**Innovative Line of Products for the Control of Harmful Gaseous Contaminants**

# Gas-Phase Filtration

## History of Gas-Phase Filtration

The first documented use of activated carbon (commonly known as charcoal) can be traced back to around 3750 B.C., when it was first used by the Egyptians for smelting ores to create bronze. By 1500 B.C., the Egyptians had expanded its use to healing intestinal ailments, absorbing unpleasant odors, and for writing on papyrus. By 400 B.C., the Ancient Hindus and Phoenicians recognized the antiseptic properties of activated charcoal and began using it to purify their water.

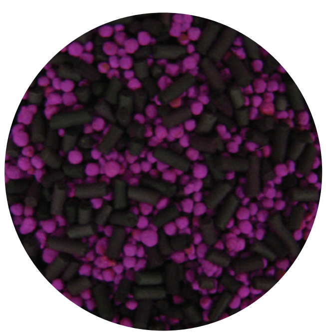
Between 400 B.C. and the 1800s, activated charcoal was used to remove odors from wounds, preserve water during ocean voyages, and by the military to treat battle wounds by removing toxins.

The earliest use of activated carbon for gas-phase contaminant removal dates back to 1854, when a Scottish chemist invented the first mask that utilized activated carbon to remove noxious gases. Wood was originally used as the base material for gas masks, since it was good at capturing poisonous gases when converted to activated carbon. By 1918, it was determined that shells and nuts converted to activated carbon performed even better than wood.

Around this same time, activated carbon began to be produced on a large scale, and its use spread to decolorization in the chemical and food industries. In the later 1900s, other industries such as corn and sugar refining, gas adsorption, alcoholic beverage production, and wastewater treatment plants began to use activated carbon.

Today, activated carbon is available in many different shapes and sizes, and its applications are growing every day. For air filtration, the most common types of activated carbon are granular activated carbon (GAC), pelletized activated carbon (PAC), and structured activated carbon. In addition, other substrates such as alumina and zeolite are used in lieu of activated carbon due to their tremendous pore structures. The most common applications for gas-phase filtration include corrosion control, odor control, and protection from toxic gases.

*AAF's SAAFCarb™ Chemical Media*



*AAF's SAAFBlend™ GP Chemical Media*

## What are Gaseous Contaminants?

Gaseous contaminants are undesirable airborne chemical compounds mixed with the normal molecular oxygen and nitrogen in the atmosphere. Because of their molecular size, in the sub-nano range, they are not visible. Some common offensive undesirable gaseous contaminants are hydrogen sulfide, the rotten egg smell, or skatole, the dirty diaper smell. Many chemicals that result from combustion are considered to be gaseous contaminants, such as carbon monoxide, oxides of nitrogen, oxides of sulfur, and polyaromatic hydrocarbons.

## Size – Gaseous and Particulate Contaminants

The graphic in Figure 1 illustrates the relative size differences of common airborne contaminants. Some viable particulate contaminants, such as viruses and bacteria, although not visible, have a mass size large enough to be filtered with specialized particulate filters. Gaseous contaminants can only be effectively removed using gas-phase, or molecular, filtration technologies.

## Types and Sources of Gaseous Contaminants

Gaseous contaminants are generally classified as Odorous, Corrosive, or Harmful/Toxic. Examples of their sources are shown in Figure 2.

**Note:** ***Many gaseous contaminants span more than one category.***

## Control of Gaseous Contaminants

The principle of specialized gas-phase filtrations systems, as seen in Figure 3, most often in combination with particulate filters, are used to remove molecular gaseous contaminants.

**Note:**

- ***Particulate filters are always required upstream of chemical media to keep dirt out of the pore structure, allowing the media to perform as intended.***
- ***Particulate filters may also be needed downstream of chemical media in cassettes or bulk fill applications to capture dust coming off the media.***

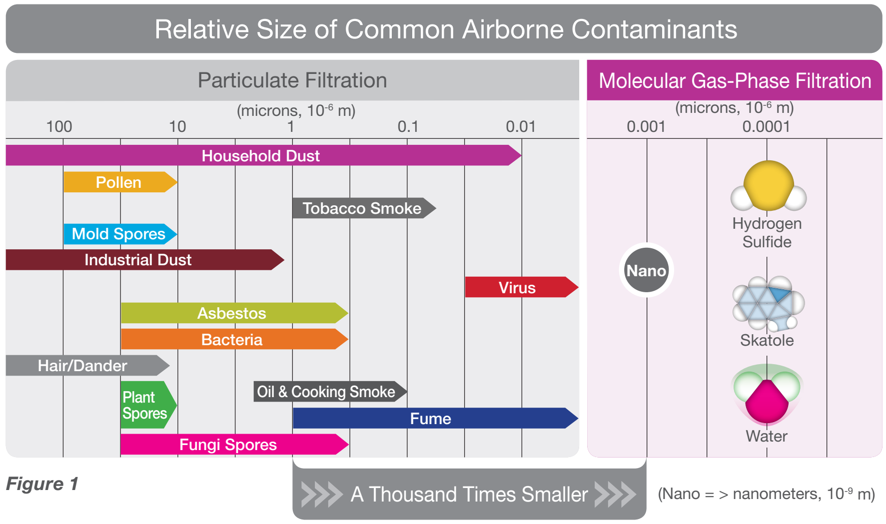



*Figure 1*

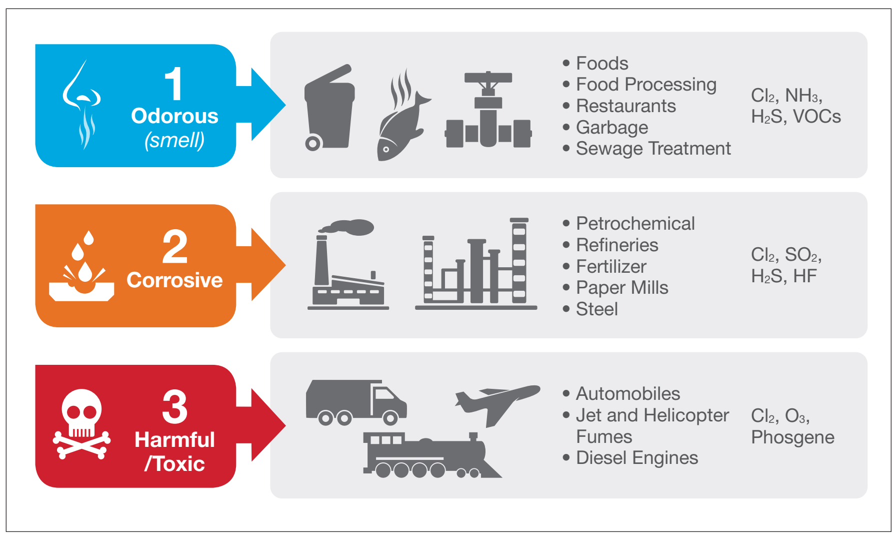



*Figure 2*

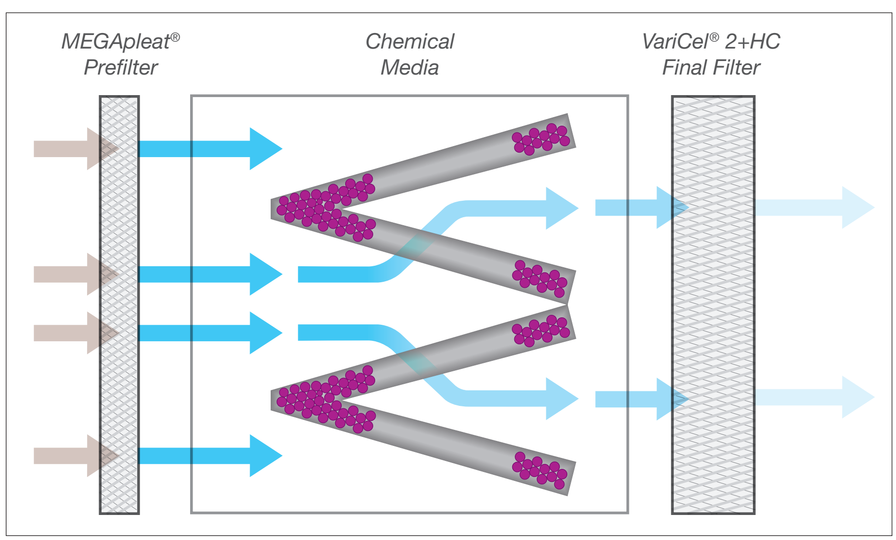



*Figure 3*

# Gas-Phase Filtration

## Industry Segments and Applications

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Segments** | Airborne Molecular Contamination (AMC) | Commercial Indoor Air Quality (IAQ) | Corrosion Control | Odor Control | | HEGA / Warfare | Nuclear |
| **Applications** | Semiconductor, Microelectronics, Photovoltaic Manufacturing | Airports | Petro Chemical (Control Rooms, Safety Valves, Compressors) | Food / Kitchen | Emergency Ventilation | Embassies | Nuclear Power Plants |
| | Pharmaceuticals / Biotechnology / IVF Lab | Schools, Homes / Offices | Pulp & Paper (Control Rooms, Compressors) | Frangrance | Cannabis | Shelter in Place (SIP) and Collective Protection | Hospitals |
| | Process Tools | Hospitals | Data Center (Emergency Power, Server) | Wastewater | Lab | | |
| **Gases** | Acids, Bases, VOCs, Oxidants, Dopants, Ozone | Acids, Bases, VOCs, Ozone, Formaldehyde | Acids, Bases, Ozone, Sulfer Compounds, Oxidants (Cl) | Bases, Ozone, Sulfur Compounds, VOCs, Amines, NOx | Acids, Bases, Ozone, Sulfer Compounds, Oxidants, VOCs, Flammable | Phosphorous Compounds, Oxidants, VOCs, Bio Contaminants | Radioactive Compounds (Iodine, F-18, Ga-68) |
| **Attributes** | Very High Requirements, Low Concentrations, High Product Value | Safety, Moderate Requirements | Moderate Requirements, Low / Medium Concentrations | Moderate Requirements, Low /Medium / High Concentrations | Typically, Big Projects, Safety, High Concentrations | Safety, Testing, Low / Medium Concentrations | Safety, Testing, Low / Medium Concentrations |
| **Products** | Pleated / Loose Fill (VariSorb, VariCel, SAAF Cassettes) | Pleated / Loose Fill (AmAir/C, Carbon Tray (Carbon tray, SAAF VariCel, VariSorb) | Loose Fill (Carbon Tray, SAAF Cassettes, SAH, DBS) | Pleated / Loose Fill (Carbon Tray, SAAF Cassetes, AmAir/C VariCel, VariSorb) | Loose Fill (Carbon Tray, SAAF Cassettes, SAH, DBS) | Loose Fill (HEGA) | Loose Fill (HEGA) |

### When is Gas-Phase Filtration Required?

Just like particulate filtration, gas-phase filtration is required in a wide variety of industries and applications. The table above is a list of the more common industry segments and their specific applications that require gas-phase filtration. These applications predominantly require gas-phase filtration to protect personnel, processes, and sensitive electronics that are exposed to harmful contaminants in the air.

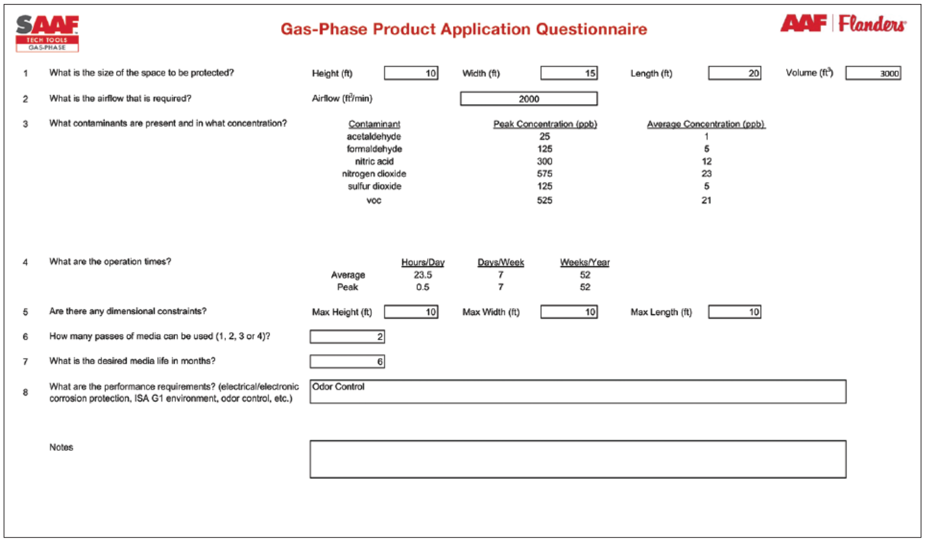
### What Gas-Phase Products are Available?

There are a wide variety of products that are available to remove gas-phase contaminants from the air. These products are typically categorized as low-, medium-, or high-removal capacity products. On the low end are products such as two-inch pleated filters containing chemical media to remove trace to low concentrations of contaminants. In the middle are 12"-18" deep filters and cassettes to remove moderate challenge levels. On the high end is equipment with loose-fill chemical media specifically designed to eliminate high concentrations of gas-phase contaminants.


**1.** *Low-challenge odor control*
**2.** *Low-challenge corrosion prevention & medium-challenge odor control*
**3.** *Medium-challenge corrosion prevention & medium-challenge odor control*
**4.** *High-challenge corrosion prevention & medium-challenge odor control*
**5.** *High-challenge corrosion prevention & high-challenge odor control*
**6.** *High-challenge corrosion nuclear & biological control*

## Selecting Gas-Phase Air Filters

Choosing the correct chemical media type and the correct chemical media delivery system is a daunting task. There is a lot of information that must be gathered first, such as the contaminants of concern (COC), the concentrations of the COC, the air volume, the desired media life, and the space available as examples. A good starting point is to complete the Gas-Phase Product Application Questionnaire depicted below to document as much of this information as possible.



SAAF TECH TOOLS GAS-PHASE

**Gas-Phase Product Application Questionnaire**

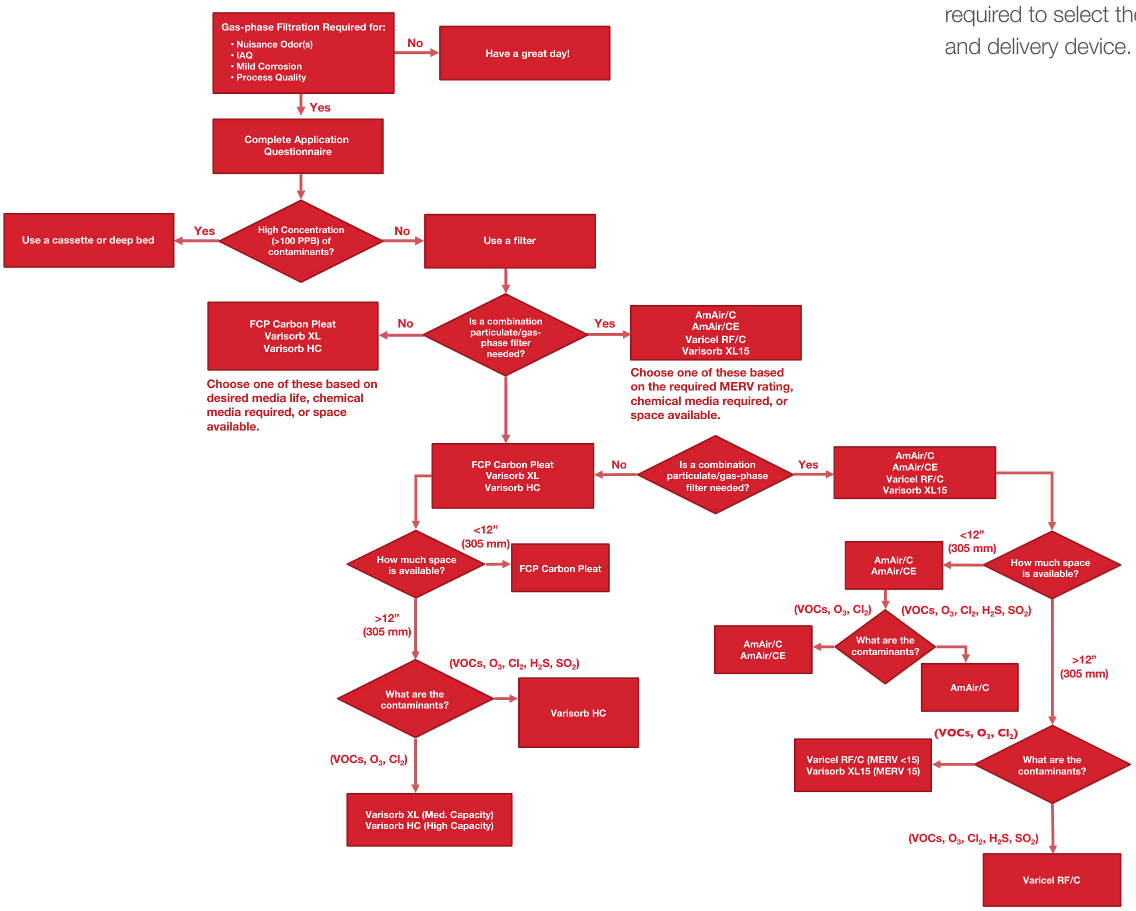
AAF Flanders

| # | Question | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | What is the size of the space to be protected? | Height (ft) | 10 | Width (ft) | 15 | Length (ft) | 20 | Volume (ft³) 3000 |
| 2 | What is the airflow that is required? | Airflow (ft³/min) | | 2000 | | | | |
| 3 | What contaminants are present and in what concentration? | Contaminant | | Peak Concentration (ppb) | | Average Concentration (ppb) | | |
| | | acetaldehyde | | 25 | | 1 | | |
| | | formaldehyde | | 125 | | 5 | | |
| | | nitric acid | | 300 | | 12 | | |
| | | nitrogen dioxide | | 575 | | 23 | | |
| | | sulfur dioxide | | 125 | | 5 | | |
| | | voc | | 525 | | 21 | | |
| 4 | What are the operation times? | | Hours/Day | Days/Week | Weeks/Year | | | |
| | | Average | 23.5 | 7 | 52 | | | |
| | | Peak | 0.5 | 7 | 52 | | | |
| 5 | Are there any dimensional constraints? | Max Height (ft) | 10 | Max Width (ft) | 10 | Max Length (ft) | 10 | |
| 6 | How many passes of media can be used (1, 2, 3 or 4)? | 2 | | | | | | |
| 7 | What is the desired media life in months? | 6 | | | | | | |
| 8 | What are the performance requirements? (electrical/electronic corrosion protection, ISA G1 environment, odor control, etc.) | Odor Control | | | | | | |
| | Notes | | | | | | | |

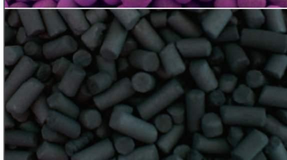
This gathering of the data is the first step in determining the correct type of media. In most applications, there is one chemical media effective for a particular contaminant. There are times, however, when more than one media type may be effective for a particular contaminant. In other cases, more than one media type is required as part of a comprehensive solution due to the list of contaminants that need to be removed.

To further complicate matters, there are multiple chemical media delivery systems available, and most of the time, more than one of these systems will work. The amount of space that is available, along with the number of media types required, are the two main factors that determine which delivery system will best serve the application at hand.

Due to this complexity, it is recommended that you reach out to your local AAF representative to assist you with making the proper selection. The sample flowchart below shows the various decision points and steps that are required to select the best chemical media and delivery device.



## Chemical Media

| | Media Type | Impregnant | Target Gases | Typical Applications |
|---|---|---|---|---|
|  | SAAFOxidant<br>*Brochure GPF-1-101* | $KMnO_4$ (Potassium Permanganate) | $H_2S$, $SO_2$ Formaldehyde, Ethylene, $NO_X$ | Refineries, Pulp and Paper, Labs, Wastewater |
|  | SAAFCarb<br>*Brochure GPF-1-110* | Virgin Activated Carbon | VOCs, Ozone, Hydrocarbons, Nuisance Odors | Cooking, IAQ, Painting, Outdoor Air |
|  | SAAFCarb MA<br>*Brochure GPF-1-112* | KOH (Potassium Hydroxide) | $H_2S$, $SO_2$, $NO_X$ | Pulp and Paper, Wastewater, Exhaust |
|  | SAAFCarb MB<br>*Brochure GPF-1-113* | $H_3PO_4$ (Phosphoric Acid) | $NH_3$, Amines | Fertilizer Plants, Petrochemical Plants |
|  | SAAFCarb MC<br>*Brochure GPF-1-114* | $Na_2S_2O_3$ (Sodium Thiosulfate) | $Cl_2$ | Pulp and Paper, Wastewater, Water Treatment |
|  | SAAFCarb MA.HT<br>*Brochure GPF-1-119* | MgO (Magnesium Oxide) | $H_2S$, $SO_2$, Hydrocarbons | Pulp and Paper, Wastewater |
|  | SAAFBlend GP<br>*Brochure GPF-1-102* | 50/50 Blend | SAAFCarb and SAAFOxidant | Helipad, Exhaust, Refineries, Urban Outdoor Air |
|  | SAAFBlend CB | 80/20 Blend | SAAFCarb and SAAFOxidant | Cannabis Odors |

# Gaseous Filtration Solutions

AAF has assumed an industry-leading position with the development of its innovative gas-phase product line designed to reduce or eliminate harmful gaseous contaminants. In combination with our expertise in airborne particulate filtration, these products allow us to develop unique and effective total filtration solutions.

## SAAF™ Pleated Panel Filters

### FCP Carbon Pleat

*Brochure GPF-1-142*

**Product Overview**

- Maximum carbon surface area to optimize efficiency and available capacity
- Media with exceptional adhesion of carbon granules to preclude dusting
- Far superior performance to filters made with carbon slurry media
- Directly replaces existing 2" or 4" filters, adding odor control without requiring new hardware
- Three types of carbon media available to specifically target certain contaminants and odors
- High-capacity option available in each type

### AmAir®/CE Pleated Carbon Filters

*Brochure GPF-1-124*

**Product Overview**

- Economical solution to many odor problems, from light to moderate
- Directly replaces existing 1", 2", or 4" filters, adding odor control without requiring new hardware
- Fast, easy remediation of minor odor problems
- High wet-strength beverage board frame
- MERV 6 particulate efficiency

### AmAir®/Family of Products

*Brochure GPF-1-118*

**Product Overview**

- Available particle efficiencies: MERV 13 (AmAir/C M13), MERV 7 (AmAir pleated filters), and MERV 5 (Am/Air/CP panel filter)
- Three types of chemical media available to target specific contaminants and odors:
  - SAAFCarb: Removes volatile organic compounds (VOCs), hydrocarbons, and diesel/jet fuel fumes
  - SAAFOxidant: Removes $H_2S$, $SO_X$, $NO_X$, and formaldehyde
  - SAAFBlend GP: a 50/50 blend of the above for wide-spectrum air quality control
- Filter frame: High wet-strength beverage board
- Available in 1", 2", and 4" pleats, panels, and pads
- UL Classified

## SAAF™ Extended Surface Filters

### VaporClean®

*Brochure GPF-1-146*

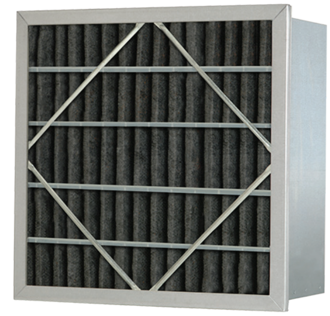
**Product Overview**

- Designed for removal of molecular contaminants at low concentration levels
- Utilizes dry processed carbon composite media (DPCC) for high-efficiency removal of multiple contaminants
- Five impregnated carbon blends available for targeted control of difficult contaminants
- Maximized chemical media surface area and consistent distribution
- Non-dusting design with carbon media granules bonded to polyester fibers
- Low initial pressure drop

## SAAF™ Extended Surface Filters

### VariCel® RF/C & RF/C+SAAFOxi

*Brochure GPF-1-122*



#### Product Overview

- Offers both particulate and gaseous contaminant removal
- Two types available:
  – Varicel RF/C: removes volatile organic compounds (VOCs), hydrocarbons, and diesel/jet fuel fumes
  – Varicel RF/C+SAAFOxi: removes the above along with $H_2S$, $SO_X$, $NO_X$, and formaldehyde
- Galvanized steel construction withstands the most demanding conditions
- Media pack designed to maximize effectiveness and service life
- Directly replaces existing 12" deep single header filters, adding odor control without requiring new hardware

### VariSorb® XL

*Brochure GPF-1-121*

#### Product Overview

- Highest-activity carbon media for superior indoor air quality (IAQ)
- Effective removal of most common urban contaminants, including $SO_X$, $NO_X$, ozone, and volatile organic compounds (VOCs)
- Small granule carbon ensures a much higher efficiency per pound than media used in deep bed adsorbers
- Carbon media is securely bonded to synthetic fibers, nearly eliminating dusting
- Designed to minimize pressure drop
- Metal-free design will not rust or corrode, and is fully incinerable

### VariSorb® XL15

*Brochure GPF-1-141*

#### Product Overview

- A complete solution to indoor air quality (IAQ) by providing high level filtration of both odors and particulates
- Directly replaces existing 12" deep single header filters, adding odor control and/or upgrading particulate filtration without requiring new hardware
- Highest-activity carbon for most odor/contaminant adsorption
- Minipleat design for low resistance and energy savings, allows for upgrade to chemical filtration without adding resistance
- Higher dust holding capacity (DHC) and higher molecular contaminant efficiency than any similar dual purpose filter produced today
- Lighter weight than any competitive dual purpose filter, for additional savings on operating costs
- Completely incinerable, no metal components
- MERV 15 particulate efficiency

### VariSorb® HC

*Brochure GPF-1-126*

#### Product Overview

- High chemical media content for superior indoor air quality (IAQ)
- Three types of chemical media available to specifically target contaminants and odors:
  – SAAFCarb: removes volatile organic compounds (VOCs), hydrocarbons, and diesel/jet fuel fumes
  – SAAFOxidant: removes $H_2S$, $SO_X$, $NO_X$, and formaldehyde
  – SAAFBlend GP: a 50/50 blend of the above for wide spectrum air quality control
- V-bank design minimizes pressure drop
- Honeycomb design with fine mesh to retain the media
- Metal-free design will not rust or corrode, and is fully incinerable

## SAAF™ Cassettes

*Brochures GPF-1-111, GPF-1-109, and GPF-1-108*

### Product Overview

- Media: Various application-specific options (see page 6 for media options)
- Frame: High-impact polystyrene
- Available in heavy-duty, medium-duty, and cleanroom-grade models in 12-18" depths
- Available in 1" and 3" media bed depths with 0.5 -1.0 $ft^3$ of media per cassette
- UL Classified
- Works with SAAF Front Access Housings (see page 10) to optimize media life and prevent contaminant bypass

## HEGA Filters

Originally developed to protect the military from toxic gases, high-efficiency gas adsorbers (HEGAs) are to gas-phase filtration as HEPA filters are to particulate filtration. These adsorbers are typically used in containment systems where high-removal efficiency of dangerous gaseous contaminants is required.

To be called a HEGA, an adsorber must exhibit a minimum contaminant removal efficiency of 99.9% when tested in accordance with the Recommended Practice (RP) of the Institute of Environmental Sciences and Technology (IEST) as outlined in IEST-RP-CC008.2. In addition, the adsorber must be designed, built, and packaged in accordance with the intent of the standard.

It is highly recommended that a HEGA be installed in a housing from the same manufacturer that is specifically designed for sealing and servicing them. Depending on the contaminants that the HEGA will be adsorbing, careful consideration should also be given to whether the housing containing the HEGA is required to be a bag-in/bag-out type of housing to protect personnel when replacing the HEGA.

### HEGA Filter Type IV – Cinersorb

*Brochure CSP-3-108*

#### Product Overview

- Polystyrene frame allows for disposal by incineration
- 99.9% mechanical efficiency when tested in accordance with IES-RP-CC-008
- Weighs 40-50% less than metal-framed adsorbers
- Common application is for high-efficiency removal of gaseous contaminants from nuclear, biological, and/or chemical process exhaust air
- Designed, manufactured, and tested under a Quality Assurance program meeting the requirements of ASME NQA-1
- Test reports accompany the filter (copies available on request)
- Activated impregnated carbon media meets requirements of Article FF-5000 or ASME/ANSI AG-1

### HEGA Filter Type IV-Stainless Steel

*Brochure CSP-3-108*

#### Product Overview

- 99.9% mechanical efficiency when tested in accordance with IES-RP-CC-008
- Common application is for high-efficiency removal of gaseous contaminants from nuclear, biological, and/or chemical process exhaust air
- V-bank configuration allows high airflow at low pressure drop
- Designed, manufactured, and tested under a Quality Assurance program meeting the requirements of ASME NQA-1
- Test reports accompany the filter (copies available on request)
- Activated impregnated carbon media meets requirements of Article FF-5000 or ASME/ANSI AG-1

## SAAF™ Equipment

### SAAF™ Front Access Housings (FAH)

*Brochure GPF-1-115*

**Product Overview**

- Combines particulate filters and gas-phase cassettes to create a total clean air solution
- Stand-alone system can be easily incorporated into new and existing air handling units
- Patented SAAF™ Seal sealing system design and manufacturing process patents covered under US 7,588,629 B2

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### SAAF™ PORTA-Scrubber

*Brochure GPF-1-120*


**Product Overview**

- Units available as powered and non-powered
- Ideal for a wide variety of applications
- Suitable for outdoor installation
- Compact design is space-efficient while reducing capital and installation costs
- Quick, easy installation and operation in a self-contained system—virtually maintenance-free
- Corrosion-resistant, cast aluminum fan
- Designed to remove gaseous and particulate contaminants from the airstream in the most demanding applications
- Ultra-high-capacity SAAFCarb™ MA.HT chemical media provides complete contaminant removal and longer service life than conventional scrubber media currently available

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### SAAF™ Air Purification Systems: Pressurization and Recirculation Unit (PRU) and Recirculation Unit (RU)

*Brochure GPF-1-107*

**Product Overview**

- Recirculate, clean, and pressurize the air in a controlled environment
- Ideal for a wide variety of applications
- Insulated double-wall construction provides whisper-quiet operation
- Compact design is space-efficient while reducing capital and installation costs
- Quick, easy installation and operation in a self-contained system—virtually maintenance-free
- Corrosion-resistant, cast aluminum fan with EC motor and for variable fan speed
- Designed to remove gaseous and particulate contaminants from the airstream in the most demanding applications

## SAAF™ Side Access Housings (SAH)

*Brochure GPF-1-106*

### Product Overview

- Combines particulate filters, gas-phase cassettes, and high-efficiency filters to create a total clean air solution (removing both airborne particulate and gaseous contaminants)
- Patented SAAF™ Seal sealing system design and manufacturing process patents covered under US 7,588,629 B2
- Wide range of sizes and combinations of filter banks
- Available with internal fan
- Available in single-wall or double-wall construction
- Allows for easy installation, operation, and maintenance in a totally self-contained system

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## SAAF™ Machine Intake Filter (MIF)

*Brochure GPF-1-117*

### Product Overview

- Specifically designed for machine air intakes within hostile air quality environments, such as industrial manufacturing facilities, mining, smelting, petrochemical, and pulp and paper processing
- Combines decades of AAF air filtration expertise in gas turbine and complex machine air intakes
- Incorporates AAF low pressure drop, enhanced performance air filtration technologies for high-efficiency, high-capacity, maintenance-effective solutions
- Patented SAAF™ Seal sealing system design and manufacturing process patents covered under US 7,588,629 B2

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## SAAF™ Deep Bed Scrubber (DBS)

*Brochure GPF-1-128*

### Product Overview

- Combines AAF's particulate and gas-phase technologies for an AAF Total Filtration Solution
- Provides highest chemical media-to-air ratio for heavily polluted environments that require air quality guarantees and optimal cost of ownership
- Available with internal fan: wide range of sizes and combination of AAF Filtration technologies
- Offers the best flexibility and control to adapt to changes in the environment

## SAAF™ Environmental Monitoring

### SAAFShield® Technology

SAAFShield Technology allows users to protect expensive electronics and priceless works of art by monitoring the level of corrosive gases. The SAAFShield Detecting Unit works together with either the SAAFShield Reading Unit or SAAFShield Communications Module to display and trend corrosion data, in real time or on a periodic basis, so users can evaluate operational procedures, environmental factors, or other items to identify threats to sensitive equipment and materials.

*Brochure GPF-1-140*


*SAAFShield® Detecting Unit, SAAFShield® Reading Unit, and SAAFShield® Communications Module*

### SAAF™ Reactivity Monitoring Coupons

Reactivity monitoring coupons (RMCs) function by reacting with environmental conditions. Laboratory analysis of the corrosion that forms on the specially prepared copper and silver strips (coupons) provides an excellent indication of the type and amount of gaseous contamination present in the environment, allowing the user to find a solution tailored to the specific conditions present.

*Brochure GPF-1-129*


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### Remaining Life Analysis

Remaining life analysis is a service that determines the remaining capacity of chemical filtration media that is installed in filtration systems. The information obtained from this testing can be used to confirm system performance, determine the media replacement schedule, and assist with inventory control of replacement media. Replacing media based on testing maximizes the media life, reducing the total cost of system ownership.

*Brochure GPF-1-133*

# Gas-Phase Standards

As the methods and uses of gas-phase air-cleaning grew and diversified, the air filtration industry recognized the need to establish standards for measuring performance and efficiency within gas-phase applications. The table below provides at-a-glance information on some of these standards that are commonly used.

| Standard | Purpose | Conditions |
|---|---|---|
| **ASHRAE Standard 145.1**<br>Laboratory Test Method for Assessing the Performance of Gas-Phase Air Cleaning Systems: Loose Granular Media (ANSI Approved) | Compare gas-phase media options | Elevated gas challenge concentrations that exceed those in typical applications |
| **ASHRAE Standard 145.2**<br>Laboratory Test Method for Assessing the Performance of Gas-Phase Air Cleaning Systems: Air Cleaning Devices | Compare gas-phase device options | Elevated gas challenge concentrations that exceed those in typical applications but mimic the mix of contaminants and/or gases in these applications |
| **ASHRAE Guideline 27P**<br>Measurement Procedures for Gaseous Contaminants in Commercial Buildings | Plan and implement measurement and sampling of gaseous contaminants | Actual conditions in live commercial building applications |
| **ASTM D6646**<br>Standard Test Method for Determination of the Accelerated Hydrogen Sulfide Breakthrough Capacity of Granular and Pelletized Activated Carbon | Establish relative breakthrough performance of activated carbon in granular or pelletized form in terms of removal of hydrogen sulfide | Elevated challenge concentration and humidified gas stream that does not simulate actual conditions in typical applications |
| **ISO 10121-1**<br>Test methods for assessing the performance of gas-phase air cleaning media and devices for general ventilation — Part 2: Gas-phase air cleaning devices (GPACD) | Compare gas-phase device options | Elevated gas challenge concentrations that exceed those in typical applications |
| **ISO 10121-2**<br>Test methods for assessing the performance of gas-phase air cleaning media and devices for general ventilation — Part 2: Gas-phase air cleaning devices (GPACD) | Compare gas-phase device options | Elevated gas challenge concentrations that exceed those in typical applications |
| **IEST-RP-CC008**<br>Design Considerations for Airborne Molecular Contamination Filtration Systems in Cleanrooms and Other Controlled Environments | Specify suggested design and testing of modular gas-phase adsorber cells in single-pass or recirculating air cleaning systems | Applications that require high-efficiency removal of gaseous contaminants |

*Please refer to the Gas-Phase Testing information in the next section for additional details.*

# Gas-Phase Testing

## ASHRAE Standard 145.1

**Laboratory Test Method for Assessing the Performance of Gas-Phase Air Cleaning Systems: Loose Granular Media (ANSI Approved)**

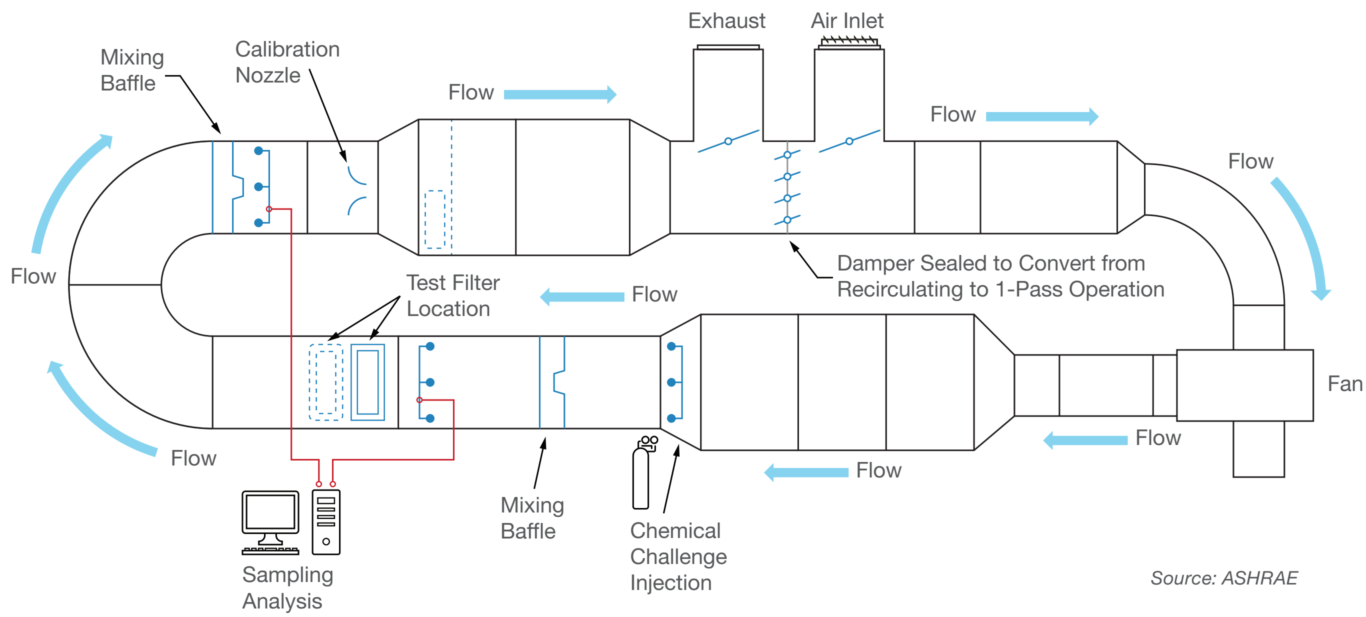
The purpose of this standard is to provide a standard laboratory test method for assessing the performance of loose granular media used in gas-phase air-cleaning systems. The standard details a small-scale laboratory test method for measuring the contaminant removal efficiency of loose granular sorptive media used in gas-phase air-cleaning equipment as installed in a test apparatus in an airstream challenged with test gases under steady-state conditions. The testing is conducted at elevated gas challenge concentrations relative to actual applications, and this testing should therefore be used to compare media rather than directly predict the performance in a particular application.

## ASHRAE Standard 145.2

**Laboratory Test Method for Assessing the Performance of Gas-Phase Air Cleaning Systems: Air Cleaning Devices**

The purpose of this standard is to provide a standard laboratory test method for assessing the performance of in-duct sorptive media gas-phase air-cleaning devices. The standard details a small-scale laboratory test method for measuring the contaminant removal efficiency of loose granular sorptive media used in gas-phase air-cleaning equipment as installed in a test apparatus in an airstream challenged with test gases under steady-state conditions. The testing is conducted at elevated gas challenge concentrations relative to actual applications, and therefore this testing should be used to quantify the performance of air cleaning devices for removing one or more specified gaseous contaminants or gas mixtures intended to simulate operation during service life.

## Laboratory Test Method for Assessing the Performance of Gas-Phase Air-Cleaning Systems: Air Cleaning Devices




*Source: ASHRAE*

## ASHRAE Guideline 27P

**Measurement Procedures for Gaseous Contaminants in Commercial Buildings**

The purpose of this guideline is to assist engineers and other professionals with planning and implementing the measurement and sampling of gaseous contaminants in commercial buildings.

## ASTM D6646

**Standard Test Method for Determination of the Accelerated Hydrogen Sulfide Breakthrough Capacity of Granular and Pelletized Activated Carbon**

This test method is intended to evaluate the performance of virgin, newly impregnated or in-service activated carbon media, in either granular or pelletized form, for the removal of hydrogen sulfide from an air stream, under laboratory test conditions. The method determines the relative breakthrough performance of activated carbon for removing hydrogen sulfide from a humidified gas stream. This test does not simulate actual conditions encountered in an odor control application, and it therefore is meant only to compare the hydrogen sulfide breakthrough capacities of different carbons under the conditions of the laboratory test.

## ISO 10121-1

**Test Method for Assessing the Performance of Gas-Phase Air Cleaning Media and Devices for General Ventilation — Part 1: Gas-Phase Air Cleaning Media**

This standard provides an objective laboratory test method, a suggested apparatus, normative test sections, and normative tests for evaluation of three different solid gas-phase air cleaning media (GPACM) or GPACM configurations for use in gas-phase air cleaning devices intended for general filtration applications.

## ISO 10121-2

**Test methods for assessing the performance of gas-phase air cleaning media and devices for general ventilation — Part 2: Gas-phase air cleaning devices (GPACD)**

This standard provides an objective test method to estimate the performance of any full-size gas filtration device (GPACD) for general filtration regardless of media or technique used in the device. Test apparatus properties and validation tests are specified along with design examples.

## IEST-RP-CC008

**High-Efficiency Gas-Phase Adsorber Cells**

This Recommended Practice (RP) covers the design and testing of modular gas-phase adsorber cells in single-pass or recirculating air-cleaning systems where the need for high-efficiency removal of gaseous contaminants is a requirement.

## IEST-G-CC035

**Design Considerations for Airborne Molecular Contamination Filtration Systems in Cleanrooms and Other Controlled Environments**

This guideline covers areas of concern for filtration systems used to eliminate trace amounts of airborne molecular contamination (AMC) from the air supplied to cleanrooms and other controlled environments. The guideline also establishes the information required to design and implement an effective AMC filtration system.

# Minimum Viable Product

| | VOC Concentration (PPB) | | | | |
|---|---|---|---|---|---|
| | 10 | 25 | 50 | 100 | 1000 |
| AmAir/ CE | 0.9 | 0.4 | 0.2 | 0.1 | 0 |
| AmAir/C 1" | 1.8 | 0.7 | 0.4 | 0.2 | 0 |
| AmAir/C 2" | 2.2 | 0.9 | 0.4 | 0.2 | 0 |
| AmAir/C 4" | 2.6 | 1.1 | 0.5 | 0.3 | 0 |
| VariCel RF/C | 6.8 | 2.7 | 1.3 | 0.7 | 0.1 |
| VariSorb XL | 6.9 | 2.7 | 1.4 | 0.7 | 0.1 |
| VariSorb XL15 | 6.9 | 2.7 | 1.4 | 0.7 | 0.1 |
| VariSorb HC | 24 | 9.7 | 4.8 | 2.4 | 0.2 |
| MD Cassette | 36 | 24 | 24 | 6.1 | 0.6 |
| HD Cassette | 36 | 36 | 36 | 12 | 1.2 |

The *minimum viable product* is usually determined by the customer or end user and is defined as the minimum acceptable service life of the filtration system before the chemical media removal capacity is exhausted. The table to the left demonstrates how there is usually more than one viable product solution for most gas-phase applications. The table shows the expected life in months versus the contaminant challenge for various gas-phase filtration products. The **blue boxes** show acceptable products for roughly a **three-month minimum life,** and the **green boxes** show acceptable products for a **six-month minimum life.** When evaluating a gas-phase application, it's important to understand the most important requirements for that application, such as first cost, replacement cost, ease of replacement, and space available to ensure that the best product value is chosen.

# When to Replace Chemical Media

There are two primary factors that determine if the capacity for removing a contaminant has been consumed in chemical media, thereby requiring a changeout:

**Flux (loading rate) of contaminant into the media.** Flux is determined by the concentration of the contaminant in the airstream, the velocity of the airflow through the media, and the actual capacity of the media to remove the contaminant.

**Working capacity of the media.** Working capacity is determined by the impregnate chemistry and loading, the media size, and the high activity of the type of media.

Once the capacity has been consumed, contaminants pass through the chemical media and into the protected spaces without being removed, effectively flooding the protected space with contaminated air. Replacing the chemical media does not reverse damage done to systems by contaminated air.

The most common reasons to replace chemical media include:

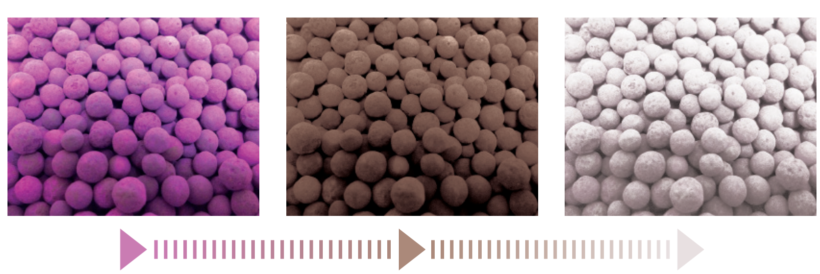
- The working capacity of the media has been depleted
- The outlet contaminant concentration has exceeded specified limits
- The media has become contaminated or obstructed due to poor particulate filtration
- There was a known catastrophic contaminant release
- The contaminant odor has returned

If all the contaminants and their concentrations are known, then the expected life of the chemical media can be estimated based on the working capacity of the media being utilized. Without this information, the best way to determine the remaining media life is to test the media every three to six months for remaining life. For filters containing chemical media, the only way to test the media is a destructive test of the filter. For any filtration device containing bulk media, a sample of media can be extracted and sent off for testing. Ensure that you replace the extracted media with new media to prevent air bypass and also ensure that future media extraction does not include the new media replaced the old media.

For many non-critical control applications, once the media replacement cycle has been determined from testing, no further testing is required unless it is required for internal verification.

A less scientific method of determining the media life in odor control applications is to replace the media once the odor returns. This can be somewhat subjective, but it is a valid technique for determining when there is contaminant breakthrough in the media. It does not, however, provide for timely replacement of the media unless a complete changeout is kept on site.

For activated carbon, the color of the media does not change over time. *For potassium permanganate impregnated alumina, the color of the media will change from deep purple, to brown, and finally to white as the chemical impregnant is consumed. The chemical media should be replaced while it is still brown and prior to it turning completely white.*



## AAF International Plant Locations

AAF, the world's largest manufacturer of air filtration solutions, operates production, warehousing and distribution facilities in 22 countries across four continents. With its global headquarters in Louisville, Kentucky, AAF is committed to protecting people, processes and systems through the development and manufacturing of the highest quality air filters, filtration equipment, and associated housing and hardware available today.

Contact your local AAF representative for a complete list of Air Filtration Product Solutions.

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