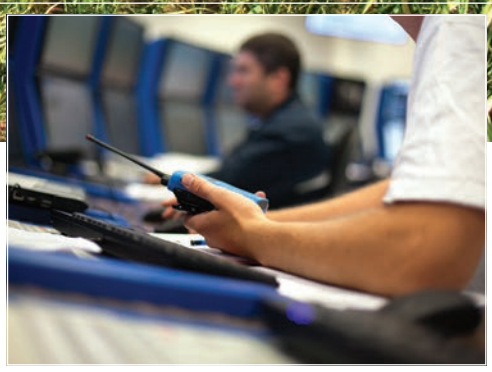
THE WORLD LEADER IN CLEAN AIR SOLUTIONS



Corrosion Control for Control Rooms & Process Control Environments

AIRBORNE PARTICULATE AND GASEOUS CONTAMINANT SOLUTIONS

AAF® INTERNATIONAL

BETTER AIR IS OUR BUSINESS®

Corrosion Control - Control Rooms & Process Control Environments

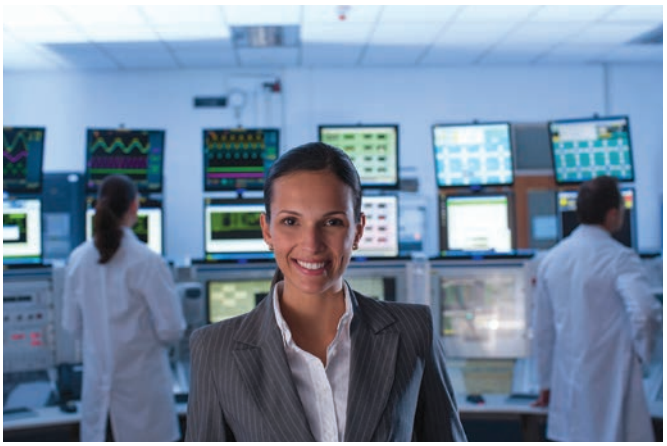
AAF® International understands the need to provide gas-phase and particulate filtration systems for process control environments. Employing such systems can:

- **Eliminate process shutdown due to control equipment failures**
- **Maintain high process efficiency**
- **Extend circuit board life and reduce replacement cost**

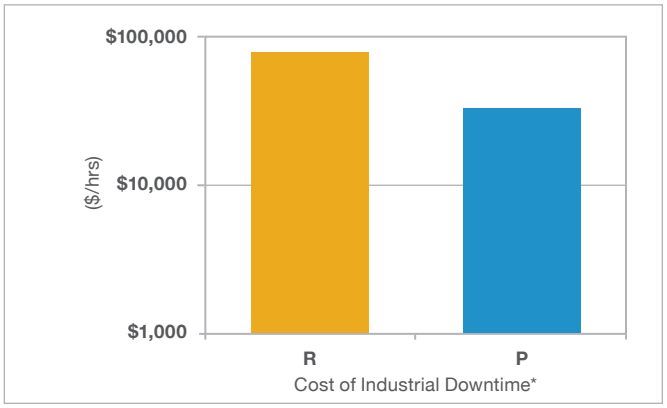
Control rooms are utilized by large scale industrial plants to monitor and control plant operations. Examples of such plants are geothermal power plants, petrochemical refineries, and pulp and paper plants. The control room and network of control equipment are essential to plant operation and enable the plant to maintain the highest efficiency possible. If the control room malfunctions, it can cost a plant tens of thousands of dollars per hour (see Cost of Industrial Downtime chart).

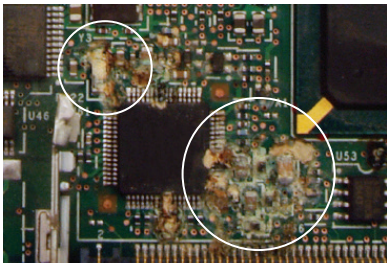
Corrosive gases in industrial environments (ammonia, chlorine, hydrogen sulfide, mercaptans, nitrogen oxides, sulfur oxides) can cause corrosion of control equipment circuitry as shown in the circuit board picture. Corrosion products form random circuit paths and nonconductive layers which result in false signals and loss of process control.

In response to these problems, ISA (Instrumentation, Systems, and Automation Society) developed a standard to classify control rooms and process control environments – ISA 71.04. Most equipment manufacturers require that the control room environment meet the ISA G1 - Mild classification to maintain a reliable communication network in industrial environments (see ISA classification scheme below). The only way to meet this requirement in many industrial environments is to protect the control room with gas-phase and particulate filtration.



Control Room





Corrosion Formed on Circuit Board Components

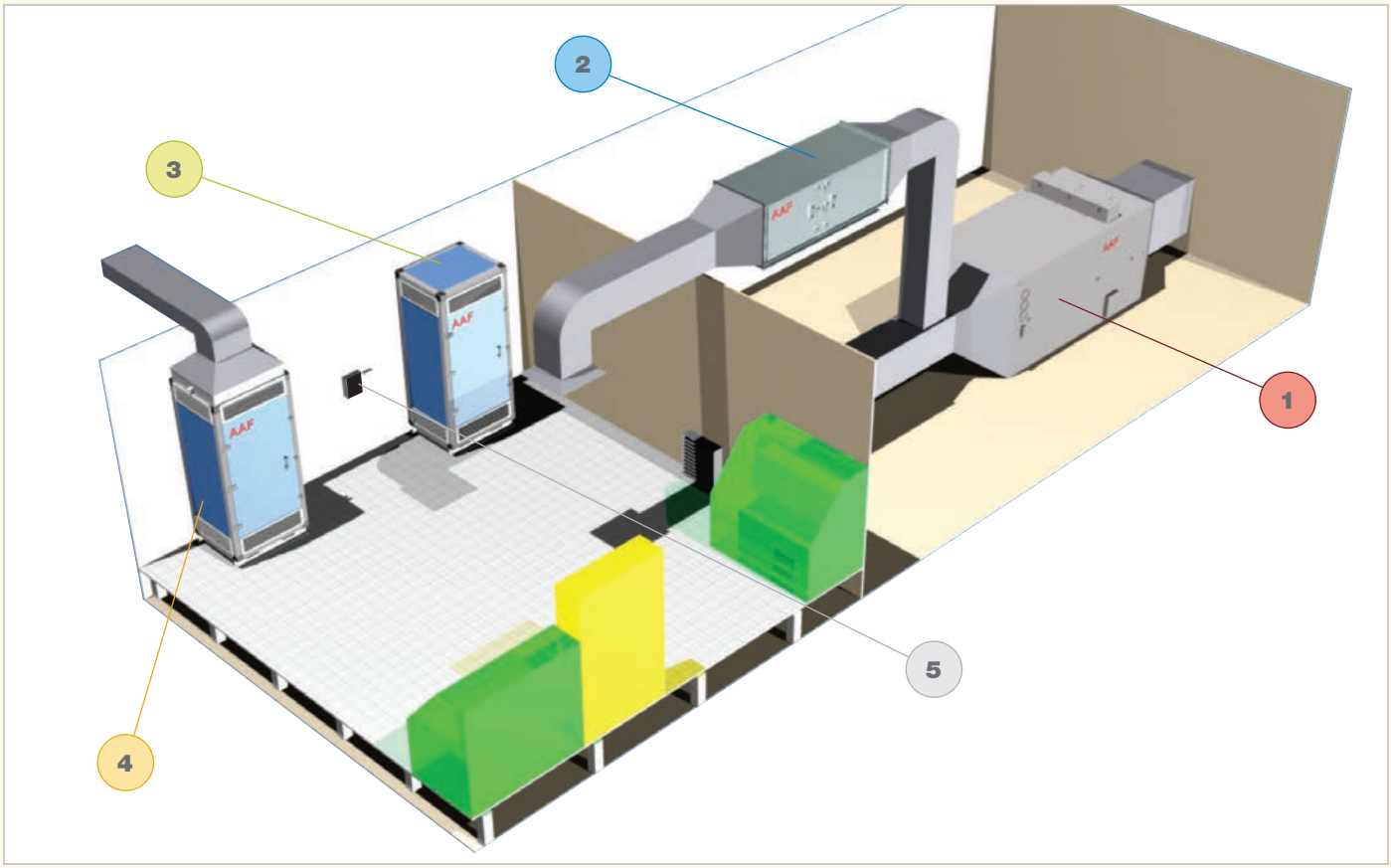
ISA-71.04-2013 Classification Scheme

Classification	Copper Angstroms /30 days	Silver Angstroms /30 days	Reliability Statement Summary
G1 Mild	< 300	< 200	Sufficiently well controlled
G2 Moderate	< 1000	< 1000	Effects of corrosion are measurable
G3 Harsh	< 2000	< 2000	High probability that corrosive attack will occur
GX Severe	≥ 2000	≥ 2000	Only specially designed and packaged equipment would be expected to survive

*R = Refinery; P = Pulp and Paper Mill; Assumptions - European styrene production; 446,000 tons/yr; 24/7 operation; $1,335/ton. 4.78 M tonnes of pulp / 46 days; 24/7 operation; Pulp price of $590/ton.

Filtration Options for Control Room & Process Control Environments

Protection of an industrial control room includes at a minimum pressurization with purified air. This prevents corrosive gases from infiltrating the control room and causing corrosion problems. Additionally, recirculation air may require cleaning if the room is a high traffic area or there are other internal sources of contaminants. The following diagram displays typical methods of accomplishing these filtration goals, as well as monitoring the condition of air inside the space.



1 SAAF™ Deep Bed Scrubber

Filters the fresh air inlet of the HVAC system and pressurizes the control room with purified air.

2 SAAF™ Side Access Housing

Filters the recirculation airstream of the HVAC system and removes contaminants from personnel, events such as opening the control room doors, or other internal sources.

3 SAAF™ Recirculation Unit

Draws air directly from the control room and returns the purified air directly to the control room. It removes contaminants from personnel, events such as opening the control room doors, or other internal sources.

4 SAAF™ Pressurization and Recirculation Room Air System

Draws in both outdoor air and room air providing a purified air stream of mixed out-door and room air. The outdoor air portion pressurizes the control room and prevents contaminants from infiltrating the space.

5 SAAF™ Reactivity Monitor

Reactivity Monitoring Coupons (RMCs) or SAAFShield® Technology Unit monitor air quality within the space to provide the resulting ISA classification. Many times temperature and RH are also monitored at this location.

1 SAAF™ Deep Bed Systems

SAAF Deep Bed Systems are suitable for the most challenging applications where heavy particulate and gaseous contaminant loading is anticipated. These systems are workhorses and provide the largest media volume holding capacity and air-to-media ratios. Systems can be combined with AAF's patented technologies to provide air free of particulates and problem gases. SAAF Deep Bed Systems are available as Deep Bed Scrubbers and Deep Bed Adsorbers.

SAAF™ Deep Bed Scrubbers

Features

- Adjustable bed depths
- Chemical and particulate filters included
- FRP, stainless steel 316, 304, or CRS with epoxy coating construction
- Horizontal airflow
- Multiple sample ports for air quality and media bed usage analysis
- Rugged, heavy-duty, industrial construction
- Single-wall or double-wall insulated options available
- Wide range of custom sizes
- 100% fan redundancy and back-up capability

Brochure GPF-1-105

Also available SAAF™ Deep Bed Absorbers
Brochure GPF-1-105

2 SAAF™ Side Access Housings

SAAF Side Access Housings are designed to support chemical media cassettes, prefilters, after-filters, and high efficiency particulate filters in one self-contained unit for the removal of gas-phase contaminants and airborne particulate. Housings offer the advantages of a conventional side access housing and maximum flexibility in the selection of chemical media and gas phase filter elements to remove contaminants from the air.

SAAF™ Side Access Housings

Features

- Combines particulate filters, gas-phase cassettes, and high efficiency filters to create total clean air solutions
- Easy installation, operation, and maintenance in a totally self-contained system
- Insulated, double-wall construction and subsequent quiet operation
- Internal fan option
- Patent-pending SAAF™ Seal provides the best seal available and superior filtration efficiency
- Stainless steel, painted steel, aluminum, or corrosion resistant Galvalume®
- Wide range of sizes and combinations of housings and filter banks

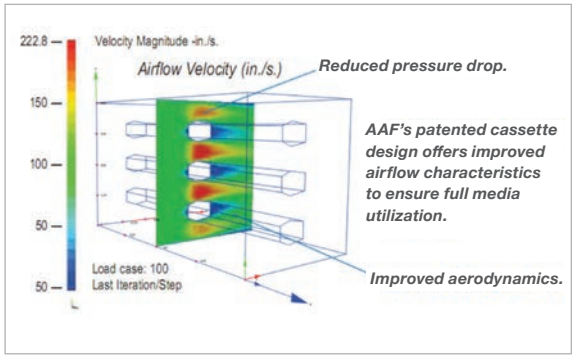
Brochure GPF-1-106

SAAF™ Innovative Gas Phase Cassettes

Features

- Cassette-to-Cassette Mating Seals - Smooth mating end panels with no penetrations or outward turned flanges allow excellent cassette-to-cassette sealing.
- Filled cassettes rated UL Classified
- No-glue design eliminates problems of off-gassing, bypass, and leakages.
- SAAF-T-Butterfly Seal and SAAF-T-Groove - Designs provide near absolute sealing, even in existing retrofit applications.
- SAAF-T-Screens - Patent pending. Precision engineering allow optimized apertures for better energy efficiency through improved aerodynamics and reduced pressure drop.
- SAAF-T-Seal - Patent pending plastic rivets secure the solid fill caps at multiple points and secure against bursts or leaks in normal usage.
- SAAF-T-Track - System utilizes the SAAF-T-Groove feature and provides a compression fit that eliminates by-pass.
- SAAF-V - Patent pending enhanced media utilization design eliminates the “nose cavity” typically created by legacy cassettes.

Brochures GPF-1-108; GPF-1-109; GPF-1-111



3 4 SAAF™ Air Purification Systems

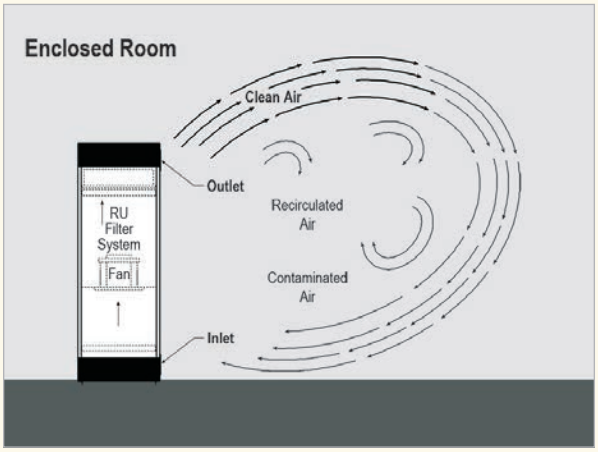
SAAF Air Purification Systems are stand-alone, multi-stage systems designed to remove particulate and gaseous contaminants from confined spaces, while reducing the amount of outside air needed to dilute contaminants. All units are double-wall insulated construction to reduce noise and thermal transfer.

SAAF™ Recirculation Unit and SAAF™ Pressurization and Recirculation Unit

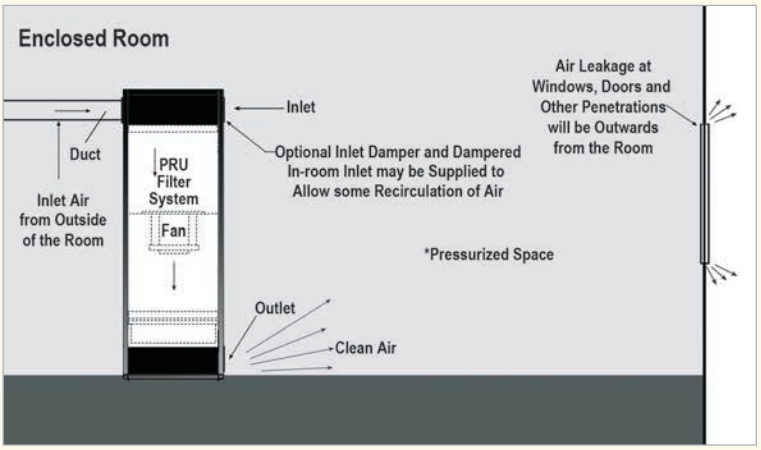
Features

- Combines particulate filters, gas-phase cassettes, and high efficiency filters to create total clean air solutions.
- Easy installation, operation, and maintenance in a totally self-contained system.
- Insulated double-wall construction provides whisper-quite operation
- Internal fan and wide range of filter sizes and combinations to meet specific requirements.
- Patent-pending SAAF™ Seal provides the best seal available and superior filtration efficiency
- Recirculation Unit or Pressurization and Recirculation Unit
- Stand-alone complete air purification systems; excellent for quick retrofit solutions

Brochure GPF-1-107



SAAF:RU *draws contaminated air from a contained space; cleans the air, and then returns the cleaned air back into the space.*



SAAF:PRU *pressurizes the space by drawing air from outside the space. After cleaning the air, the unit discharges the cleaned air to the space, preventing infiltration of outside contaminants.*

5 Air Quality Assessments

SAAF laboratories and tools allow clients to assess control room air quality as well as evaluate the performance of the gas-phase filtration systems. These include Reactivity Monitoring Coupons to assess air reactivity over a 30 day period, and the Environmental Condition Monitor to assess air reactivity in real time. All tests are carried out and correlated to applicable industry standards.

Reactivity Monitoring Coupons (RMCs)

Reactivity Monitoring Coupons (RMCs) provide the ISA Classification of an environment or information on the performance of a gas-phase filtration system during a 30 day exposure. Results relate directly to the ISA 71.04 classifications of G1-Mild through GX-Severe.

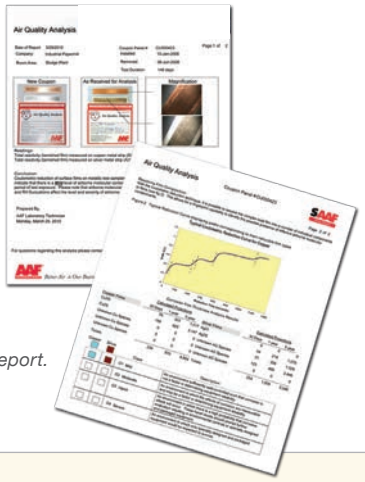
RMCs can indicate the presence of gas types, because different gas types will form different corrosion films. From these film types and the film thicknesses, the corrosive environment is classified and gas concentration ranges can be estimated.

There are two types of coupons available, metal coated glass coupons and full metal coupons. The metal coated glass coupons are ideal for environments with lower concentrations of corrosive gases, while the full metal coupons are ideal for applications involving higher concentrations of corrosive gases (fresh air intakes at industrial facilities, industrial site surveys directly exposed to outdoor air).

Brochures GPF-1-129

Metal Coated Glass Coupons

Full Metal Coupons



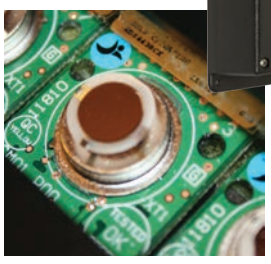
SAAF™ Reactivity Monitoring Coupon Report.

SAAFShield®

SAAFShield technology allows users to take immediate action to protect expensive electronics and priceless works of art by monitoring corrosion in real-time or on a periodic basis to determine equipment or material vulnerability to corrosion. The SAAFShield Detecting Unit works together with either the SAAFShield Reading Unit or the SAAFShield Communications Module to display and trend corrosion data over time, which allows users to evaluate operational procedures, environmental factors, or other items that occur at specific times for their impact on sensitive materials.

Brochure GPF-1-140

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



The SAAFShield® Detecting Unit utilizes quartz crystal microbalance to measure the corrosion of metal due to reactions with the environment.

Corrosion Control for Control Rooms and Process Control Environments

SAAF™ Chemical Media

Protection of an industrial control room includes at a minimum pressurization with purified air. This prevents corrosive gases from infiltrating the control room and causing corrosion problems. Additionally, recirculation air may require cleaning if the room is a high traffic area or there are other internal sources of contaminants. The following diagram displays typical methods of accomplishing these filtration goals, as well as monitoring the condition of air inside the space.

Brochure GPF-1-103

SAAF™ Media for Control Room & Process Control Environment Applications

		ammonia	chlorine	hydrocarbons	hydrogen sulfide	mercaptans	nitrogen dioxide	sulfur dioxide	VOCs
	SAAFBlend™ GP		✔	✔	✔	✔	✔	✔	✔
	SAAFBlend™ GP SC		✔	✔	✔	✔	✔	✔	✔
	SAAFCarb™		✔	✔		✔	✔		✔
	SAAFCarb™ MA		✔		✔	✔	✔	✔	
	SAAFCarb™ MA.HT		✔	✔	✔	✔	✔	✔	✔
	SAAFCarb™ MB	✔							
	SAAFOxidant™				✔			✔	
	SAAFOxidant™ SC				✔			✔	

Media Remaining Life Analysis

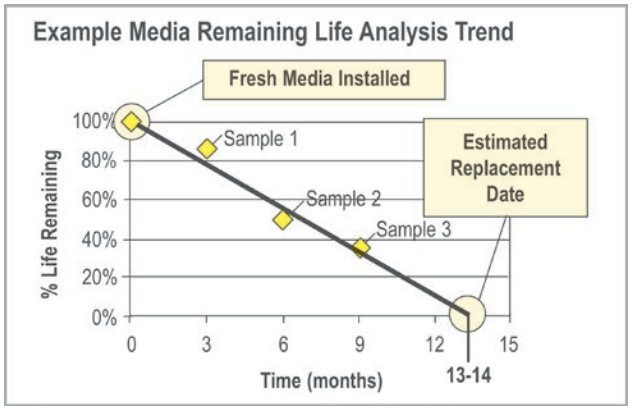
As a service to its customers, AAF offers remaining life testing services of chemical media. This information can be used to determine the characteristics of an existing filter system, system adequacy, filter replacement schedules, replacement filter ordering schedules, and filter inventory requirements.

Media Sampling and Frequency

Media life analysis requires a sample of media to be sent to a SAAF Laboratory. This media is tested according to applicable industry or AAF internal methods to determine the remaining capacity of the media. The best way to estimate a media replacement date using media remaining life analysis is by trending the results over time. This requires the establishment of a media sampling schedule. One conservative method is to sample the media every quarter during the first year and develop a history of media life analysis.

Remaining Life Data Analysis

As an example, this graph displays 9 months of remaining life analysis results from a gas-phase filtration system. It shows that the end user installed fresh media at time zero. The end user sampled the media after 3 months of service. At the 3 month period, the media had 85% of its original life. The end user sampled the media again after 6 months of service. At the 6 month period, the media had 50% of its original life. The end user sampled the media again after 9 months of service. At the 9 month period, the media had 35% of its original life. Using this data to extrapolate a replacement date points to the 13-14 month period as the end of life. This information can be used to help end users budget for and schedule media replacement.



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