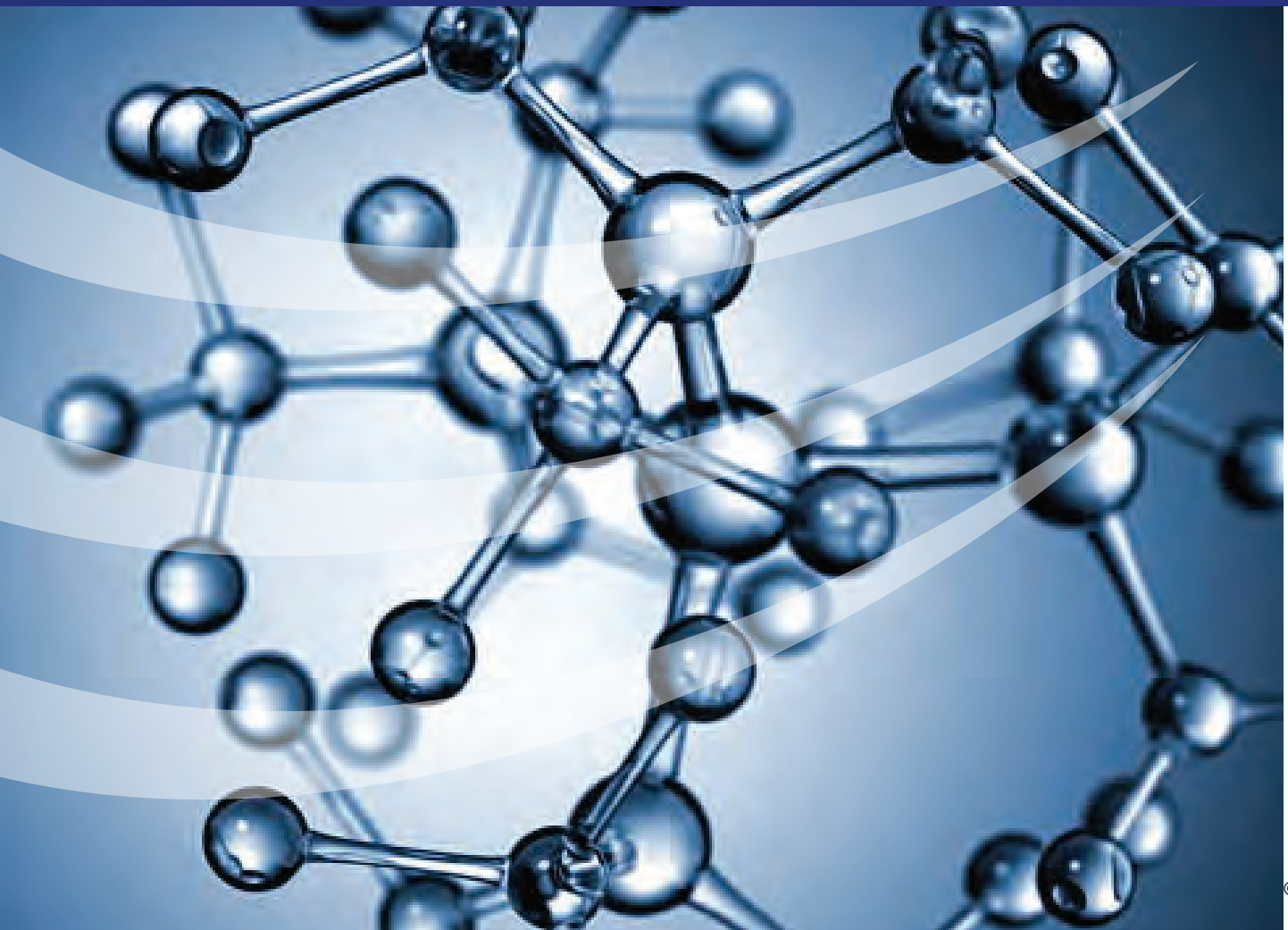
NAFA®
National Air
Filtration
Association

Guidelines

Recommended Practices for

Filtration for Molecular Filtration



About this publication

Why NAFA Guidelines?
The National Air Filtration Association (NAFA) provides "Best Practice Guidelines" to help supplement existing information on the control and cleaning of air through proper filtration. Many organizations recommend "minimum" air cleaning levels. NAFA publishes best practice based on the experience and expertise of our membership along with information and research of the governmental, medical and scientific communities showing the short and long term impact particulate and molecular contaminants have on human health and productivity.

This Guideline provides advice on achieving the cleanest air possible based on the design limits of existing HVAC equipment and with consideration of the impact on energy and the environment. For a more complete explanation of principles and techniques found in this Guideline, go to the website www.nafahq.org and purchase the *NAFA Guide to Air Filtration*, 5th Edition.

Disclaimer
The information contained in this Guideline is intended for reference purposes only. NAFA has used its best efforts to assure the accuracy of information and industry practice. NAFA encourages the user to work with a NAFA Certified Air Filter Specialist (CAFS), to assure that these Guidelines address specific user equipment and facility needs.

Issues regarding health information may be superseded by new developments in the field of industrial hygiene. Users are therefore advised to regard these recommendations as general guidelines and to determine whether new information is available.

NAFA does not guarantee, certify or assure the performance of any products (other than those bearing the NAFA Certified Product label), components, or systems operated in accordance with NAFA Guidelines.

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Filtration for Molecular Filtration

Purpose
This best practice guideline is designed to provide a general overview of how best to apply molecular filtration in HVAC applications where the need to remove gaseous airborne contaminants exists.

Scope
This guideline will provide the end user or facility engineer the guidelines to the type of information required to help properly choose the best system for their needs. The NAFA Guide to Air Filtration 5th edition Chapter 11 offers more in depth detail for applying Molecular Filtration. This guideline is meant to be a general overview.

Background
It is well known that molecular filtration is necessary in many commercial and industrial applications. Some of the more common applications include, but are not limited to, hospitals, airports, semiconductor facilities, pharmacies, laboratories, restaurants, waste water treatment facilities, pulp and paper mills, and refineries. These applications generate contaminants that need to be removed. In addition many office buildings have a need for molecular filtration as a result of contaminants brought in from outside air, and contaminants generated within the space. It is important to note that each application is different and unique; however there are some general principles that can be applied to help begin the process of determining the best molecular filtration option.

NAFA Best Practice Recommendations
Since this is not application specific there are no best practice filtration recommendations. What is offered is a list of several questions that should be answered prior to choosing a molecular filtration system. These can be applied to all applications:

Contaminant(s)
It is always best to know the contaminants and the levels to ensure that the proper molecular filtration media is used, if specific contaminant information is not available, identification of the source can often be helpful, for example hair salon, vehicle exhaust, restaurant exhaust, and perhaps building renovation. With that information the manufacturer, has a general idea of the contaminants associated with these applications and can make a recommendation on the best media. At the end of this section there is a brief table outlining the media and the contaminants that they are capable of removing. Keep in mind, when using this table that there are several other factors listed below that can affect how well this media will perform.

Air volume and air velocity
In order to ensure that the molecular filtration media can remove the contaminants it must have enough residence time. In most cases molecular filters have been designed to provide the proper residence time when operating at the same velocity that your particulate filter operates.

Temperature and humidity
Since molecular filtration media can be adversely affected by these, it is always recommended that this information be made available.

Having these three items above is the first step in a molecular filter system design.

Molecular filters come in many different sizes, shapes, efficiencies, and capacities. Selection of the proper filter depends upon several factors. These include pressure drop restraints, amount of room in the HVAC system, the desired efficiency, and the desired capacity or life of the filter. It is also important to understand whether this is a single pass or is it recirculated air where a filter may have more than one chance to capture the contaminants, as you can see these items are not just application dependent, they are unique to the given building. Below is a general guideline for using different types of filters.

For general nuisance odors, without health-related or safety problems, a low efficiency molecular filter in a recirculating system is generally acceptable. These are easily retrofitted into standard filter tracks and can be very cost-effective. If the level of contaminant is high enough or generated with enough frequency, molecular filters from 4" to 12" inches in depth are generally required to provide sufficient life and efficiency.

Single pass systems such as cleaning exhaust air or cleaning intake air where the molecular filter has only one chance to remove the contaminants, a filter with a higher efficiency is generally recommended. Disposable and refillable V bank filters are often recommended in these applications.

Critical applications, where the health and well-being of occupants are concerned, will generally require a much higher efficiency filtration system. This can be achieved in several ways, generally with filters a minimum of 12 inches in depth and often times with the use of side or front access housings.

With this information in hand, the manufacturer will be able to recommend a best practice molecular filtration system for your particular application. To see an actual best practice recommendation for an application NAFA has a "best practice guide" on museums, libraries and archives that goes into detail on both particulate and molecular filtration.

Examples of these different types of filters can be seen in the NAFA Guide to Air Filtration 5th edition Chapter 11.

Table 1 shows the most common types of media used along with the contaminants it is capable of removing and some typical applications.

Media Type	Contaminant	Typical Application
Activated Carbon*	Molecular weights >50 Boiling points over 120F	Paint spray booths Ozone non-attainment areas Cafeterias
Permanganate Impregnated Media	Formaldehyde Acid Gases (H_2S and $S0_2$)	New buildings Waste water treatment facilities
Base Impregnated Carbon	Acid Gases (H_2S and $S0_2$)	Waste water treatment Pulp and paper mills Semiconductor facilities
Acid Impregnated Carbon	Ammonia Amines	Pet kennels Semiconductor facilities Nursing homes
Sulfur Impregnated Carbon	Mercury	Dental offices Fluorescent light bulb recycling facilities

Activated carbon can often be regenerated which helps to avoid cost of disposal. Activated Carbon blended with Permanganate cannot be regenerated. This is often taken into consideration when using large amounts of media. Separate beds of media may reduce cost in the long run. Your local manufacturer can offer assistance in determining if your media can be recycled.

Table 2 shows some typical applications and the potential contaminant source. An abbreviated list of some of the chemical compounds associated with the source is also included. It is important to note that this is not a complete list but a guide to show some of the contaminants you may be trying to remove in these various applications.

Application	Potential Contaminant Source	Contaminant
Airports	Fuel exhaust	Aldehydes Carbon Monoxide Hydrocarbons Oxides of Nitrogen Oxides of Sulfur Organic Acids
Hospitals/helipad	Fuel exhaust	Aldehydes Carbon Monoxide Hydrocarbons Oxides of Nitrogen Oxides of Sulfur Organic Acids
Schools	Laboratories/outside air**/cleaning material	Formaldehyde & other Laboratory reagents, Sulfur Gases, Ozone , Nitrogen Dioxide, ammonia
Commercial buildings	Fuel exhaust from loading dock/cleaning supplies/internal restaurant exhaust/ outdoor air	Sulfur gases, Nitrogen Dioxide, Ammonia, Food odors, Ozone Sulfur Dioxide
Museums, libraries & archives	outdoor air	Acid Gases, Ozone
Beauty Parlors/nail Salons	Chemicals used on hair/nail polish and polish remover	Acetone, Ammonia, Methacrylate
Semiconductor facilities	Internally generated contaminants/ outdoor air	Ammonia, Amines, Hydrogen Chloride, Sulfur Dioxide, Ozone
Waste water treatment facilities/ lift stations	Internally generated contaminants	Sulfur Gases
Pulp & paper mills	Internally generated contaminants	Sulfur Gases
Nursing homes	Internally generated contaminants	Ammonia
Dental offices/flourecent recyling facilities	Internally generated contaminants	Mercury

***** Information on acceptable levels of outside air contaminants can be found on the EPA website www.epa.gov/air/criteria.html. The EPA monitors levels of outdoor air contaminants, using this tool can help you determine if you need to clean the outside air coming into your facility.***

Combining the information provided in Tables 1 & 2 will help with the selection of the proper media required for the application.

It is important to note that in many applications a combination or blending of two media is your best option, since most of the time you are dealing with multiple contaminants.

To help finalize your molecular filtration selection contact your local N.A.F.A Certified Air Filter Specialist.

Operation and Maintenance

Installation

NAFA Installation, Operation and Maintenance of Air Filtration Systems, 3rd Ed., 2012, Chapter 9.

Monitoring

Most molecular filters, over time, will not increase in pressure drop. Some particulate media when impregnated with sorbent media could increase in pressure drop, however, it is not indicative of service life of the sorbent. Service life of a molecular filter is a function of types and concentration of contaminants, and filter design. Most manufacturers offer testing services to determine remaining filter service life. It is important to note that as the media life decreases so does the efficiency of the molecular filter. Molecular filters are often recommended for change out before the media is 100% spent.

Disposal

All filters should be disposed of in accordance with local, state and federal regulations. Spent activated carbon media in molecular filters may sometimes be returned to the manufacturer for reactivation. Contact your supplier for information.

Summary

The focus of this guideline is to offer a general overview of the types of media available & the contaminants they remove along with an overview of the types of filters, but most importantly it offers the guidelines as to the information necessary to provide a best practice recommendation for your specific application.

Glossary

H_2S: Hydrogen Sulfide

HVAC: Heating, Ventilating, Air Conditioning

MERV: Minimum Efficiency Reporting Value refers to the lowest efficiency of a filter when tested in accordance with ANSI/ASHRAE Standard 52.2 2012.

NAFA®: registered acronym for the National Air Filtration Association, the trade association for air filter manufacturers and distributors, worldwide.

Pressure Drop: describes the drop in static pressure of the air from the upstream side of a filter to the downstream side.

Residence Time: The time it takes air to cross a distance equal to the thickness of the filter without accounting for the resistance of the media through which it travels.

SO_2: Sulfur Dioxide : Ratio of the airflow to the space volume per unit time, usually expressed in air changes per hour (ACH).

Bibliography

Installation Operation and Maintenance of Air Filtration Systems, 3rd Ed., 2012.

NAFA Guide to Air Filtration, 5th edition, 2014

The source for expertise, education and standards in air filtration.

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