NAFA®
National Air
Filtration
Association

Guidelines

Recommended Practices for Technicians and Contractors Servicing the Residential HVAC Industry

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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 consumption and the environment. For a more complete explanation of principles and techniques found in this Guideline, go to the NAFA website www.nafahq.org and purchase the *NAFA Guide to Air Filtration* and/or the *Installation, Operation and Maintenance of Air Filtration Systems*.

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Issues regarding health information may be superseded by new developments in the field of industrial hygiene.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, components, or systems operated in accordance with NAFA Guidelines.

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Filtration for Technicians and/or Contractors Servicing the Residential HVAC Industry

Purpose

This best practice guideline establishes air filtration for the removal of particulate and gaseous contaminants for the protection of the Heating, Ventilating, and Air Conditioning (HVAC) equipment and components, as well as providing comfort and a healthy environment for the occupants and visitors of a residential property. The recommendations in this guideline are considered by the National Air Filtration Association (NAFA) to be "best practice" in contrast to "minimum standards" as put forth by other organizations. It will help guide qualified HVAC service technicians, manufacturers, contractors, and end users with the necessary information to make an informed decision when procuring, installing, and maintaining filtration products for the residential market.

Scope

This best practice guideline will address filtration products, installation, and maintenance practices for the various air handling systems that are used in the majority of residential properties. It will take into consideration health, comfort, equipment protection and tenant retention as factors involved in the filtration decisions.

For the purpose of this guideline, we will concentrate on single, multi-family, and low-rise multi-family residences. High rise apartments and condominiums are not specifically addressed in this guideline as the HVAC equipment in these buildings tend to be commercial in design and would follow closely the recommendations in NAFA's *Guideline for Commercial Office Spaces*.

Background

The quality of air in a residential building has a significant impact on human health and comfort. Poor indoor air quality (IAQ), as referenced in ASHRAE Std. 62.1-2019: "Ventilation for Acceptable Indoor Air Quality," can lead to discomfort, ill health, and building related illness, making IAQ an important environmental health issue. The number of complaints related to IAQ has increased with the trend towards tighter sealed buildings, energy conservation, the growing use of synthetic materials, the increase in office and home equipment (photocopiers, laser printers, and computers), cleaning products, outdoor air pollution, and not the least, the increased awareness of the public to the symptoms and effects of poor IAQ. Contaminants that present specific problems in residential properties include: plant and animal allergens, gases and odors, bio aerosols (viruses, bacteria, fungal spores), and particulate, specifically below 2.5 micrometers in size ($PM_{2.5}$). Exposure to a high concentration of fine particles in the $PM_{2.5}$ range can cause short term health effects such as eye, nose, throat and lung irritation, coughing, sneezing, runny nose and shortness of breath. Research has shown that long term exposure to $PM_{2.5}$ has been associated with increased rates of chronic bronchitis, asthma, heart disease, reduced lung function and increased mortality. People with breathing and heart problems, children, and the elderly are particularly at risk. $PM_{2.5}$ can be attributed to outdoor sources, specifically the burning of fossil fuels, as well as from indoor activities, such as, smoking, cooking, burning candles, and functioning fireplaces.

Filtration is often expressed as a key component for a healthy indoor environment; however, the only mandatory reference to filtration performance is in ANSI/ASHRAE Standard 62.2-2019 "Ventilation for Acceptable Indoor Air Quality in Residential Buildings:" *"Mechanical systems that supply air to an occupiable space through ductwork exceeding 10 feet in length and through a thermal conditioning component, except evaporative coolers, shall be provided with a filter having a Minimum Efficiency Reporting Value (MERV) 6 or better when tested in accordance with ANSI/ASHRAE Standard 52.2 2017 Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size, or a minimum particle size efficiency of 50% in the 3-10 micron range in accordance with AHRI Standard 680, Performance rating of Residential Air Filter Equipment."*

The Challenge

The minimum filtration level of MERV 6, as referenced in ASHRAE Standard 62.2, does little to address the removal of $PM_{2.5}$ size particulate which is a key component of air quality evaluation in an occupied space. To improve IAQ in residential properties, and to meet NAFA's minimum filtration recommendations, as detailed in this guideline, requires more than replacing the current filter with a higher MERV product. The goal needs to be system performance which will require a synergy of all the HVAC components. In addition to a quality filtration product, the ideal residential system should have a dedicated outside air source supplied directly to the air handler system, filter hardware that will eliminate the chance of air bypassing the filter system, sufficient filter system area and depth to accommodate newer filter technology, fans capable of overcoming the increase in resistance to higher efficient filters, and control features that allow the home occupant the ability to realistically evaluate the condition and service life of the filter based upon pressure differential and the quality of the air supplied to the occupied space. These technologies and concepts are currently available in commercial systems and could quite easily be made available to the residential market. The public demand for improved IAQ in residential properties is there and needs to be embraced by all facets of the HVAC industry.

NAFA Best Practice Recommendations

The residential property of today is often more than just a space for living and more complex than properties of the past. People are spending more time indoors, as well as more time working from the home. Specialized mechanical equipment is required for servicing these situations and the unique activities associated with them. The following mechanical equipment are the most common types found in residential properties.

System Approach

Furnaces

Forced air furnaces are permanently installed appliances that provide heated air through ductwork to interior spaces. The most common heat sources are natural gas, electricity, and heating fuel. A forced air furnace is equipped with a blower/fan that draws air into the heat exchanger through a filter and then distributes heated air through the ductwork to the interior spaces. Additional equipment can be added that enables a forced air furnace to humidify, dehumidify and cool the air. NAFA recommends a MERV 11 or better filter* for residential furnaces. A MERV 11 filtration system will provide an improved removal efficacy of the targeted $PM_{2.5}$ particulate than less efficient traditional products.

Unitary Air Conditioners (UAC)

In forced air systems the same duct work can be used for both heating and cooling. Split system central cooling is the most widely used forced air system. Condensing units are installed on a non-combustible pad outside the dwelling. UAC units are factory-made systems that normally include heat/cool coils, fan, motor, humidification, filtration, and ventilation components. NAFA recommends a MERV 11 or better filter* for residential UAC systems. A MERV 11 filtration system will provide an improved removal efficacy of the targeted $PM_{2.5}$ particulate than less efficient traditional products.

Fan Coil Units

Fan coil units are small unitary systems that provide a combination of heating or cooling to condition a space. The units can sometimes be supplied with outdoor air dampers for ventilation. In a residential space, fan coils are often used to supply conditioned air to the entire property. NAFA recommends a MERV 11 or better filter[1] for residential fan coil systems. A MERV 11 filtration system will provide an improved removal efficacy of the targeted $PM_{2.5}$ particulate than traditional products.

Heat Pumps

Heat pumps for residential applications are normally centrally ducted unitary or split systems. Heat is taken from one source and transferred to another. Heat pumps are capable of heating in the cooler months and cooling in the warmer months. NAFA recommends a MERV 11 or better filter[1] for residential heat pump systems. A MERV 11 filtration system will provide an improved removal efficacy of the targeted $PM_{2.5}$ particulate than traditional products.

Room Air Conditioners, Mini-split System/ Ductless Split System and Room Air Conditioners/Mini-split System/Ductless Split System

These units are often used for single room cooling applications and do not normally have a filter as a component of the system. If a filter is included it is generally a permanent washable filter. Follow the manufacturer's recommended guidelines for filtration and maintenance.

Other forms of heating residential spaces such as radiant heat, hydronic (hot water baseboard), and steam radiant can provide comfortable and controlled heating spaces but do not allow for the introduction of outside air for ventilation, nor are they capable of filtering, humidifying, dehumidifying or cooling the air.

Additional Air Cleaning Device options

To improve air quality in residential spaces consider any of the following air cleaning technologies which can be deployed as stand-alone units.

Ultraviolet Germicidal Irradiation (UVGI) is an air purification system that is gaining popularity in the residential market. Successfully used for years in the commercial and health care industry, UV-C light effectively reduces the transmission of airborne germs, bacteria, mold, viruses, and fungi by disrupting the micro-organism's ability to replicate. UVGI is effective as surface kill on a coil or airborne via an in-duct system. UV lamps are usually installed in the return duct or downstream of coils in the supply duct. For best results, use in combination with a particulate filter.

Gas Phase filtration addresses the need for removal of airborne molecular contaminants (odor/chemicals). This requires a different approach than particulate filtration in that gas phase filters are designed for the removal or elimination of molecular contaminants. Gas phase filters for residential applications might look similar to particulate filters but are quite different in design, specifically the treatment or type of media used in the filter. An example of a gas phase product is a carbon-impregnated filter. Ideally, a gas phase system would still require a particulate filter for protection. A combination particulate and gas phase single filter or dual stage filter system would be necessary. Most residential HVAC systems can only accommodate low pressure drop filters which limits the selection for effective gas phase filters. It is best to contact a NAFA CAFS to help with the selection of the gas phase filtration system.

Room Air Cleaners are self-contained filtration packages incorporating a single, or multi-stage filter system along with a blower/fan to draw in dirty air and disperse filtered air back into the space. Effectiveness of these units relies on the capacity in cubic feet per minute (CFM) of the fan/blower, the quality of the filtration media, and the integrity of the filter holding device. There are a myriad of products on the market making, in many cases, unsubstantiated performance claims. A buyer beware attitude needs to be taken by the consumer.

1. Increasing filter performance can possibly have an adverse effect on system operation as well as increasing energy consumption. Refer to the section "Monitoring of Airflow and Pressure Drop" for additional information and/or consult with a qualified NAFA Certified Air Filter Specialist (CAFS) or HVAC technician.

Electronic Air Cleaners/Electrostatic Precipitators (EAC) are packaged filter systems attached to the furnace duct work. In the first stage, or ionizing section, particles in the airstream are given an electrostatic charge. In the second stage the charged particles are removed from the airstream by oppositely charged collector plates. Electronic air cleaners can be very effective on fine particulate but are prone to the creation of ozone. "Ozone is harmful for health and exposure to ozone creates risk for a variety of symptoms and diseases associated with the respiratory tract" (Koran et al. 1989; Touloumi et al. 1997; Bell et al. 2004). EAC units require diligent maintenance of the ionizing wires and collector plates to maintain performance. EAC units cannot be tested by ANSI/ASHRAE Standard.52.2-2017 and therefore, do not have MERV data associated with performance. For these reasons, NAFA does not recommend the use of EAC units in residential applications.

Installation, Operation and Maintenance

"Evolving complexity and increasing operating costs demand that equipment and systems providing thermal comfort and beneficial IAQ be properly maintained to achieve energy efficiency and building owner's reliability requirements."

- ASHRAE 2019 handbook – HVAC Applications

Installation of Filters and System Integrity

Filtration in the majority of residential applications has not received a level of importance equal to the benefits associated with proper use. As filters increase in efficiency, the importance of the fit of the filter cannot be understated. The recommended MERV 11 filter in this document will not provide MERV 11 system performance if the tracking or holding apparatus does not securely seal the filter in place effectively preventing unfiltered air to bypass the filter. Maintaining the integrity of the filter system is vital for the efficacy of the HVAC system and imperative for air filtration performance, because unfiltered air by-pass is a key contributor to poor IAQ. After each filter installation, the system, including filter frames, fastening devices, caulking, and gaskets must be checked to ensure that there are no possible leaks or gaps in and around the filters. Any repairs must be made at this time. A positively-sealed filtration system will prevent unfiltered air bypass and maintain system integrity.

When changing or modifying the model or design of a filter system, consult the manufacturer's specifications of the air handling system. Consideration must be given for size, fit, media area, airflow rate, and initial and final pressure drop of the new filter system. NAFA further recommends consulting with a mechanical engineer, or HVAC technician, prior to making any modifications to your HVAC system.

Maintenance

Good operating procedure should include a monthly inspection of filters, filter frames, fastening devices, caulking, gaskets and ductwork. Removing and replacing damaged or defective filters, gasket, and duct insulation will keep unfiltered air from bypassing the filter system. As a rule of thumb, filters should be changed based on manufacturers' recommendations, or minimally twice annually, at the beginning of the heating and cooling cycles. Filters often need to be changed more frequently due to outdoor air conditions and/or particulate loads generated in the occupied space. Operating the fan on a continuous basis can also increase the change frequency. Keeping the coils and blower free from dirt and debris by filtration will improve airflow, increase system efficiency, reduce electrical consumption, and maintain overall system integrity. In summary, good maintenance will keep the HVAC system in proper working order and will provide the building with air that is not only conditioned, but also cleaned with a reduction in contaminant levels.

As a supplement to manufacturers' guidelines, see NAFA's *Installation, Operation and Maintenance of Air Filtration Systems Manual.*

Monitoring of Airflow and Pressure Drop

Particulate filters in an HVAC system increase the resistance to the flow of air, gradually reducing the volume of air supplied to the occupied space. This increase in resistance is referred to as "pressure drop" or "differential pressure." A newly installed filter will have an initial pressure drop specific to that product. As the filter loads with dirt, the pressure drop increases resulting a reduction in supply airflow. This pressure drop can be measured with a pressure sensing device such as a Magnehelic® gage or a digital electronic pressure drop indicator. Measuring the change in pressure drop can help monitor airflow and provide an indicator of filter life and suggested replacement (often recommended as twice initial pressure drop). When a filter reaches its recommended pressure drop reading it should be replaced. Leaving a filter in place after this point can reduce air volume, increase operational and energy costs, and could damage the HVAC system.

Most gas phase filters do not increase in pressure drop over their service cycle if they are installed downstream and protected by a particulate filter. Some particulate media when impregnated with sorbent will 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. 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 sorbent is 100% spent and NAFA would recommend replacement on at least an annual basis.

Disposal

Both particulate and molecular filters should be disposed of in accordance with all local, state and federal regulations.

Summary

This guideline identifies what NAFA considers as the "best practice" recommendation for filtration in residential properties. It looks at a system specific approach to improve indoor air quality and equipment protection in single, multi-family, and low-rise multi-family residential buildings. It raises awareness of the filter as one element in the HVAC system by emphasizing the importance of the filter hardware, proper installation, and good maintenance practices. It also issues a challenge to the HVAC industry to provide the best and latest technology in filtration and IAQ solutions.

Glossary

AHRI: Air-conditioning, Heating, and Refrigeration Institute.

Air Filter/Air Cleaning: A device used for the removal of particulate or gaseous impurities from the air.

AHU: Air handling unit. Describes the unit or units supplying a building with conditioned air. It can be described as the lungs of a building.

ANSI: American National Standards Institute. ANSI is the voice of the U.S. standards and conformity assessment system, ANSI empowers its members and constituents to strengthen the U.S. marketplace position in the global economy while helping to assure the safety and health of consumers and the protection of the environment.

ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers. ASHRAE is an international organization that sets standards and guidelines for the heating, ventilating, air conditioning, and refrigeration industry.

ACH: Air changes per hour computed by taking the cubic area of a space and dividing by the volume of air per hour supplied to it.

CAFS: Certified Air Filter Specialist. Is an accreditation granted by NAFA to those who pass an exam on air filtration.

CFM: Cubic feet per minute describes volume of air.

FPM: Feet per minute describes velocity of air. FPM is always positive and always measured in one direction.

HEPA: High Efficiency Particulate Air filter. HEPA describes a filter that achieves a minimum of 99.97% efficiency on 0.3 micrometer particles or similar challenge.

HVAC&R: Heating, Ventilating, Air Conditioning and Refrigeration.

Makeup Air: Air supplied to a space for the purpose of replacing exhausted air from a space.

MERV: Minimum Efficiency Reporting Value refers to the lowest efficiency of a filter when tested in accordance with ANSI/ASHRAE Standard 52.2 2017.

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

OSHA: Occupational Safety and Health Administration. OSHA is the group that is charged with enforcement of health and safety legislation.

Sorbent: A substance that has the property of collecting molecules of another substance by sorption.

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To Be The Global Source for Expertise, Education
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