NAFA®
National Air Filtration Association

Guidelines

Recommended Practices for Commercial Office Spaces

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, 4th 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Issues regarding health information may be superseded by new developments in the field of industrial hygiene.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, components, or systems operated in accordance with NAFA Guidelines.

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Filtration for Commercial Office Spaces

Purpose

This best recommended practice establishes air filtration guidelines for the removal of particulate contamination for the protection of the air handling equipment and components, as well as providing comfort and a healthy environment for all who work, visit, live and play in these facilities. The recommendations in this guideline are considered by NAFA to be "best practice" in contrast to "minimum standards" as put forth by other organizations. It will serve to provide owners and facility managers with the necessary information to make educated decisions when providing filtration products for their building, and an essential component of their Indoor Air Quality (IAQ) and life safety program.

Scope

This best practice guideline will address the filtration practices associated with the complex systems and applications found in today's commercial office buildings. It will take into consideration life safety, security, health, comfort, equipment protection and tenant retention as factors involved in the filtration decisions. Per ANSI/ASHRAE Standard 62.1-2010, this guideline will not include recommendations for the removal of cigarette smoke in a commercial building. It will look at operating and maintenance of filtration systems as well as conditions such as renovations, internal construction and localized exhaust. This document does not address the special requirements for healthcare facilities; a guideline specifically for Healthcare Facilities will be available at a future date.

For the purpose of this Best Practice we will use ASHRAE's definition of Commercial buildings as found in ANSI/ASHRAE/ACCA Standard 180-2008 – "Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems," "Commercial buildings shall include, but are not limited to, government and educational facilities, healthcare and hospitality facilities, institutional buildings, offices, places of assembly, restaurants, and buildings for retail and wholesale businesses."

Background

The quality of air in the built environment has a significant impact on human health and comfort. Poor IAQ can lead to discomfort, ill health, building related illness, absenteeism, and reduced productivity making IAQ an important occupational and 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 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 commercial office spaces include: plant and animal allergens, gases and odors, bioaerosols (viruses, bacteria, fungal spores), and particulate, specifically below 2.5 microns in size. The facility management team of a commercial building must be cognizant of these issues and develop a filtration and IAQ program that meets or exceeds their tenant's expectations. Never before has the task of maintaining occupant comfort in a commercial structure been more challenging.

Although the importance of filtration is often expressed as a key component in an IAQ program the only mandatory reference to filtration performance is in ANSI/ASHRAE Standard 62.1-2010 "Ventilation for Acceptable Indoor Air Quality."

"9/11 raised the issue of the quality of the indoor air environment from a comfort and housekeeping issue to a health and safety issue."
~William Coad,
ASHRAE President 2001-2002

ANSI/ASHRAE Standard 62.1 "Ventilation for acceptable Indoor Air Quality"
This standard defines acceptable indoor air quality as: "air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (80% or more) of the people exposed do not express dissatisfaction."

The standard identifies two procedures for providing acceptable IAQ. The most commonly used is the Ventilation Rate Procedure (VRP) which prescribes the amount of ventilated air to be delivered to a space based on space type/application, occupancy level, and floor area. The VRP is an indirect solution for the control of indoor contaminants as it does not address the quality of the outside air used for ventilation and applied on its own may not be the best means for improving IAQ.

The IAQ Procedure offers an option to the VRP by reducing and controlling the concentration of contaminants through air cleaning to specified levels.

The IAQ Procedure can reduce the amount of ventilation air below prescribed levels if it can be demonstrated that the air quality meets the required performance.

"The standard acknowledges that air cleaning along with recirculation is an effective means for controlling levels of contaminants."

6.2.1.1 Particle Matter Removal smaller than 10 Micrometers (PM10).
When the building is located in an area where the national standard or guideline for PM10 is exceeded, particle filters or air-cleaning devices shall be provided to clean the outdoor air at any at any location prior to its introduction to occupied spaces. Particulate matter filters or air cleaners shall have a Minimum Efficiency Reporting Value (MERV) of 6 or higher when rated in accordance with ANSI/ASHRAE Standard 52.2.

6.2.1.2 Particle Matter Removal smaller than 2.5 Micrometers (PM2.5).
When the building is located in an area where the national standard or guideline for PM2.5 is exceeded, particle filters or air-cleaning devices shall be provided to clean the outdoor air at any at any location prior to its introduction to occupied spaces. Particulate matter filters or air cleaners shall have a Minimum Efficiency Reporting Value (MERV) of 11 or higher when rated in accordance with ANSI/ASHRAE Standard 52.2.

The ASHRAE recommendations are a good start but may not address the unique needs associated with today's modern commercial office buildings.

NAFA Best Practice Recommendations

The commercial office buildings of today provide more than just a space for tenants to work. They are small communities that can include restaurants, health clubs, medical clinics, retail shopping, parking garages, living quarters and more. For a facility management team this presents some unique challenges. Specialized mechanical equipment is required for servicing these varied applications and the unique activities associated with them. The following mechanical equipment and applications can be found in some, or all, commercial office buildings.

System Approach

Central Air Handling Units

The Central Air Handling Unit (CAHU) in commercial buildings provides thermal comfort (temperature and humidity), ventilation and the removal of odors and contaminants.

In many commercial buildings the Central Air Handling Unit is the main mode of supplying conditioned air to tenant spaces. The filtration system is just one component of the system that could contain all, or some, of the following components: heating and cooling coils, humidification systems, fans, dampers and motors.

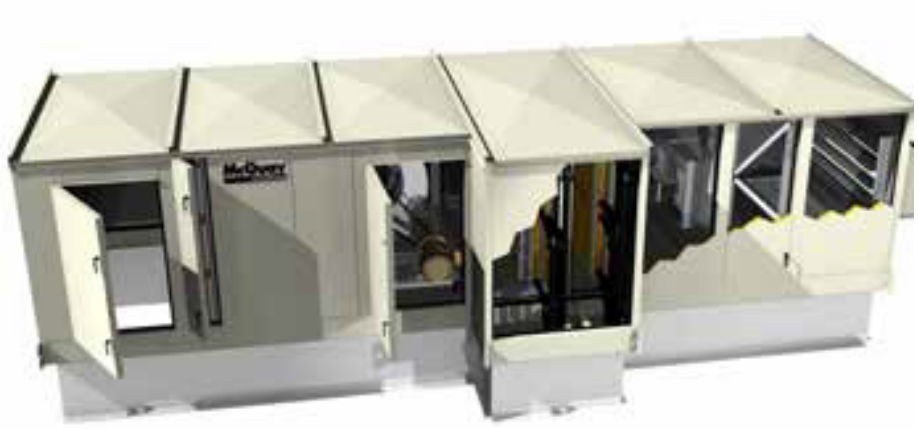
Central Air Handling Units condition the largest percentage of outside air (OA) entering a building. This necessitates the need to remove a variety of contaminants to maintain the effective operation of the system and its components and to provide a healthy environment for its tenants. In some instances the air being returned to the CAHU is more contaminated than the OA requiring the need for particulate and sometimes odor removal at the source.

Effective filtration for a CAHU is accomplished with a two-stage approach incorporating a pre-filter of MERV 8 and a final filter of MERV 13 at prescribed air flow. Some cold weather climates, a summer and winter bank are used with the pre-filter alternating positions depending upon the season while the secondary filter remains in the downstream winter position. In some locations a single filter system is effective and in this case we recommend a MERV 13. The decision to use a single stage system versus a two stage system is based upon particulate load, LCC, and energy conservation.

Photograph courtesy of Engineered Air

Rooftop Air Handling Unit

A Rooftop Air Handling Unit (RAHU) maintains comfort conditions in a zone by providing a constant volume of air that varies according to load. Rooftop units can be the entire source of heating and cooling for a building or supplemental systems to the existing Heating, Ventilating and Air Conditioning (HVAC) system. To control particulate effectively a rooftop system supplying air to a commercial office building should be designed with a two stage system of a MERV 8 pre-filter and MERV 13 final filter. A singlestage filter system can also be considered and our recommendation is for a MERV 13 filter.



Photograph courtesy of McQuay International

Make-Up Air Units

Make-up air (MUA) units are designed to provide ventilation air into a space or replace air exhausted from the building. It may be used to prevent negative pressure within the building or to control the contaminant level in the space. An example of MUA units for commercial use is the parking garage where the units provide replacement outside air when contaminated vehicle air is exhausted. An MUA unit operates on 100% outside air and a single stage filtration system of MERV 11 is recommended. The area serviced by these systems are typically not tenant occupied areas so the lower MERV filter is acceptable to protect the equipment components of the unit.

Photograph courtesy of Engineered Air

Unitary Units

Unitary units are factory made systems that normally include heat/cool coils, fan, motor, humidification, filtration, and ventilation components. Unitary systems are commonly used as compartmental floor units where return air from the indoor space is mixed with outside air from the central air handling unit to provide conditioned air to the floor. Because the outside air is already filtered at the Central system the compartmental unit traditionally has a single stage filter with a recommendation of MERV 8. The task for this filter is to remove the contaminants which are generated in the indoor space.

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

These units are not intended for air filtration but are used for environmental control. Follow manufacturer's recommended guidelines for filtration.

Photograph courtesy of David Lee

Unit Ventilators

Unit ventilators are an assembly of elements whose principal function is to heat a space. They are often used in commercial offices to provide an air current for windows to prevent condensation. Components of unit ventilators include a fan, motor, heating element, filter and an enclosure. No central air is provided to a unit ventilator so air is taken from the space and conditioned at the unit. A unit ventilator can also be supplied with an outdoor air damper for ventilation. A MERV 8 filter is recommended for this application as the majority of the air being used has been filtered at the CAHU.

Photograph courtesy of Engineered Air

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 dampers for ventilation. In a commercial office building, fan coils are often used to supply conditioned air to areas such as elevator machine rooms, electrical vaults, telecommunication rooms etc. A filter system of MERV 8 is recommended.

Photograph courtesy of McQuay International

Self Contained Units

Self contained units are typically constant volume heat/cool units. Outside air to meet ventilation requirements is usually provided by a dedicated outside air duct. Multi tenant office buildings are often served by multiple self contained units. Recommended filtration is MERV 8.

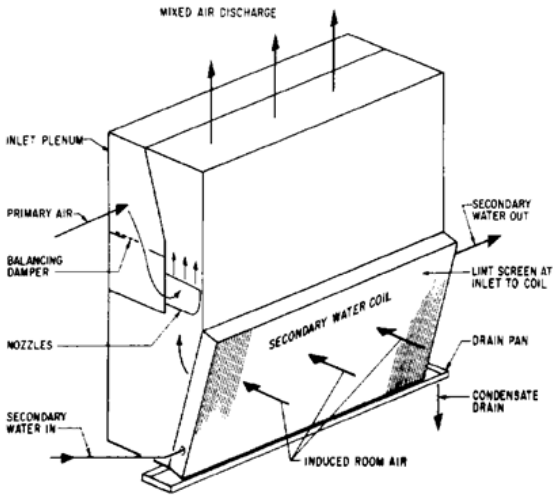
Heat Pumps

Commercial heat pumps are unitary systems that can operate either in heating or cooling mode. Conditioned air is discharged either directly into the zone or into a ducted system. Recommended filtration is MERV 8.

Photograph courtesy of Carrier Corp.

Induction Units

Induction Units are used to save space and give temperature control for each room in which they are installed. Induction units are made for handling the different cooling and heating loads in the perimeter areas of larger buildings. They can be used in combination with a central HVAC system or as a stand-alone system recirculating air within the space. Some induction units have the ability to bring in outside air. They are commonly used in hospitals, hotels, apartments, office buildings, schools, and universities. Recommended filtration is MERV 8.



Application Approach

Localized Supply and Exhaust

The complexity of operating a commercial office building necessitates the use of special ventilation, cooling and filtration strategies for operational activities such as: elevator machine rooms, electrical vaults, telecommunication rooms, data rooms, and mechanical equipment. In these applications equipment protection and their ultimate performance are paramount. If the air servicing these spaces is already filtered at the central air handling system then a MERV 8 filter is recommended. If air is introduced to these applications directly from the outside, a filter system of MERV 13 is recommended.

Internal Construction

Renovation and internal construction present a major operational balancing act for the facility management group. They are responsible to maintain operation while activities such as painting, carpet replacement, and complete floor overhauls are taking place. For small renovations on an individual floor then consideration must be made for the other tenants on the floor. In these situations, if possible, the work should be performed during off hours and the contaminants removed at the source. In many cases a negative air HEPA fan unit in conjunction with barrier isolation, will remove the particulate from the area under renovation before it is exhausted outside or enters the occupied space. Any odors created during this process will have to be addressed with the addition of molecular contaminant removal filters.

For larger projects, such as complete floor overhauls, then consideration for contaminants returning to the central air handling system will need to be addressed. Additional filters of a minimum MERV 8 or higher should be temporally installed at each return air grill on the individual floor under construction and should be removed immediately upon tenant occupancy. During construction filters need to be monitored and changed more frequently due to the higher particulate load. Any odors created during this process may need to be addressed with the addition of molecular contaminant removal filters.

For more information see SMACNA – IAQ "Guideline for Occupied Buildings Under Construction."

Food Preparation

Many commercial office buildings contain restaurants, cafeterias, and specialty food and beverage providers. Minimizing the food odors within a building requires these areas to be kept under a negative pressure with respect to adjacent spaces. The kitchen exhaust air should be removed to a location remote from the outside air intakes. In many cases the air is contaminated with grease, particulate, and odor and these may need to be removed before exhausting. On all kitchen exhaust hoods, a primary filtration system consisting of baffle filters is installed. In certain situations where contamination occurs and exhausting to the outdoors or exhausting remote from the air intake is not possible some combination of ultraviolet lights, high efficiency particulate filters and molecular contaminant removal filter is recommended.

Business Processing Center

Rooms designated and dedicated for activities such as printing, photocopying, document shredding, or other specialized office activity may lead to the generation of odor and particulate contamination. This issue requires special consideration to limit the spread of the contamination to the rest of the building. Air from these activities should be filtered for particulate and odor removal at the source or exhausted directly outdoors. A particulate filter of MERV 13 is recommended along with molecular contaminant removal filters for odor and gaseous removal.

Ozone is one of the contaminants found in these rooms. An activated carbon filter is effective for controlling ozone levels. Some printing technology will have other contaminants associated with it and may require different adsorbent/chemisorbent media to effectively remove them from the space. It is best to contact a NAFA CAFS to help with the selection of the molecular filtration system.

Life Safety

Certain buildings and geographic locations may be more at risk for bioterrorism attacks than standard commercial office buildings. For information on filtration for these types of buildings, please refer to the NAFA Position Statement on Bio-terrorism. Also, see "Risk Management Guidance for Health, Safety, and Environmental Security under Extraordinary Incidents."

Operation and Maintenance

The following is a list of some of the more important factors to consider when operating and maintaining an HVAC system. As a supplement to manufacturers' guidelines, see NAFA's Installation, Operation and Maintenance of Air Filtration Systems manual.

Installation of Filters & System Integrity

An understanding of the entire HVAC system is helpful to ensure that the air filters are properly installed. When changing model or design, consult manufacturer's instructions. Maintaining the system's integrity is vital to proper air filtration. After installation, the system, including filter frames, fastening devices and gaskets should be checked to insure that there are no leaks or gaps. A properly sealed system will prevent bypass and maintain system pressure.
Additional information regarding maintenance of HVAC and filter systems may be found in the ANSI/ASHRAE/ACCA Standard 180, "Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems."

Maintenance

A preventive maintenance program should be in place and should include inspection of filter frames, fastening devices, gaskets and ductwork. Removing and replacing damaged or defective gasketing and duct insulation will keep air from bypassing the filter. Keeping the coils and blower free from dirt and debris by regular cleaning will improve airflow, increase system efficiency and maintain overall integrity. In summary, good housekeeping will keep the HVAC system in proper working order and will provide the facility with air that is not only heated and cooled, but also cleaned with a reduction in contaminant levels.

Monitoring of Airflow and Pressure Drop

All filters in an HVAC system increase the resistance to the flow of air. This increase is called "pressure drop." As an example, in a draw-through system as the filters load and the resistance increases, the fan pressure is lower on the downstream side, hence the pressure "drop" downstream, of the filters. This drop can be measured with a pressure sensing device such as a manometer or magnehelic gage. All HVAC units should have a pressure-sensing device installed to accurately monitor the airflow and pressure drop across the filter bank. When a filter has exceeded its useful life, based on life cycle costing (LCC), it should be replaced. Leaving a filter in place after this point may increase operational and energy costs and could damage the HVAC system.

Most molecular filters, over time, will not increase in pressure drop. Some particulate medias when impregnated with sorbent 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 media is 100% spent.

Disposal

Both particulate and molecular filters should be disposed of in accordance with all local, state and federal regulations. Spent carbon in molecular filters may sometimes be returned to the manufacturer for reactivation.

Summary

This guideline identifies what NAFA considers as the "best practice" recommendation for filtration in Commercial Office Buildings. It looks at both a system and application specific approach to improve indoor air quality in and equipment protection in Commercial Office Buildings. It raises awareness of the filter as one element in the filtration system by emphasizing the importance of the filter hardware system, proper installation and maintenance.

Glossary

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 – As 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 cubic feet per hour of air supplied to it.

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

DOP: Dioctyl Phthalate is a chemical used to challenge HEPA filters. Factory testing involves heating DOP to produce a monodispersed particle challenge and distribution through a Laskin nozzle produces a polydispersed particle challenge.

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

HEPA: High Efficiency Particulate Air filter – 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.

IAQ: indoor air quality describes the quality of air supplied to an interior space. The goal of IAQ is to provide air that is clean and healthy to building occupants.

In-situ: translated means "in position." This refers to measuring a filter installed in a system commonly using cold DOP for HEPA filters to test for leaks or using ambient air and a particle counter to perform ANSI/ASHRAE GP 26.

Life Cycle Costing (LCC): the investigation and valuation of the environmental impacts of air filters.

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 2012.

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, the group that is charged with enforcement of health and safety legislation.

PM 2.5: Fine particulate matter (PM2.5) is an air pollutant that is a concern for people's health when levels in air are high. PM2.5 are tiny particles in the air that reduce visibility and cause the air to appear hazy when levels are elevated.

PPM: parts per million refers to the concentration of a substance within another substance. One ppm is equivalent to 1 milligram of something per liter of air (mg/l).

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

OA: outdoor air.

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Photographs

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