NAFA®
National Air Filtration Association

Guidelines

Recommended Practices for Filtration for Schools

This NAFA Guideline has been provided, courtesy of:

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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 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Issues regarding health information may be superseded by new developments in the field of industrial hygiene.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 Schools

Purpose

This best practice air filtration guideline is established for the removal of particulate and molecular contaminants for the improvement of indoor air quality and protection of HVAC equipment in K-12 schools. It serves to provide the facility managers with the necessary tools to make measurable differences to the operation of the HVAC systems in their campus through air filtration.

Scope

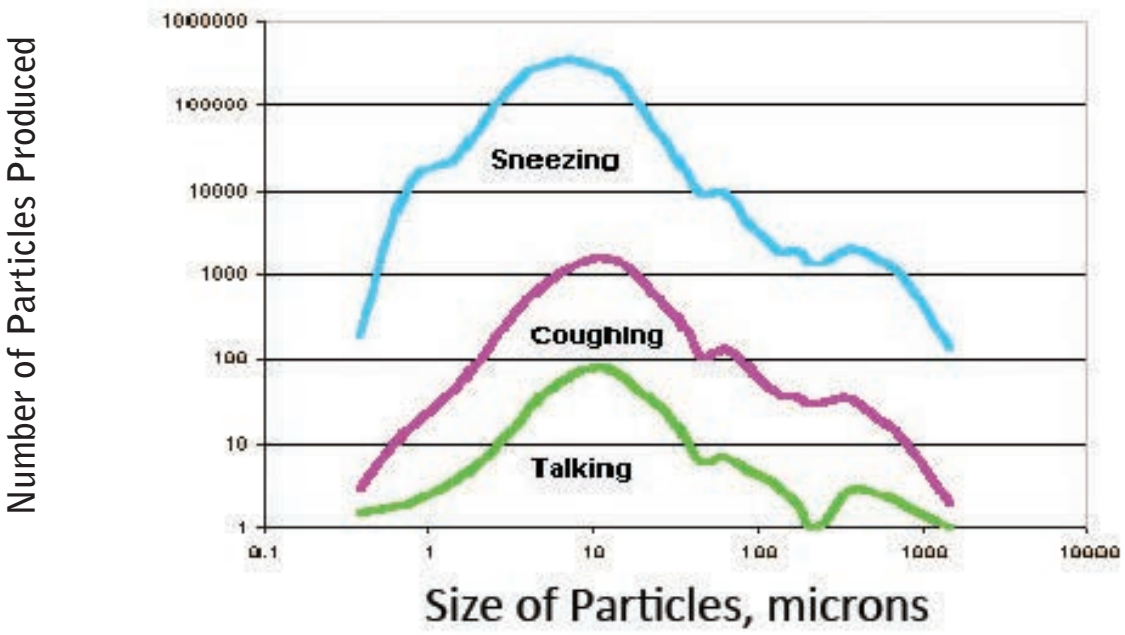
This Guideline identifies air quality issues associated with typical schools K-12. It establishes design criteria and performance specifications for new construction, as well as existing HVAC systems. This shall include methodology for contaminant removal by filtration and associated system maintenance.

Background

School districts around the world are some of the most frequently used high traffic buildings in our society. They also hold some of our most important resources - those being students and faculty. School districts are always under financial constraints to achieve high quality education at low cost. This may result in neglect to their facilities and HVAC maintenance due to staffing, lack of knowledge and operational costs. With new research showing the benefits of cleaner environments on learning and health, our students and faculty should have cleaner air to breathe.

Sneezing, coughing and talking add condensate nuclei particles to air and increases the possibility of transmission of disease. Most public schools are funded based on student attendance and as such, excessive absenteeism potentially caused by IAQ issues may ultimately result in school districts losing funding.

While cutting small costs for proper air filtration may show an immediate savings impact on the budget, keeping up with proper preventative maintenance and scheduled air filter changes will have a more sustainable impact in the long run. Without proper maintenance and filtration, key components of HVAC systems will deteriorate, resulting in costly repairs or increase operating costs.



School HVAC systems

Most school districts have commercial grade HVAC systems with single stage filtration. Since many of these systems are dated and have been using filters with a very low efficiency minimum efficiency reporting value (MERV) based on ANSI/ ASHRAE Standard 52.2) number, it is essential to clean evaporator coils, fans, and all other major components of HVAC systems when implementing a new filtration system. Cleaning the system and installing higher efficiency/low pressure drop filters may achieve lower pressure in the system, higher airflow and higher levels of particle removal resulting in cleaner air.

NAFA Best Practice Recommendations

Based on the EPA's "Tools for Schools" program, "…all schools should have a minimum filtration efficiency of MERV 8 in all HVAC applications."

Filter Efficiency

"Air filters should have Minimum Efficiency Reporting* Value (MERV) of between 8 and 13."

The higher the air filter efficiency, the better the protection for the equipment and the occupants. It has been estimated that a 30% increase in static pressure across a coil results in a $200 (electric cost) per 10,000 cfm of air movement (at 7 cents per KWH). This does not include the added cost of cleaning dirty heating or cooling coils, drain pans, or air ducts. Designers should consider specifying a low efficiency (~10%) pre-filter upstream of the main filters. The pre-filters are generally easy and inexpensive to change, and will capture a significant amount of the particulate mass in the air thereby extending the useful life of the more expensive main filters[1].

NAFA recommends MERV 13 efficiency filtration for all HVAC applications in schools. Key to this efficiency is the protection for the HVAC components from particles that promote biofilm, particulate fouling, and microbial contamination in the equipment and more importantly reducing the respirable (0.3 to 3 microns) concentration of pollutants for students and faculty (ASHRAE Guideline 10).

It is recognized that some induction units and other room specific heating or cooling equipment may not be capable of MERV 13 filtration due to configuration or fan capacity. In these applications careful seal and selection of media filtration methods should be assessed for the protection of the HVAC component. The EPA's "Tools for Schools" program also recommends designing more filter surface area into ventilation systems.

" This has two advantages: the number of filter changes each year is reduced, thereby reducing the cost of labor to properly maintain the filters; and static pressure loss is lower, which saves money by reducing the amount of power needed to operate fans and blowers. Since different filter media are approximately proportional in their efficiency/pressure drop ratio, the most effective method for reducing pressure drop is to design more filter surface area into the filter system. This can be done by the specification of a filter with larger amounts of surface area, such as a pleated filter or bag filter. The next method is to increase the number and/or size of the filters in the airstream, for example, by mounting the filter slots in a "V" pattern, rather than a filter rack that is simply flat and perpendicular to the airstream."[2]

[1] U.S. Environmental Protection Agency, IAQ Design Tools for Schools, Heating, Ventilation and Air-Conditioning (HVAC) Systems. http://www.epa.gov/iaq/schooldesign/hvac.html.

[2] EPA Tools for Schools Program - IAQ Design for Schools - Heating, Ventilation and Air-Conditioning Systems. http://www.epa.gov/iaq/schooldesign/hvac.html#Filter Efficiency.

* Disclaimer: NAFA would like to correct a mistake made in the EPA's "Tools for Schools" document. MERV is not a Rating. It stands for Minimum Efficiency Reporting Value. It is the intention of NAFA to inform the EPA of this mistake so it can be corrected.

A proper filter should be selected and a proper change out frequency should be established. This change out frequency can vary from unit to unit within a certain building and should be established based on the following criteria:

1. The specified or allowable pressure drop
2. Filter manufacturers' recommended final pressure drop
3. Values demonstrated by experience
4. Value determined by life cycle cost analysis.

For more information about selecting the proper change out frequency, please refer to Chapter 11 of the *NAFA Installation, Operations, and Maintenance* of Air Filtration Systems manual.

Special Applications

There are certain areas in schools that require more specific filtration beyond general HVAC.

Molecular Filtration: Use of molecular filtration is recommended in the following areas:

Metal working (welding fumes)

Locker Rooms

Chemistry and Biology Labs

Swimming Pool areas

Dust Separators: Use of specialized filtration equipment such as a dust collection systems are recommended in woodworking areas.

In these special applications a NAFA Certified Air Filter Specialist (CAFS) should be contacted to determine the proper filter and /or filtration media required to remove the contaminants associated with these areas.

Operation and Maintenance

It is recommended that the manufacturer's guidelines be followed in all circumstances when retrofitting an existing system. What follows is a list of some of the more important factors to consider when operating and maintaining an HVAC air filter system. As a supplement to manufacturer's guidelines, (see NAFA *Installation, Operation and Maintenance of Air Filtration Systems* (IOM) manual.)

Installation of Air Filtration Framing Systems

These systems may consist of built-up filter banks, side access housings, or modular tracks. A qualified HVAC system design engineer should be consulted to specify the required quantity, arrangement, airflow, and pressure requirements of the air filter installation.

Installation of Filters

Refer to the manufacturer's instructions when installing filters into the HVAC system. An understanding of the entire HVAC system is helpful to ensure that the air filters are properly installed. Proper size and gasketing is imperative to the integrity of the filter system. It is also beneficial to a maintenance program to add a filter log near the filter bank of each HVAC unit or in a computerized data base. This will help to insure that filters are changed on time and that each filter bank is using the proper change out frequency.

System Integrity

Start Up

Maintaining the HVAC system's integrity is vital to proper air filtration. After installation, the system should be checked for:

1. Correct size of filter frames
2. Fastening devices, i.e. filter holding clips
3. Filter gaskets on frames, doors, and filters should be checked to insure that there are no leaks or gaps
4. Filter frames and housing should also be properly sealed as this will prevent air bypass and maintain system pressure.

Maintenance

A preventative maintenance program should be in place and should include:

1. Inspection of filter frames, fastening devices, gaskets, and ductwork.
2. Removing and replacing damaged or defective gasketing and duct insulation will keep air from bypassing the filter banks.
3. Keeping the coils and blower free from dirt and debris by regular cleaning.

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 clean.

Monitoring of Flow and Pressure Drop

All filters increase the resistance to the flow of air in an HVAC system. This increase is called "pressure drop" because 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. Pressure drop can be measured with a pressure sensing device or air filter gauge such as a manometer, or magnehelic.

All HVAC units should have a pressure-sensing device installed to accurately monitor the pressure drop across the filter bank. When a filter has exceeded its useful life, based on life cycle costing, it should be replaced. Leaving a filter in place after this point may increase operational and energy costs and could damage the HVAC system components.

Most molecular (gaseous removal contaminates) filters will not increase in pressure drop over time, especially with proper pre-filtration. Some particulate media 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

Filters should be disposed of in accordance with all local, state, and federal regulations.

Summary

There are many contributing factors involved in the degree of filtration needed in schools. These recommendations are given based on the ideal filtration to protect HVAC equipment and improve the health of students and faculty in the school system. MERV 13 filters are capable of protecting HVAC equipment and will remove target respirable particulates, which could cause illness, and should reduce overall school absenteeism.

In order to maintain the degree of filtration needed, an active maintenance program is essential. Problems arising from poor filter maintenance can cause HVAC breakdowns and a decrease in overall indoor air quality.

Glossary

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

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.

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

cfm: Cubic feet per minute; a volumetric measurement used to size fans and duct work.

HVAC: Heating, Ventilating & Air Conditioning

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.

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

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.

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EPA Tools for Schools Program – IAQ Design for Schools – Heating, Ventilation and Air-Conditioning Systems. http://www.epa.gov/iaq/schooldesign/hvac.html#Filter Efficiency

ASHRAE Position Document on Airborne Infectious Diseases, 2009

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