Best Practice Guidelines

Filtration for Computer Data Centers

This guideline is provided courtesy of:

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NAFA® National Air Filtration Association

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Why NAFA Guidelines?

The National Air Filtration Association (NAFA) provides "Best Practice Guidelines" to help supplement existing information on air quality management through proper filtration. While many organizations recommend "minimum" air cleaning levels, NAFA publishes best practices based on the expertise of its membership, combined with research from governmental, medical, and scientific communities. This guideline offers recommendations for achieving optimal air quality while considering the energy and environmental impact of data center HVAC systems.

For a complete explanation of principles and techniques found in this guideline, visit www.nafahq.org to purchase the NAFA Guide to Air Filtration.

ABOUT US

Our Mission:
The National Air Filtration Association (NAFA) mission is to be the global source for expertise, education & best practices in air filtration.

What can NAFA membership do for you?
NAFA brings together air filter and component manufacturers, sales and service companies, and HVAC and indoor air quality companies. By becoming a member, you can:

- Meet with industry thought leaders
- Strengthen your network
- Share best practices
- Receive up to date industry information
- Access professional development, certification and education

Be a part of something bigger
As a NAFA member, you are a part of a support system that shares the common goals of supporting industry growth and creating healthier communities. Following the coronavirus pandemic, we are more aware than ever of the important role that our members play in a well society. We know that our work is important to maintaining healthy, happy communities.

Benefits of Membership

As a member of NAFA, you'll have access to a host of benefits that offer networking, learning, and advertising opportunities. Here are just a few of our most popular benefits:

- Annual conferences and webinars
- Professional development programs (CAFS and NCT Level I & II certification)
- Air Media magazine
- Best practices guidelines
- Clean Air Award recognition program
- Library of resources, manuals, seminars, and training.
- NAFA advertising and sponsorship programs
- Exposure through NAFA social media and a listing on the NAFA website
- NAFA volunteer and leadership opportunities

...and more!

Click here to become a member today!

CAFS & NCT Certifications

Educate your team
Attract new customers
Be known as a leader in your industry

Now more than ever, customers seek professionals with the credentials for quality assurance and knowledge to ensure that their complex needs will be met. Addressing this concern, NAFA offers two certification programs to increase the level of education and professionalism in the industry.

The NAFA Certified Air Filter Specialist (CAFS) program
CAFS is the first education and certification program offering an extensive examination on the principles, methods and applications of air filtration. It differentiates professionals who have demonstrated a high level of professionalism and a thorough, up-to-date understanding of air filtration technology. The CAFS exam is pass/fail, and is based on the NAFA Guide to Air Filtration.

NAFA Certified Technician (NCT) Program
This open-book exam is based on the NAFA Installation, Operation, and Maintenance of Air Filtration Systems manual. This program was designed to increase the knowledge of technicians, facility managers, and building owners.

Both certifications are renewable on an annual basis pending successful completion of continued education requirements. While the exams are open to members and nonmembers alike, test fees are dramatically reduced for members. To find out more about the cost, study aids, test dates/locations, and requirements, visit the weblinks below.

CAFS information page

NCT information page

About This Publication

1 PURPOSE

Data centers require highly controlled air quality to protect critical Information Technology (IT) infrastructure from airborne contaminants such as particulate, volatile organic compounds (VOCs), and corrosive gases. Uncontrolled contamination can lead to overheating, hardware failure, and reduced operational efficiency.

This best practice guideline establishes air filtration standards for the removal of particulate and molecular contaminants in computer data centers. It provides facility managers with one of the necessary tools to maintain air cleanliness and protect critical IT infrastructure from airborne contaminants, ensuring the highest standards of air purity while maintaining energy efficiency and cost-effectiveness.

2 SCOPE

This guideline addresses air quality issues related to IT equipment housed in data centers, server rooms, and cloud computing facilities. It includes recommendations for contaminant removal through filtration and guidance for system maintenance to ensure equipment longevity and operational efficiency. It covers particulate and molecular filtration strategies, HVAC system integration, air quality monitoring, regulatory compliance, and long-term maintenance best practices.

Some other resources to consider include, but are not limited to:

1. Equipment Manufacturer Specifications
2. Industry Standards and Guidelines (ASHRAE, ISO, LEED, IWBI, etc)
3. Environmental & Operational Risk Assessments
4. Facility Load and Runtime Profile
5. Life Cycle Cost Analysis
6. Building Automation & Monitoring Systems
7. Accredited industry professionals and vendors

Together, these resources will be a strong foundation for developing a comprehensive air filtration and Indoor Air Quality program.

About This Publication (continued)

3 BACKGROUND

Data centers house mission-critical IT infrastructure that must operate continuously with minimal downtime. Maintaining precise environmental conditions such as temperature, air cleanliness, flowrate, and relative humidity in these applications is critical.

Airborne contaminants, such as particulates, volatile organic compounds (VOCs), and corrosive gases, can lead to equipment failure, overheating, and reduced efficiency.Maintaining stringent air quality standards within data centers is essential to reducing maintenance costs and improving hardware reliability. Given the unique demands of these facilities, including high airflow, constant uptime, and strict temperature and humidity tolerances—it is essential to select the right air filters.

A crucial step in this process involves reviewing and understanding the manufacturer's recommendations. These recommendations are developed through extensive research, testing, and engineering to ensure optimal system performance, equipment longevity, and should always be considered when developing any type of air filtration or indoor air quality plan. Manufacturers of both air handling units (AHUs) and air filters provide specific recommendations for filter types, MERV ratings (Minimum Efficiency Reporting Value), pressure drop tolerances, replacement intervals, and installation procedures. These recommendations are not arbitrary—they are based on detailed assessments of system performance, component tolerances, and real-world operating conditions. Here are several reasons why referring to Manufacturer recommendations are vital:

1. System Compatibility and Performance Optimization

Air handlers are engineered to work within specific parameters for airflow, pressure drop, and temperature control. Manufacturers' design filters that complement these specifications. Using a filter that deviates from the recommended specifications can cause airflow restrictions, inefficiencies, and system malfunction.

For example, a filter with a MERV rating that is too high for the system may offer better filtration but could significantly increase the resistance to airflow. This results in higher static pressure, which forces the fan motor to work harder, consuming more energy and potentially causing premature wear. Over time, this can lead to equipment failure or even void the AHU's warranty.

By following the filter specifications provided by the air handler or filter manufacturer, facility managers ensure that they are maintaining the correct balance of air cleanliness and system performance.

About This Publication (continued)

3

BACKGROUND

2. Preserving Equipment Lifespan

Manufacturers consider the long-term health of air handlers when issuing filter guidelines. Filters that are not designed for a specific AHU can cause imbalances in the system that contribute to mechanical strain. Overloaded fans, fluctuating pressure, and inconsistent air delivery can accelerate wear on motors, belts, and bearings.

In data centers—where reliability is paramount—even a small deviation from optimal filtration performance can increase the risk of unplanned downtime. Manufacturer-recommended filters help avoid these risks by ensuring that the AHU operates within safe and sustainable performance thresholds.

3. Energy Efficiency Considerations

Energy efficiency is a critical factor in data center operation, often representing a significant portion of operational costs. Air filters influence energy usage by affecting the resistance air encounters as they pass through the system (measured as pressure drop). Higher pressure drops require more energy to maintain the same air flow.

Filter manufacturers conduct performance testing to determine the energy consumption profiles of their products when used with various AHUs. Recommendations take these variables into account, guiding facility managers toward options that balance filtration efficacy with energy efficiency. Selecting filters outside these parameters can lead to higher-than-expected utility bills and compromised sustainability goals.

4. Regulatory and Warranty Compliance

Many air handlers and filter manufacturers include language in their documentation that voids warranties if components are used outside the recommended specifications. This is particularly relevant in mission-critical environments like data centers, where even a minor equipment issue can have severe consequences.

In addition, compliance with ASHRAE standards and other industry's best practices may be contingent on following manufacturer guidance. For example, ASHRAE Standard 52.2 provides methodologies for testing filter performance and is often referenced in both manufacturer and operational standards.

Choosing filters that align with these standards—when recommended by the manufacturer—ensures compliance, simplifies auditing processes, and supports best practices in facility management.

About This Publication (continued)

3

BACKGROUND

5. Filter Life and Maintenance Scheduling

Another important consideration is the anticipated life cycle of an air filter. Manufacturers test filters to determine how long they can perform effectively under normal operating conditions. These life cycle estimates help data center managers schedule preventive maintenance and replacements without compromising uptime.

If a facility uses filters that differ from the manufacture' recommendations, the actual performance and longevity of those filters may vary widely, making it difficult to rely on standard maintenance intervals. This unpredictability increases the likelihood of operating with clogged or underperforming filters, which can degrade air quality and stress HVAC components.

Following manufacturers' recommendations support consistent maintenance routines and minimizes the risk of unexpected air quality issues.

NAFA Best Practice Recommendations

SPECIFICATIONS TO CONSIDER

When choosing air filters for commercial AHUs in data centers, NAFA recommends considering these key specifications typically outlined by manufacturers:

- **Filter Size and Geometry:** Ensures proper sealing and eliminates air bypass.
- **MERV Rating:** Specifies the appropriate filtration level to remove harmful particulates without overloading the system.
- **Initial and Final Pressure Drop Ratings:** Defines acceptable resistance levels that correspond with energy use and airflow.
- **Material Construction:** Some filters are electrostatically charged, or made of synthetic media, each affecting performance differently.
- **Operational Temperature and Humidity Tolerances:** Prevents degradation of filter materials under high-load conditions.
- **Change-out Frequency:** Based on expected dirt-holding capacity and particulate loading in the environment.
- **Pleat Orientation:** In some cases, Manufacturers may "reverse" the orientation of an air filter in order to withstand higher than normal filter Face Velocity. Refer to the NAFA Guide to air Filtration for more information on calculating FPM across an Air Filter.
- **Gasketing Orientation:** Foam or Rubber gaskets play an important role in ensuring an airtight seal to ensure minimal airflow bypass. This allows for an increase in system efficiency and particulate removal.

EXTERNAL FACTORS TO CONSIDER

Some of the considerations that should be granted include, but are not limited to:

- **Environmental Factors** – Depending on the location of the Data Center, various filtration strategies should be considered (i.e. Saltwater corrosion for coastal areas, exhaust fumes for Urban areas, increased pollen count for rural areas, etc.). Filters should be selected to balance air quality and energy efficiency. Low-pressure-drop filters minimize HVAC energy consumption while maintaining required cleanliness levels.
- **Initial and Final Pressure Drops** – the primary infrastructure goal of a Data Center is to operate at the highest levels of energy efficiency due to its massive power consumption. Critical attention to the pressure drop of the air filters will allow for a greater energy conservation impact to the blower motors that service the space.
- **Gaseous Contamination (Corrosion Control)** – Based on ASHRAE TC9.9 Standards, Gas-Phase Filtration should be considered if contamination is elevated based on target coupon corrosion rates of:
  - Copper: less than 300 Å/month
  - Silver: less than 200 Å/month
- **Free Cooling / Air-side Economization** - When data centers use outside air for economization, filtration requirements become more stringent.
  - Indoor air can still be managed with MERV 8 recirculated filters.
  - Incoming air requires MERV 13 (depending on the specific contamination levels in the outdoor environment).

NAFA Best Practice Recommendations (continued)

ORIGINAL EQUIPMENT MANUFACTURER (OEM) SPECIFICATIONS

In addition to the above approaches and strategies, special attention should be given to the type of equipment being serviced. Below are some examples of CRAH (Computer Room Air Handling), CRAC (Computer Room Air Conditioning), and DOAS (Dedicated Outside Air Systems) and the OEM Recommendations for replacing Air Filters:

Computer Room Air Handler (CRAH)
Proper air filtration for Computer Room Air Handlers (CRAH) ensures clean airflow to protect sensitive IT equipment. Use MERV 8 prefilters with MERV 13 final filters, monitor pressure drop, and replace on an as needed basis. Maintain ISO Class 8 cleanliness, prevent bypass leakage, and adapt filtration for outdoor air quality and operational conditions.

Vertiv Model CW Chilled Water Air Handler

Similar to Ductless Split systems, Wall mounted Split systems are used in smaller area IT Rooms and IDF (intermediate distribution frame) Closet. These systems contain specialized OEM Plastic “Washable” filters that cleaned on an as needed basis, and replaced based on the OEM’s Specifications (typically 5 years). This will ensure proper fit and limited air bypass.

Vertiv™ CoolPhase Wall, Wall-Mount Split System

Unlike Indoor units that primarily filter Recycled (Indoor) Air, Dedicated Outdoor Air Systems (DOAS) incorporate unfiltered air into the space. NAFA recommends MERV 13 High-Capacity Filters; ideal for enhanced air quality. Ensure proper installation, regular replacement, and consider system static pressure when specifying filter grade.

Trane Horizon® Dedicated Outdoor Air System

NAFA Best Practice Recommendations (continued)

FILTRATION REQUIREMENTS

Application	Contaminant Removal	Filter Type
Pre-Filtration* (Indoor Recycled Air)	Indoor particulates (i.e. skin cells, mites, pollen, etc.)	2″ MERV 8 Pleated Filter
Pre-Filtration* (Outside Air)	Larger particulates i.e. pollen, feathers, sand, dust, etc.)	2″ MERV 8 Pleated Filter
Final Filtration** (Outside Air)	Smaller Outdoor particulates i.e. pollen, feathers, sand, dust, etc.)	12″ MERV 13 High Efficiency Rigid Filter
Molecular (Gas Phase) Filtration***	VOC's from Diesel Generators, Loading Docks, or by-products of power systems	12″ Activated Carbon Rigid Filter
HEPA FIltration: ****	Clean Rooms, specialized containment rooms	12″ 99.97% HEPA Filter certified in place by certified personnel

Pre-Filtration*	MERV 8 filters should be used to capture larger particulates.
Final Filtration**	MERV 13 filters should be installed to remove fine particulate matter (PM 2.5 and smaller).
Molecular Filtration***	Activated carbon or permanganate Impregnated media should be used to mitigate VOCs, ozone, and corrosive gases such as Hydrogen Sulfide (H_2S) Sulfur Dioxide (SO_2). Refer to the NAFA Best Practice Recommendations for more information.
HEPA Filtration:****	For ultra-sensitive environments 99.97% efficiency at 0.3-micron particles.

NAFA Best Practice Recommendations (continued)

USE OF HEPA FILTERS IN DATA CENTERS

While not a widely known application, some applications for clean room environments in Data Centers utilize HEPA Filters to safeguard sensitive equipment by capturing microscopic particles, dust, and contaminants that threaten cooling efficiency and uptime. By maintaining clean airflow, they reduce risks of hardware failure and ensure compliance with air quality standards; supporting long-term reliability of mission-critical operations.

HEPA filters are required to be tested in situ to confirm that they provide the designed level of air purification, after installation and at least annually, to detect leaks in the filter media, gaskets, or housing, which could allow contaminated air to bypass the filter. This on-site testing is crucial because a filter's performance in the field can differ from its factory-tested efficiency due to damage during transport, poor installation, or aging, putting people, processes, and products at risk.

Certification may be performed by the manufacturer or by an accredited professional in the field as a part of a complete system test. IEST - The Institute of Environmental Sciences and Technologies is generally recognized for providing testing standards relating to HEPA filters. (www.IEST.org).

Operation & Maintenance

INTALLATION OF AIR FILTRATION SYSTEMS

In addition to referring to the Manufacturers' recommendations on proper filtration maintenance, NAFA Recommends several factors be considered when installing and maintaining Air Filtration systems to ensure a safe and successful change.

- Assess the space for any potential hazards, specialized PPE requirements, Equipment, tools and or Hardware
- Filters should be installed per manufacturer recommendations and NAFA Guidelines to ensure proper sealing and prevent bypass leakage.
- Gaskets and fasteners should be inspected for integrity at each installation.

MONITORING AIRFLOW AND PRESSURE DROP

Pressure drop is a key factor in scheduling air filter maintenance, as it directly impacts HVAC system performance and energy efficiency. As filters collect particulate, resistance to airflow increases, causing higher pressure drop. Excessive pressure drops forces fans to work harder, raising energy costs and straining equipment. Monitoring pressure drop allows facility managers to replace filters at the optimal time—before efficiency declines without running the risk of discarding filters prematurely. This data-driven approach balances air quality, system protection, and cost control. By using pressure drop as a maintenance indicator, facilities can improve reliability, extend equipment life, and reduce operating expenses.

- Differential pressure gauges (e.g., magnehelic or manometer) should be installed to monitor filter loading.
- Filters should be replaced once they reach twice their initial pressure drop or as per manufacturer recommendations.

SUGGESTED REPLACEMENT SCHEDULES

Pre-filters (MERV 8)	Replace every 3 months
Final filters (MERV 13+)	Replace every 6 months, depending on contaminant load
Molecular filters	Replace based on adsorption capacity testing, typically annually
HEPA filters (if used)	Replace every 12 months based on airflow resistance

Operation & Maintenance (continued)

Total Cost of Ownership

Total Cost of Ownership (TCO) is a critical framework for evaluating the need for air filter maintenance. Instead of focusing only on the initial purchase price, TCO accounts for the full lifecycle costs—purchase, installation, energy consumption, labor, and disposal. Air filters directly impact HVAC efficiency, with clogged or low-quality filters increasing energy use and equipment strain. By analyzing TCO, facility managers can balance filter quality, replacement intervals, and operational efficiency. This approach helps avoid false economies of low-cost filters that raise long-term expenses. Ultimately, TCO ensures decisions prioritize performance, sustainability, and reduced downtime, delivering measurable savings over the system's life. Refer to the NAFA Guide to Air Filtration or consult a NAFA CAFS for more information.

Collaboration with Manufacturers and Vendors

Data center operators should develop working relationships with both the air handling equipment and filter manufacturers. This collaboration ensures clear communication of operating conditions, helps interpret evolving guidelines, and provides early insight into any product changes.

In addition, certified vendors and service providers often receive direct training and updates from manufacturers. Using these partners can help ensure that filters are properly installed, maintained, and replaced according to the latest recommendations.

Custom Solutions and Exceptions

In certain high-contamination environments—such as data centers located near construction zones, heavy traffic, or industrial areas—standard recommendations may need adjustment. Even in these cases, however, changes should be made in consultation with the equipment manufacturer. Many suppliers can provide custom solutions that meet enhanced air quality needs while preserving system integrity. Rather than risking trial-and-error or self-directed substitutions, it is far better to rely on the manufacturer's expertise in adapting to these unique requirements.

ASHRAE AND ISO STANDARDS

Air Quality Standards

To maintain optimal operational efficiency, data centers should adhere to ISO 14644-1 Class 8 cleanroom standards. For Class 8, the maximum allowable concentration for particles ≥0.5 µm is 3,520,000 particles per cubic meter of air, and for particles ≥5.0 µm it is 29,300 particles per cubic meter. Compliance requires continuous or periodic airborne particle monitoring, depending on the criticality of operations. Cleanroom airflow, filtration, and maintenance practices must control particle levels below these thresholds. Achieving Class 8 involves proper HEPA filtration, positive pressure control, and adherence to gowning and cleaning protocols to minimize contamination. Regular testing ensures the environment consistently meets the standard's particle concentration limits. This is not to be mistaken for MERV 8 based on the ASHRAE 52.2 Test.

Table 1 — ISO Classes of air cleanliness by particle concentration

ISO Class number (*N*)	Maximum allowable concentrations (particles/m³) for particles equal to and greater than the considered sizes, shown below[a]					
	0,1 µm	0,2 µm	0,3 µm	0,5 µm	1 µm	5 µm
1	*10*[b]	d	d	d	d	e
2	100	*24*[b]	*10*[b]	d	d	e
3	1 000	237	102	*35*[b]	d	e
4	10 000	2 370	1 020	352	*83*[b]	e
5	100 000	23 700	10 200	3 520	832	d, e, f
6	1 000 000	237 000	102 000	35 200	8 320	293
7	c	c	c	352 000	83 200	2 930
8	c	c	c	3 520 000	832 000	29 300
9[g]	c	c	c	35 200 000	8 320 000	293 000

a All concentrations in the table are cumulative, e.g. for ISO Class 5, the 10 200 particles shown at 0,3 µm include all particles equal to and greater than this size.

b These concentrations will lead to large air sample volumes for classification. Sequential sampling procedure may be applied; see Annex D.

c Concentration limits are not applicable in this region of the table due to very high particle concentration.

d Sampling and statistical limitations for particles in low concentrations make classification inappropriate.

e Sample collection limitations for both particles in low concentrations and sizes greater than 1 µm make classification at this particle size inappropriate, due to potential particle losses in the sampling system.

f In order to specify this particle size in association with ISO Class 5, the macroparticle descriptor M may be adapted and used in conjunction with at least one other particle size. (See C.7.)

g This class is only applicable for the in-operation state.

Other Industry Best Practices (continued)

ASHRAE Standard 62.1

ASHRAE Standard 62.1, "Ventilation for Acceptable Indoor Air Quality," establishes minimum ventilation rates and IAQ criteria. In data centers, while IT equipment areas are largely unoccupied, compliance is essential for occupied zones such as control rooms, offices, and maintenance spaces. These areas must receive sufficient outdoor air to dilute contaminants and maintain personnel comfort, with filtration systems designed to remove airborne particles and gaseous pollutants.

Recommendations:

- Filtration Levels: Install at least MERV 13 filters (per ASHRAE recommendations) in air handling units serving occupied areas; consider HEPA filtration for critical spaces.
- Particle Control: Monitor and maintain particle concentrations below ISO 14644-1 Class 8 limits in equipment spaces to protect sensitive hardware.
- Gaseous Contaminant Mitigation: Use activated carbon or potassium permanganate media to remove harmful gases (e.g., sulfur compounds) that can corrode electronics.
- Humidity & Temperature Management: Maintain RH between 40–60% and temperature per ASHRAE TC 9.9 thermal guidelines to reduce static discharge and microbial growth.
- IAQ Monitoring: Deploy continuous IAQ sensors to measure PM2.5, CO_2, and VOC levels, triggering filtration or ventilation adjustments as needed.
- Maintenance: Establish quarterly or semi-annual filter inspection and replacement schedules to sustain efficiency and IAQ compliance.

Other Industry Best Practices (continued)

COMPLIANCE WITH USGBC (LEED BD+C) AND LEED IWBI (WELL BUILDING STANDARDS)

Recommended Air Filtration Practices for Data Centers (LEED v4.1 BD+C)

The LEED v4.1 rating system offers both prerequisite and credit-based pathways to enhance indoor air quality through improved ventilation and filtration strategies in data center environments. Refer to the USBGC (LEED BD+C for more detailed information)

1. Minimum Indoor Air Quality Performance (EQ Prerequisite)
2. Enhanced Indoor Air Quality Strategies (EQ Credit: 1–2 pts)
3. Enhanced Indoor Air Quality Strategies Specific Guidance
4. Construction Indoor Air Quality Management Plan (EQ Credit: 1 pt)
5. Filtration Media Maintenance
6. Indoor Air Quality Assessment (1–2 pts)

Recommended Air Filtration Practices for Data Centers (WELL Building Approach)

The WELL Building Standard advocates a holistic, health-first approach to air filtration:

- Establish basic air quality via standards, ventilation, and construction filters.
- Elevate performance through tighter pollutant thresholds, advanced ventilation, source control, and occupant awareness.
- Design for flexibility, supporting filter upgrades and advanced systems.
- Balance air quality and energy through purification technologies like UVGI, energized filtration, and ERVs.

This framework optimizes occupant health and indoor wellness while aligning with sustainable, resilient building practices.

Phase	Key Air Filtration Practices
Design/Prerequisite	Follow ASHRAE 62.1-2022 for minimum ventilation and monitoring
Enhanced Strategies	Add entryway systems, enhance ventilation by +30%, install CO_2 monitoring
Construction	Use IAQ plan (SMACNA), protect materials, avoid running HVAC without filtration

Summary

Maintaining high air quality in data centers is essential for IT equipment Integrity, longevity and operational efficiency all while striving to achieve energy savings. The use of the air filtration, molecular filters, and proper airflow management outlined in this guide helps reduce contamination risks. Regular monitoring and maintenance ensure optimal filter performance while balancing energy consumption.Implementing a structured air filtration strategy, using high-efficiency filters, and following industry standards from ISO, NAFA, ASHRAE, WELL, and USGBC ensures that contamination risks are minimized and data center performance is optimized.

KEY RECOMMENDATIONS FOR YOUR HVAC SYSTEM

- Run the HVAC whenever the space is occupied.
- Direct the clean/cleaned air into the breathing zone in each occupied space.
- Return air vents should pull air from the room and not directly from the clean air inlet.
- Maintain temperature and humidity design set points.
- Set the HVAC system to bring in as much outside ventilation air as possible.

KEY RECOMMENDATIONS FOR FILTER MAINTENANCE

- To achieve the recommended MERV 13-equivalent or better levels of performance (which removes ≥85% of 1-3 µm particles), a combination of filters/air cleaners can be used.
- Use only air cleaners for which evidence of effectiveness and safety is clear.
- When upgrading filters, carefully monitor to ensure your current system can handle the upgrade (e.g. pressure drop).
- Upgrading both pre-filters and filters may cause unacceptable pressure drop. It may not be necessary to upgrade both.
- Consider using the AHAM Clean Air Delivery Rate (CADR) for sizing air-cleaners for your space.
- Confirm filters are sealed in their frames, preferably with gaskets to prevent filter bypass.
- Personnel changing filters should wear PPE. Dispose of spent filters immediately and in a safe manner.

DID YOU KNOW?

Studies with SARS CoV-1 have shown that toilet flushing can generate airborne droplets and aerosols that could contribute to transmission of pathogens. Remember to:

- Keep toilet room doors closed, even when not in use.
- Encourage putting the toilet seat lid down, if there is one, before flushing.
- Keep bathroom fans running continuously and vent separately, where possible.

Glossary

Term	Definition
Activated Carbon Filter	Molecular filtration media that removes gaseous contaminants such as VOCs, ozone, and corrosive gases (H_2S, SO_2).
AHU (Air Handling Unit)	HVAC component that conditions and circulates air. In data centers, integrates filtration, cooling, and humidity control.
Angstrom (Å)	The angstrom is a unit of length equal to 10^{-10} m; that is, one ten-billionth of a metre, a hundred-millionth of a centimetre, 0.1 nanometre, or 100 picometres.
ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers)	Professional association that sets HVAC standards, including ASHRAE 52.2 (filter testing), ASHRAE 62.1 (ventilation), and TC 9.9 (data center guidelines).
Bypass Leakage	Air passing around a filter instead of through it due to poor installation or sealing, reducing efficiency.
CRAC (Computer Room Air Conditioner)	Precision cooling unit for data centers, maintaining strict control of temperature and humidity.
CRAH (Computer Room Air Handler)	Uses chilled water or other methods to condition and distribute filtered air to IT spaces.
Magnehelic	Measures pressure drop across a filter to determine when replacement is needed.
DOAS (Dedicated Outdoor Air System)	HVAC system that brings in and conditions outdoor air, requiring robust filtration (MERV 13 or higher).
Electrostatic Filters	Filters with charged fibers to capture airborne particles; efficiency may decline as charge dissipates.
ESD (Electrostatic Discharge)	Sudden static electricity release that can damage IT equipment. Managed through humidity control and filtration.
Face Velocity (FPM – Feet per Minute)	Speed of air moving across the face of a filter; excessive velocity can reduce filter performance.
Free Cooling / Air-Side Economization	Cooling strategy using outdoor air to reduce mechanical load. Requires stronger filtration for contaminants.
Gaseous Contamination (Corrosion Control)	Molecular pollutants (sulfur compounds, VOCs, emissions) that corrode IT hardware.
HEPA (High-Efficiency Particulate Air Filter)	Captures 99.97% of particles ≥0.3 microns. Used in cleanrooms and ultra-sensitive IT environments.

Glossary (continued)

Term	Definition
IAQ (Indoor Air Quality)	Condition of indoor air relative to particulates, gases, humidity, and temperature. Critical in data centers for hardware reliability.
ISO 14644-1	Cleanroom standard defining maximum allowable particle concentrations for different cleanliness classes.
LEED (Leadership in Energy and Environmental Design)	USGBC certification program promoting sustainable and efficient building practices. Data centers earn credits via advanced filtration.
MERV (Minimum Efficiency Reporting Value)	ASHRAE 52.2 rating for filter effectiveness (1–16). • MERV 8: Large particles (dust, pollen). • MERV 11–13: Smaller particulates, recommended for data centers. • MERV 13+: Required for outside air
Molecular Filtration	Filtration that removes gases and odors using activated carbon or chemically treated media.
NAFA (National Air Filtration Association)	Organization publishing best practice filtration guidelines, supplementing standards like ASHRAE, ISO, and USGBC.
OEM (Original Equipment Manufacturer)	The maker of HVAC or IT cooling equipment. OEM specs define proper filter types, ratings, and replacement intervals.
Pressure Drop	Resistance to airflow through a filter (in. w.g.). Lower pressure drop = better energy efficiency; high drop increases HVAC strain.
Pre-Filtration	First-stage filtration (MERV 8 or similar) to capture larger particulates and extend life of final filters.
TCO (Total Cost of Ownership)	Lifecycle cost framework covering purchase, energy use, maintenance, and disposal of filters.
VOC (Volatile Organic Compounds)	Airborne chemicals (fuels, emissions, building materials) that corrode electronics and reduce IAQ.
WELL Building Standard	Certification program (IWBI) emphasizing occupant health and wellness, including air quality optimization.

Bibliography

ASHRAE Standard 62.1-2022 – Ventilation for Acceptable Indoor Air Quality.

ASHRAE Technical Committee 9.9 – Data Center Thermal Guidelines.

ASHRAE Standard 52.2-2025 Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

ISO 14644-1:2015 – Cleanrooms and Associated Controlled Environments.

NAFA Guide to Air Filtration

NAFA Technicians on Site Guideline

WELL Building Standard for Air Quality Optimization.

NAFA Best Practice Guidelines – Filtration for Molecular Filtration

USGBC LEED IAQ Standards.

Institute of Environmental Sciences and Technology (IEST)

For additional information, visit www.nafahq.org.

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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 practices. NAFA encourages the user to work with a NAFA Certified Air Filter Specialist (CAFS), to ensure that these guidelines address user specific equipment and facility needs. Issues regarding health information, including COVID- 19, may be superseded by new developments in the field of industrial hygiene or by new information revealed by experts in science/medicine. Users are therefore advised to regard these recommendations as general guidelines and to determine whether new information is available.

Send questions to nafa@nafahq.org