Best Practice Guidelines

Filtration for Hospitals and Healthcare Facilities: Surgical and Sterile Environments



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Filtration for Hospitals and Healthcare Facilities: Surgical and Sterile Environments

NAFA guidelines provide 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. Our guidelines are created and updated to collect and supplement existing information. However, we go beyond the "bare minimum," publishing best practices based on the experience and expertise of our membership, as well as current mandates and research provided by governmental and scientific communities.

For a more complete explanation of principles and techniques found in this guideline, visit www.nafahq.org to purchase the *NAFA Guide to Air Filtration*. If you have any questions or comments about this publication, please contact NAFA Headquarters.

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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

Minimum MERV Requirements

In reference to the NAFA Best Practice Guidelines, MERV recommendations refer to the baseline filtration efficiency levels that HVAC air filters should meet to achieve effective indoor air quality and protect building occupants, equipment, and systems. MERV (Minimum Efficiency Reporting Value) is a standardized rating determined by ANSI/ASHRAE Standard 52.2 that quantifies a filter's ability to capture airborne particles of varying sizes.

The recommendations set forth by the NAFA Best Practice Guidelines are produced by intense research into industry-wide best practices from accredited organizations such as (but not limited to) ASHRAE, ANSI, EPA, ISO, and Industry Experts. The Guidelines Committee researches, compiles, and analyzes this data, along with their own Industry Experiences to produce a comprehensive document.

NAFA's objective is to go beyond minimum standards set by other organizations. For example, in many commercial and institutional settings, NAFA's best practice recommendations typically call for a MERV 13 air filter to effectively remove fine particulate matter (PM2.5) that can impact occupant health and harm sensitive equipment performance. Lower MERV-rated filters (e.g., MERV 8) may be acceptable for pre-filtration stages, or less demanding environments, but NAFA's best practices strive to elevate performance above these basic minimums.

By specifying appropriate MERV requirements tailored to system design and environmental conditions, NAFA guidelines help industry professionals make informed decisions that improve indoor air quality, increase occupant wellbeing, and support HVAC system operation and longevity.

MERV Statement: Version 1, May 2026

Purpose, Scope and Background

1 PURPOSE

This best practice guideline establishes air filtration recommendations for surgical and sterile healthcare environments where contamination control is directly tied to patient outcomes. 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 is intended to give owners, facility managers, and mechanical designers the necessary information to develop effective filtration strategies that protect patients, staff, and equipment in the highest-risk clinical spaces.

This guideline is one in a series of publications addressing air filtration within hospitals and healthcare facilities. Given the breadth and complexity of filtration requirements across the many distinct environments found in these facilities — from surgical suites to sterile processing, from isolation rooms to general patient care areas — NAFA has determined that a single, comprehensive document cannot adequately serve the specific needs of each application. Instead, this series presents focused application-specific guidelines, allowing filtration professionals to reference targeted best practices tailored to each distinct area of the healthcare environment, ensuring more precise and actionable recommendations.

2 SCOPE

This best practice guideline addresses filtration practices for surgical and sterile applications including, but not limited to:

- Operating Rooms (OR)
- Hybrid ORs
- Procedure Rooms
- Endoscopy Suites
- Sterile Processing Clean Areas

These spaces share a common requirement: airborne particulate and bioaerosol levels must be minimized at the point of use, and pressure relationships must be actively controlled and verified, not merely assumed. This guideline addresses filter efficiency selection, HEPA application, pressure control, and air quality monitoring. It also includes operating and maintenance considerations specific to these spaces.

This guideline is written to complement, not replace, the following governing industry standards and guidance documents:

ANSI/ASHRAE/ASHE Standard 170, ***Ventilation of Health Care Facilities*** Sets the baseline minimum air change rates, pressure relationships, and filtration efficiencies for each healthcare space type. The recommendations include a minimum of 20 total air changes per hour (at least 4 of which must be outdoor air), a minimum MERV 16 filtration efficiency for ORs, and a positive pressure of at least +0.01 in. w.g. relative to adjacent spaces.

Purpose, Scope and Background

ASHRAE Standard 52.2, *Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size* Defines the MERV rating methodology referenced throughout this guideline.

ANSI/ASHRAE/ACCA Standard 180, *Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems* Establishes the minimum inspection, testing, and maintenance cadence needed to preserve the design performance of filtration and air distribution systems over the life of the facility.

ASHRAE Standard 241, *Control of Infectious Aerosols* — Builds on the outdoor air and filtration minimums of Standard 170/62.1 by defining Equivalent Clean Airflow (ECA) targets and an Infection Risk Management Mode (IRMM) that facilities can invoke, through a Building Readiness Plan, to increase ventilation and air cleaning during periods of elevated infection risk.

Facility Guidelines Institute (FGI), *Guidelines for Design and Construction of Hospitals* Adopted by most state licensing authorities and incorporates ASHRAE 170 by reference as the enforceable ventilation baseline for new construction and major renovation. FGI defines room-by-room space requirements for surgical and sterile environments, including Operating Room (ORs) classification (Class B/C), Infection Control Risk Assessment (ICRA) requirements during construction, and minimum finish and containment criteria that work alongside ASHRAE 170's air change and filtration values.

ASHRAE Technical Committee 9.6 (Healthcare Facilities) Maintains the ongoing research and technical guidance base behind Standard 170 and related healthcare ventilation practice. For more information, visit tc0906.ashraetcs.org.

USP General Chapters <797>/<800> Governs pressure cascade, air change rate, and HEPA filtration requirements specific to sterile and hazardous compounding pharmacies.

3 BACKGROUND

Surgical site infections (SSIs) and other healthcare-associated infections remain a leading source of preventable patient harm. Airborne particulate, including skin squames, lint, and bioaerosols shed by staff and patients, is a recognized vector for contamination in the sterile field. Because these spaces cannot rely on occupant awareness or behavior alone to control risk, the mechanical system is the primary and continuous line of defense.

ASHRAE 170 has historically served as the enforceable engineering baseline for these spaces and is incorporated by reference into the FGI Guidelines used by most state licensing bodies. FGI further defines the space-by-space design requirements, room classifications, and construction protections (ICRA) that surround the ventilation values set in ASHRAE 170. More recently, ASHRAE 241 has introduced a complementary framework: rather than a single fixed design minimum, it defines an Equivalent Clean Airflow rate that can be met through a combination of outdoor air, filtration, and air cleaning, and allows facilities to elevate performance during an Infection Risk Management Mode.

NAFA Best Practices Recommendations

1

HEPA Filtration vs MERV 16 Final Filters

HEPA filtration, rated at 99.97% efficiency on 0.3 micron (µm) particles per IEST RP-CC001 (or EN 1822 H13), must be applied at supply terminals serving ORs, Hybrid ORs, and other spaces where Facility Guidelines Institute (FGI) and ASHRAE 170 designate HEPA as required. HEPA filters must be factory-certified with documentation, installed in leak-free frames with gasketed seals, and field-tested in place by a certified technician using photometer or particle-counter scan methods after installation and periodically thereafter, consistent with the commissioning and verification expectations of ASHRAE 180 and 241.

Where terminal HEPA filtration is not mandated, NAFA recommends the final filter be rated MERV 16, tested and rated in accordance with ASHRAE 52.2-2025. NAFA recommends a three-stage filter arrangement, consisting of a MERV 10 prefilter, MERV 13 secondary filter, and a MERV 16, or HEPA final filter. The prefilter and secondary filter will extend final filter life, while maintaining consistent airflow and pressure drop.

2

Positive Pressure Control

ORs, Hybrid ORs, Procedure Rooms, and Sterile Processing clean/prep areas should be maintained at positive pressure relative to adjacent, less-clean spaces, with airflow directed from clean to less-clean areas, consistent with the ASHRAE 170 requirement of at least +0.01 in. w.g. positive pressure and 20-25 total air changes per hour (with at least 4 air changes of outdoor air) for ORs. USP <797> compounding pharmacies require similarly engineered pressure cascades between buffer, ante, and containment areas. Door seals, pass-throughs, and envelope penetrations should be inspected regularly, as pressure relationships are only as dependable as the space's physical containment.

3

EQUIPMENT CONSIDERATIONS

Central or Dedicated Air Handling Unit (AHU)



The AHU serves the OR suite conditions and filters both outdoor air and return air before it reaches the terminal HEPA units at the room level. This unit typically houses two filtration stages: a MERV 10 prefilter to capture larger particulate and protect downstream components, followed by a MERV 14 final filter. ASHRAE 170 sets MERV 14 as the central-station filtration efficiency for spaces served by terminal HEPA filtration, NAFA recommends MERV 14 as a minimum even where local codes allow for less. It is important to keep in mind that the AHU filter bank is the primary defense against particulate contamination prematurely loading the HEPA filters, thus extending their effective filter life.

Recommended filter: Two-stage MERV 10 prefilter / MERV 14 final filter, tested to ASHRAE 52.2.

NAFA Best Practices Recommendations

4

Terminal HEPA Filter–Diffuser Modules



Mounted in the ceiling directly above the sterile field, these unidirectional (laminar) airflow units are the last stage of filtration before air enters the OR and are the single most critical filtration component in the room. Because they are deployed at the point of use, any leak, bypass, or degradation of the filter or holding apparatus has an immediate and direct effect on the sterile field. These modules combine a diffuser plenum with a factory-sealed HEPA cell and should be field leak-tested by a certified technician with a photometer or particle counter at commissioning and on a recurring schedule thereafter.

Recommended filter: HEPA, minimum 99.97% efficient at 0.3µm (IEST RP-CC001 / EN 1822 H13), factory-certified and installed in a gel-seal or gasketed frame to eliminate bypass.

5

Low Wall Return and Exhaust Grilles



Return and exhaust grilles, typically positioned low on opposing walls to support the unidirectional downward airflow pattern from the terminal HEPA modules, do not require HEPA-level filtration themselves but should include a replaceable prefilter to keep debris out of the return ductwork and to prevent re-entrainment of settled particulate into the airstream.

Recommended filter: MERV 10 disposable prefilter at the grille or return duct inlet.

6

Portable/Supplemental HEPA Recirculation Units



Portable HEPA recirculation units are increasingly used as a supplemental or surge-capacity measure. They are often utilized to temporarily convert a room to negative pressure in order to create an airborne isolation area, or to raise Equivalent Clean Airflow during an ASHRAE 241 Infection Risk Management Mode event.

These units are not a substitute for the fixed terminal HEPA system but provide flexible and additive filtration capacity.

Recommended filter: HEPA, minimum 99.97% efficient on 0.3µm size particles, at the unit manufacturer's rated airflow, with a MERV 10 prefilter to extend HEPA service life.

NAFA Best Practices Recommendations

Location / Component	Filtration Requirement	Notes
Supply Terminals (ORs, Hybrid ORs)	HEPA, 99.97% @ 0.3µm size particulate. IEST RP-CC001 or EN 1822 H13.	HEPAs should be Factory-certified, leak-free gasketed frames, field-tested via photometer/particle-counter scan at commissioning and periodically thereafter, per ASHRAE 180/241. ASHRAE 170 recommends OR supply-air minimum filtration of MERV 16 where HEPA is not mandated.
Central or Dedicated AHU	Two-stage: MERV 10 prefilter, MERV 14 final filter.	ASHRAE 170 recommends MERV 14 as central-station minimum for HEPA-served spaces; NAFA recommends MERV 14 as a minimum regardless of whether local codes permit lower efficiencies.
Terminal HEPA Filter–Diffuser Modules	HEPA, min. 99.97% @ 0.3µm (IEST RP-CC001 / EN 1822 H13), factory-certified, gel-seal or gasketed frame.	Ceiling-mounted above sterile field; unidirectional (laminar) array; last stage before air enters OR; field leak-tested at commissioning and on a recurring schedule by a certified technician.
Low Wall Return / Exhaust Grilles	MERV 10 disposable prefilter.	Positioned low on opposing walls to support downward unidirectional airflow; prevents debris/re-entrainment into return ductwork; no HEPA-level filtration required.
Portable/Supplemental HEPA Recirculation Units	HEPA, min. 99.97% @ 0.3µm size particulate, sized to unit's rated airflow, with MERV 10 prefilter.	Supplemental/surge capacity — e.g., temporary negative-pressure conversion or ECA boost during ASHRAE 241 Infection Risk Management Mode; not a substitute for fixed terminal HEPA.
Anesthesia Gas Scavenging/ Molecular Filtration	Activated carbon or potassium-permanganate-impregnated media, sized to specific agents in use.	Only where scavenging is integrated with room air handling return rather than ducted directly outdoors.

Installation, Operation & Maintenance

Filter housings and terminal HEPA units in these spaces should be installed with rigid, leak-tested frames and inspected on a schedule defined by the manufacturer's recommendations for gasket integrity and bypass by a certified technician. Maintenance activities, including filter change-out, should be scheduled and documented to avoid disrupting scheduled room procedures, and change-out of terminal HEPA filters should follow manufacturer-specified procedures to prevent contamination during replacement.

Inspection and maintenance intervals should follow the practices established in ASHRAE Standard 180, which sets the baseline for HVAC inspection and maintenance programs needed to preserve a system's designed thermal comfort, energy efficiency, and indoor air quality performance.

Any renovation, construction, or filter-system work affecting a surgical or sterile space should be planned and executed under an Infection Control Risk Assessment (ICRA), as required by FGI, to protect adjacent occupied clean spaces from construction-generated particulate and pressure disruption during the work.

Facilities should maintain records of ACH, room pressure differentials, and filter performance as part of their infection prevention and engineering program, consistent with CDC (Centers for Disease Control) guidance for environmental infection control in health-care facilities.

Frequency	Task	Responsible Party
Daily	Pressure differential log, visual gauge check	OR/Facilities Staff
Weekly	Airflow and ACH spot check	Facilities Engineer
Monthly	Filter inspection, gauge calibration	Facilities Engineer
Quarterly	MERV/HEPA filter change-out on an *as-needed* basis	NAFA **CAFS**/Contracted Vendor
Annual	Full system certification, **CAFS** audit	NAFA **CAFS** / Engineer of Record

The above table outlines a tiered maintenance and monitoring schedule for OR and sterile environment air filtration systems, ensuring sustained filtration performance and reduced SSI risk.

TECHNICIAN SUPPLIES

Servicing air filtration systems in ORs and Sterile Supply/Storage requires an elevated PPE supply set beyond NAFA's standard recommendations, given the critical nature of these spaces. In addition to eye protection, gloves, masks, coveralls, safety boots, and hearing protection, technicians should carry low-shedding scrubs or coveralls, bouffant caps, and shoe covers to prevent particulate contamination of sterile fields. HEPA-filtered vacuums and lint-free wipes should replace standard cleaning tools. Gaskets, fasteners, and filter-handling equipment should be dedicated for the OR and equivalent spaces. If not, then the equipment must be sanitized between use.

As with all NAFA guidelines, technicians should maintain working knowledge of HVAC systems, lock-out/tag-out procedures, and confined space protocols, adapted here to the added demands of maintaining sterility and positive pressure integrity.

	**Personal Protective Equipment (PPE)** Eye protection, respirator/mask, and gloves form the baseline for safe filter handling, adapted for sterile-field compatibility. Coveralls and hearing protection should be added where mechanical or containment work is required.
	**Differential Pressure Gauges** Magnehelic gauges or manometers are used to monitor filter loading and pressure drop across the filter bank, and to confirm positive pressure relationships required by ASHRAE 170.
	**Specialized Procurement/Lift Devices** Lift equipment allows technicians to safely raise and lower filters at difficult-access points, such as ceiling-mounted OR housings, without direct manual handling near the sterile field.

Continuous Monitoring

Differential pressure between critical spaces and adjacent areas should be continuously monitored and integrated into the building automation system with alarms for out-of-range conditions, in line with ASHRAE 170's requirement that pressure relationships be documented at design and verified during testing and balancing. Filter pressure drop should be tracked to inform change-out scheduling based on actual loading rather than fixed calendar intervals. Endoscopy suites and procedure rooms should be included in routine ACH and pressure verification programs even where code does not mandate continuous electronic monitoring. Facilities should also evaluate whether an ASHRAE 241 Building Readiness Plan is warranted, allowing critical spaces to shift into Infection Risk Management Mode (raising Equivalent Clean Airflow through additional outdoor air, filtration, or supplemental air cleaning) during periods of elevated regional or facility-level infection risk.

Installation, Operation & Maintenance

Conclusion

The selection and operation of filtration products in an Operating Room and Surgical Sterile Environments is a system-level decision, not a single-product choice. NAFA recommends engaging mechanical engineers, filter and equipment manufacturers, and NAFA CAFS to effectively size, specify, install, and maintain filtration equivalent clean airflow (ECA), along with room pressure relationships. A collaborative approach ensures compliance with ASHRAE 170 while minimizing SSI risk and supporting long-term system performance.

NAFA recommends installation, monitoring, and maintenance of air filtration systems be performed by technicians trained to NAFA's Certified Technician (NCT) standards and equipped for the unique demands of ORs and Sterile Supply/Storage areas. Their knowledge is essential to sustaining the sterile environments these spaces require. Coordination with Infection Prevention, adherence to ICRA/ILSM protocols, and diligent pressure and airflow verification protect both patients and staff throughout construction, renovation, and routine service.

As healthcare facilities face increased scrutiny around infection control and airborne pathogen transmission, air filtration should be viewed as a foundational safeguard rather than a compliance checkbox. NAFA encourages facility managers, infection preventionists, and design teams to partner with a NAFA CAFS to ensure best practices are correctly applied to their specific facility needs.

You care about your residents and employees.
You care about the environment and your community.
You care about the fiscal health of your institution.
Indoor air quality matters.

COSTS OF POOR AIR QUALITY
Lost productivity
Decreased Health
Increased absenteeism
Increased Equipment Maintenance/Replacement
Increased Energy

BENEFITS OF IMPROVED AIR QUALITY
Reduced absenteeism
Increased productivity
Improved health, wellness and satisfaction

Extraordinary events such as wildfire smoke and the COVID-19 pandemic have created a heightened awareness for cleaner air and better filtration in the built environment. People expect to feel safe and healthy in the buildings where they live, learn, work, and play.

Today the industry is challenged to meet new guidelines and standards for healthier buildings that were never designed physically, nor mechanically, to meet these recommendations.

At NAFA we understand the challenge and suggest the following recommendations:

- Designing new or modifying existing HVAC filter banks to accommodate more filters at higher efficiencies without increasing energy demand.

- Designing extended space within the mechanical systems for deploying additional banks of filters during extraordinary events such as wildfire smoke, or ASHRAE's Infection Risk Management Mode (IRMM) per ASHRAE Standard 241.

We acknowledge that these recommendations are not always feasible with existing mechanical systems but know that they can be accomplished when designing new HVAC systems or replacing/retrofitting older ones. We have learned from past extraordinary events that we need to plan for them to properly keep people healthy, safe, and productive; and the best time to do this is at the design phase.

Glossary

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

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 an exam on air filtration.

ECA: Equivalent Clean Airflow, as defined in ASHRAE Standard 241; the flow rate of pathogen-free air that would have the same effect on infectious aerosol concentration as the sum of actual outdoor airflow, filtered airflow, and inactivation of infectious aerosols.

FGI: Facility Guidelines Institute, publisher of the Guidelines for Design and Construction of Hospitals.

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.

ICRA: Infection Control Risk Assessment, a process required by FGI to evaluate and mitigate the risk of construction or renovation activity on adjacent occupied healthcare spaces.

IRMM: Infection Risk Management Mode, an operating mode defined in ASHRAE Standard 241 for periods of elevated infectious aerosol risk.

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

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

NCT: NAFA Certified Technician certification for those who work with commercial/industrial air filtration solutions.

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

Pressure Cascade: is the regulation of pressure in an operating room (or SSI) to be either negative or positive pressure based on the needs of the occupants

SSI: Surgical site infection.

Squame: small, thin flake or scale of dead skin tissue

W.G. : Water Gauge, is used to measure static pressure in air ducts, blowers, and filters.

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Send questions to: nafa@nafahq.org