Air Filtration in Healthcare

Leadership in Filtration

MANN+HUMMEL

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Filtration in the Future: Preparing the Healthcare Industry

The demands on healthcare have drastically escalated in the wake of the pandemic. These demands include the need for improved and effective air filtration. The requirements from the filter program in these demanding times include:

REDUCING HEALTHCARE ASSOCIATED INFECTIONS (HAIs)

The reduction of HAIs should be an ongoing goal of every healthcare facility as these can affect the life and well being of patients, visitors and staff. HAIs also create a negative economic impact with potential financial penalties and associated expenses treating the nosocomial infections.

REAL, VERIFIABLE COST SAVINGS

Healthcare facilities are under enormous pressure to create real, verifiable and continual cost savings. An effective filtration program can and should provide cost savings through the total life cycle including energy savings, disposal, labor saving, and more.

EXCEPTIONAL FILTER PERFORMANCE THROUGHOUT THE LIFE CYCLE

Choosing the correct filter for the demanding applications in healthcare facilities is very important. To have your filtration system contribute to your overall goals, the filter will have to provide superior and consistent performance throughout the life of the filter – from installation to change-out.

REAL SUSTAINABILITY

Sustainability and reduced carbon footprints are common goals in healthcare so when putting together a filter program these are important considerations. Not only should the filters further sustainability goals, but the manufacturer should also be committed to similar goals. Achieving sustainability goals is one of our top priorities at MANN+HUMMEL.

MOLECULAR CONTAMINANT CONTROL

While pathogen control gets the spotlight in healthcare filtration, molecular control is also important. Patients in a healthcare facility are there for some health-realted reason and being exposed to elevated levels of contaminants is concerning. Due to the nature of most hospital designs, it is nearly impossible to prevent helicopter and ambulance exhaust from entering the facility, but molecular solutions can help.

Air Filtration Standards & Requirements

There are several guidelines and governing bodies for healthcare facilities: Joint Commission (JCAHO), Facility Guidelines Institute (FGI) Guidelines for planning, designing and constructing healthcare facilities, American Society for Health Care Engineering (ASHE) to name a few. Most rely on the ANSI/ASHRAE/ASHE Standard 170-2021 Ventilation of Health Care Facilities for all issues related to ventilation and filtration efficiencies. Below is the table from Appendix D.

TABLE D-1 MINIMAL FILTER EFFICIENCIES BY SPACE TYPE

LEVEL	SPACE CATEGORY	FILTER EFFICIENCY RECOMMENDATIONS [a,b]
I	• Primarily exhausted space (e.g., restrooms, janitor's rooms) • Any human-occupied space • Any room, inpatient or outpatient, where a patient stays less than 6 hours including waiting rooms • Laboratories • Resident rooms in assisted living or hospice • Storage of packaged sterile material, clean linen, or pharmaceuticals [c] • Treatment rooms, endoscopy procedure room • Dirty side of decontamination process	MERV 8 (equivalent to ASHRAE 62.1 or standard 62.2)
II	• Inpatient spaces, including medical-surgical, airborne isolation [d] • Special exam room for suspect airborne cases, emergency department exam rooms [e] • Resident room in skilled nursing area • Workroom for parking of sterile materials • CT or MRI procedure, interventional radiology (including biopsy), or bronchoscopy • ER procedure or trauma room	MERV 14 [f,g]
III	• Operating room [h]	MERV 16 [f]
IV	• Operating room designated for orthopedic, transplants, neurosurgery, or dedicated burn unit procedures • Protective environments, including burn units	HEPA

NOTES:
a. Where listed, MERV rating is assumed to be non degrading.
b. Transfer air due to differences in pressure between spaces may be unfiltered.
c. Pharmacy compounding spaces are not covered in this table. Follow USP 795, USP797, or USP 800, as applicable (see Section 11 references).
d. Does not include recirculated air. Air recirculated in an AII room requires HEPA filters.
e. Air from spaces where suspected airborne causes may be treated or examined should be filtered at level II prior to recirculation to other spaces. If exhausted, supply air filtration may be level I.
f. Minimum MERV rating of the highest efficiency filter in the air stream.
g. Filter efficiency if supply air is used; not intended to exclude natural ventilation if otherwise allowed.
h. An optional risk assessment, conducted with the user group, may indicate a need to increase from Level III to Level IV.

NOTE:
The above table is taken from Appendix D of ANSI/ASHRAE/ASHE 170-2021 and is provided for information purposes only. Check for updates and purchase a copy of the standard from "http://www.ashrae.org" before using this information as guidance.

Air Filtration Requirements for Compounding Pharmacies

The United States Pharmacopeia (USP) is an independent scientific nonprofit organization that has as their main focus to ensure safe and reliable medicine, dietary supplements and foods.

USP 797/800 OVERVIEW:

USP 797 - ENSURES THE STERILITY OF COMPOUNDED STERILE PREPARATIONS TO PROVIDE SAFE MEDICINE.

• The compounding environment is critical to providing a sterile preparation. USP 797 requires a dedicated space designed to minimize the risk of contamination, this cleanroom suite includes a cleanroom including buffer and ante areas. This cleanroom is constructed and maintained to meet rigorous purity standards.

USP 800 - COVERS THE HANDLING OF HAZARDOUS DRUGS THAT PROTECTS PATIENTS, WORKERS AND ENVIRONMENT.

• UPS 800 has requirements for containment engineering controls like local containment devices, ventilation systems and air pressure differential to minimize the release of hazardous particles. These controls help prevent cross-contamination, safeguard staff and patients, and maintain the integrity of the cleanroom environment.

Both standards emphasize the importance of maintaining a sterile and controlled environment for compounding sterile preparations and handling hazardous drugs. They share focus on personnel training, PPE, and environmental controls, this includes factors such as proper

MANN+HUMMEL MIRCOLOCK HEPA BAG IN/BAG OUT:

The MANN+HUMMEL Bag-in/Bag-wout HEPA housing is frequently utilized in healthcare settings for contaminated patient room exhaust systems (ASHRAE 170), as well as to capture hazardous contaminants in radiologic exhaust systems for nuclear laboratories within healthcare facilities.

MICROLOCK HEPA BAG IN/BAG OUT

- Designed for critical applications
- Utilize bag-in/bag-out system to change filters
- Available in gasket or gel seal
- Available in 304L, 316 stainless, or aluminized steel
- Optional prefilter section

Pressures of HAI Problems in Healthcare

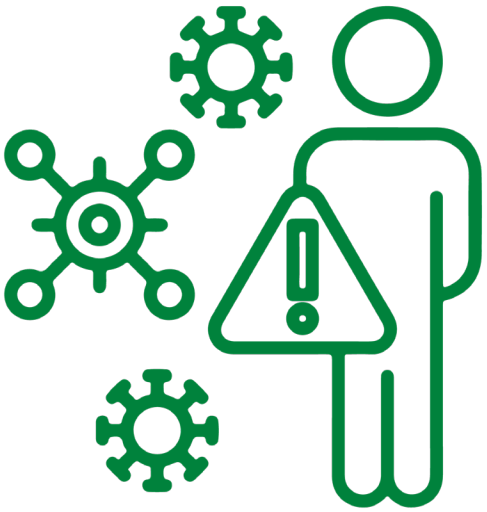
HOSPITAL-ACQUIRED INFECTIONS (HAIs) INCUR SIGNIFICANT COSTS, IN TERMS OF BOTH HUMAN HEALTH AND FINANCES.

- ESTIMATES OF 700,000 TO 1.7 MILLION ANNUAL HEATH CARE-ASSOCIATED INFECTIONS[1]
- 1 IN 31 HOSPITAL PATIENTS AND 1 IN 43 NURSING HOME RESIDENTS HAVE AN HAI[2]
- 75,000 TO 98,000 ANNUAL DEATHS ESTIMATED[1]
- MORE THAN HALF OF ALL HAIs OCCURRED OUTSIDE OF THE ICU[2]
- MORE THAN 70% OF THE BACTERIA THAT CAUSE HAIs ARE RESISTANT TO AT LEAST ONE OF THE DRUGS MOST COMMONLY USED TO TREAT THEM[3]
- THE OVERALL DIRECT COST OF HAIs TO HOSPITALS RANGE FROM $28 BILLION TO $45 BILLION[3]
- A STUDY BY DUKE UNIVERSITY DOCUMENTED THE COST OF POST-SURGICAL INFECTIONS TO BE $60,000 PER PATIENT

1-Health care-associated infections – an overview by Haque, Sartelli, McKimm and Abu Bakar 2018 Infection and Drug Resistance Journal

2-HAI Data and Statistics published by the DOC

3-Economic burden of healthcare- associated infections: an American perspective by Patricia W Stone



It is no longer simply good enough to use an equivalent product or service. MANN+HUMMEL's products and services provide real solutions to your filtration issues in the healthcare industry and prepare you for the demands of tomorrow.

Reducing the Risks: Our HAI Solutions

While proper air filtration is not the single solution to eliminating HAI's, it is an important method in reducing the risk of HAI's and the impact they have on the healthcare industry. The MERV efficiencies listed in the ASHRAE 170 standard are listed as 'minimum filtration efficiencies.' The increase in filter removal efficiency, even a small increase, makes a big difference in risk reduction.

The diagram below shows the difference in particle concentrations between a MERV 16 filter compared to a MERV 14 filter. This is based upon ASHRAE 52.2 efficiencies at 1 micron which is the target particle size for airborne microbials. This reduction of over 95% of the target particle size is simply due to using a higher MERV rating filter.

MERV 16 Filtration

MERV 14 Filtration

MANN+HUMMEL RECOMMENDS:

VB4 ELITE/ULTRA
- Fiberglass & synthetic media
- Available in MERV 15 & 16 efficiency
- High burst resistance

PROPOCKET HYBRID
- Hybrid media
- Stout peripheral header
- Various depths & pocket combinations available
- Available in MERV 13, 15 & 16 efficiency

MICROBARRIER HEPA MP HEPA/ HEPAMAX
- Efficiencies available from 99.97% to 99.99% @ 0.3 µm
- Variety of frame materials - both MDF particleboard, galvanneal & plastic

Cost Savings Demands in Healthcare

THERE IS IMMENSE PRESSURE TO REDUCE EXPENSES WITHIN THE HEALTHCARE SECTOR.

THE RISING COSTS OF MEDICAL CARE AND TREATMENTS, HAVE PROMPTED HEALTHCARE PROVIDERS, HOSPITALS, AND INSURERS ALIKE TO SEEK WAYS TO CUT COSTS WITHOUT COMPROMISING PATIENT CARE.

THE CONSTANT NEED TO IMPROVE PERFORMANCE AND MEET HIGHER STANDARDS ALSO CREATES A CHALLENGE IN REDUCING COSTS IN HEALTHCARE. AS EXPECTATIONS FOR BETTER QUALITY AND MORE ADVANCED FEATURES GROW, FINDING WAYS TO CUT EXPENSES WITHOUT COMPROMISING ON THESE DEMANDS BECOMES INCREASINGLY DIFFICULT.

FINDING REAL, VERIFIABLE COST SAVINGS CAN ALSO BE VERY CHALLENGING DUE TO THE INABILITY TO PROPERLY MEASURE AND TRACK INTANGIBLE FINANCIAL FACTORS.

These pressures have resulted in the increasing importance of the purchase price and have almost completely ignored the **Life Cycle Cost (LCC), which is the real cost of ownership** over the filter's life. LCC includes original purchase price, anticipated energy savings, shipping and storage, filter changing labor and disposal cost, system hygiene cost and the reduction of HAIs among other factors.

Cost Savings Opportunities: Our Solutions

In healthcare facilities, HVAC systems are typically responsible for 33% of the electrical and 56% of the natural gas[1] consumption. Because they are the greatest source of expenses, it makes sense to find cost savings around your HVAC system and its use of energy. A good cost savings plan will include an air filtration audit to ensure you are using the most cost effective and efficient products. In addition, it is important to ensure you are changing your air filters when they need it – not just routinely. Generally, using an air filter with a lower pressure drop (resistance) will result in energy savings leading to cost savings, however you must also consider the blower motor in your HVAC system to determine actual measurable cost savings. In addition to energy savings, choosing an air filter with a longer life cycle allows for fewer change-outs which means less downtime for your system and reduced overall maintenance costs. Not sure where to start? We can help.

A REAL COST REDUCTION PLAN SHOULD INCLUDE:

ENERGY ANALYSIS
- Reduced pressure drop

SYSTEM HYGIENE
- Coil cleanings, reduced hygiene cleaning

EXTENDED SERVICE LIFE
- Reduced filter changes
- Reduced landfill waste
- Reduced labor cost
- Reduced shipping/storage, etc

MANN+HUMMEL RECOMMENDS:

TRI-DEK® CUBES
- Extended surface filters
- Available in 2, 3, 4 ply
- MERV 11 & MERV 13

VB4 XL 17 ELITE/ULTRA
- Fiberglass & synthetic media
- MERV 15 & MERV 16
- High impact polystyrene (HIPS) cell sides

MICROBARRIER HEPAMAX 2400
- Efficiencies available from 99.97% to 99.99% @ 0.3 µm
- Gasket or gel seal available
- Mini pleat media packs manufactured in a quality controlled facility

[1]-US Energy Information Administration

The Impact of Filter Performance

CRUCIAL CRITERIA WHERE PRODUCTS CAN FAIL:

SHORTENED FILTER LIFE MEANS:

- INCREASED FILTER PURCHASES
- INCREASED COST OF LABOR
- INCREASED OF LABOR DEMAND

(NOT ENOUGH HOURS IN THE DAY)

REDUCED OR DECREASING EFFICIENCY

- INCREASED POTENTIAL OF HAIs
- INCREASED SYSTEM HYGIENE ISSUES
- INCREASED COIL MAINTENANCE NEEDED

INCREASED OPERATING RESISTANCE/ PRESSURE DROP

- ADDITIONAL ENERGY COST
- DECREASE IN FILTER'S LIFESPAN

- THE ABOVE ISSUES RESULT IN AN INCREASED SPENDING
- FILTER PERFORMANCE IS CRITICAL IN HEALTHCARE

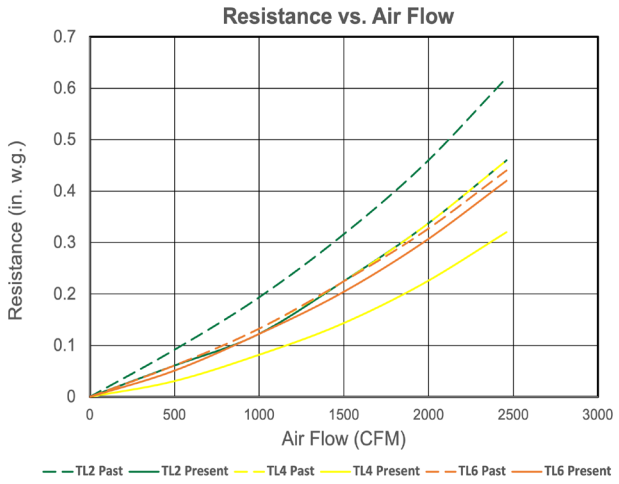
Due to the demanding nature of healthcare applications, it is critical to have filtration products that provide a high and consistent level of performance not just in a test laboratory but in real world applications.

Filter Performance: Our Innovations

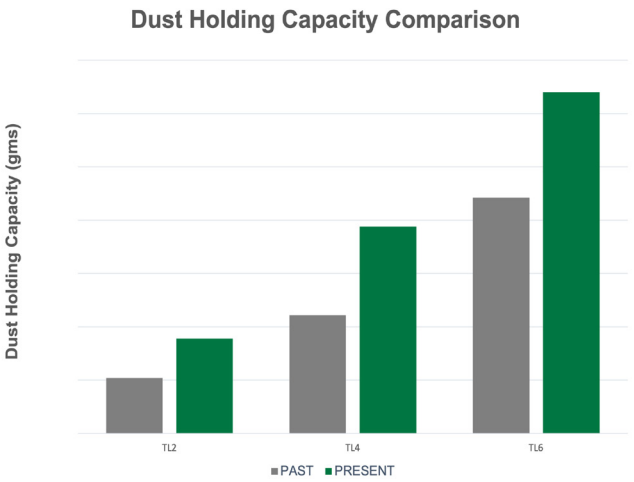
Achieving high-functioning filters depends on a manufacturing company's core values and practices, particularly its commitment to research and development (R&D). This dedication drives continuous innovation and product improvement, necessary for competitiveness.

By investing in R&D, companies can explore new materials, test designs, and adopt the latest technologies, enhancing filter effectiveness and meeting evolving customer needs. An example is MANN+HUMMEL's process trials in the Thin Line (TL) Ultra product series, where R&D focus led to significant advancements in filter performance.

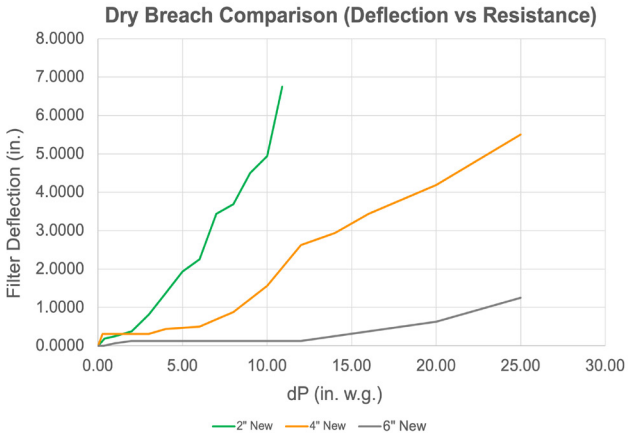
THIN LINE (TL) ULTRA PERFORMANCE:



Recent product developments have reduced resistance by 15% to 29%, enhancing efficiency, performance, and reliability while likely lowering energy costs for users.

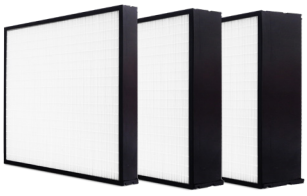


Our latest innovations have increased dust holding capacity by up to 225%, allowing filters to capture more dust, resulting in cleaner air, reduced maintenance, and longer-lasting performance.



We have significantly increased burst strength, allowing our product to withstand higher pressure levels, which enhances safety, reliability, and overall performance in demanding environments.

MANN+HUMMEL RECOMMENDS:



THIN LINE SERIES

- Available in 2″ 4″ & 6″ depths
- Available in MERV 11, 13, 14, 15 & 16 efficiencies
- Available in fiberglass & synthetic media

Molecular Contaminants in Healthcare

BACKGROUND

Proper indoor air quality is essential in healthcare applications. While pathogen control often gets the spotlight in discussions on healthcare filtration, molecular contaminant control is important and often overlooked. Studies show that median contaminant concentrations can be two to five times larger indoors with maximum concentrations over an order of magnitude higher. Given that most patients in a healthcare facility are there for some health reason, these elevated levels of contaminants are even more concerning. A hospital is a facility dedicated to health and odors inside of it will be seen as contradictory to good health. Due to the nature of most hospital designs, it is nearly impossible to prevent helicopter and ambulance exhaust from entering the facility, but our molecular solutions help mitigate those contaminants.

CONTAMINANTS IN HEALTHCARE

Like many applications, molecular contaminants in healthcare are both externally and internally generated. The contaminants range from those causing nuisance odors to those with health altering consequences.

EXTERNAL SOURCE ONE

The most common source of healthcare contaminants are various types of transportation that bring patients to the healthcare facility. These include helicopters, ambulances, passenger cars, and public transportation. These vehicles produce contaminants from tire wear, brake dust, and engine emissions.

EXTERNAL SOURCE TWO

There are many contaminants that are generated by non-healthcare sources. These include the contaminants in the ambient air, adjacent industrial process emissions, and other transportation on nearby roads, waterways, and rail lines.

INTERNAL SOURCE ONE

Many molecular contaminants are generated from within the healthcare facility. The internal sources include patients, aromatic patient medications, cleaning products, food service, service animals, building materials, and construction.

INTERNAL SOURCE TWO

There are many specialty applications within healthcare that generate contaminants. These applications release molecular contaminants through equipment sterilization, patient procedures, lab analyses, pharmacies, and morgue activities.

Our Molecular Contaminants Control Strategy

The external contaminants are brought into the healthcare facility through infiltration, pressure differential, doors and windows, HVAC system intakes, and human foot traffic. The internal sources are typically generated in a single space, but they are often transported to other spaces within the facility via the HVAC system. Here's how MANN+HUMMEL can help.

CONTAMINANT CONTROL STRATEGY

STRATEGY ONE

Manage the sources of the contaminants by either removing them from the building or isolating them from the healthcare occupants.

STRATEGY TWO

Dilute the contaminants through ventilation, this strategy often requires additional heating or cooling of outdoor air that was otherwise unneeded.

STRATEGY THREE PREFERRED

Utilize molecular filtration to clean the air of all the contaminants of concern. This is the most cost effective and reliable method for maintaining good indoor air quality.

MANN+HUMMEL RECOMMENDS:

CASSETTES

- All plastic with recyclable frame
- 12x12x12 with a 3 inch bed depth & 1 ft^3 of media
- 6x12x18 with a 1 inch bed depth & 0.5 ft^3 of media

MC VB4 HC

- Incinerable, plastic frame
- Up to 25 lb of chemical media
- Low pressure drop

MC PROCELL 50/50

- Single header or box style
- MERV 8
- Up to 580 GSM of chemical media

The Value of Sustainability in Healthcare

WHAT IS SUSTAINABILITY?

Sustainability is a core component of filtration. Cleaning our air, water, and mobility, are the core areas in which sustainability is crucial, and our filtration products contribute to each of those valuable areas. By separating the useful from the harmful through filtration – our mission and foundation of our business for 80 years – we have always been a contributor to true sustainability.

MANN+HUMMEL also provides sustainable options to our healthcare partners by creating products that:

- Reduce energy consumption – by using filters with a low pressure drop you can reduce the energy consumption of your HVAC systems, one of the largest users of electricity in your building
- Reduce waste – by using filters with a longer service life you reduce refuse to landfills
- Reduce your carbon footprint
- Are truly sustainable

MANN+HUMMEL SUSTAINABLE PRODUCTS:

TRI-DEK PANELS

- Depth loading synthetic media constructed as 2, 3 or 4 ply
- Galvanized wire
- Mold/moisture resistant

PROPOCKET DUAL ULTRA

- Dual stage media
- MERV 12 to MERV 15 efficiency
- Synthetic media

MICROBARRIER 95XL MAX MP

- Variety of frame materials MDF particle board & galvanneal
- MERV 16 efficiency
- 220 mm deep mini pleat media packs manufactured in a quality controlled facility

Innovation: Our Commitment to Continuous Improvement

MANN+HUMMEL Air Filtration Americas offers a range of solutions to tackle the challenges the healthcare industry faces. Our strong focus on quality and innovation is essential for overcoming these hurdles. With 20,000 employees worldwide, more than 1,000 are part of our research and development team, allowing us to lead in creating new ways to improve air quality and make our systems more efficient.

We hold over 3,000 patents, showcasing our commitment to finding better solutions. Each patent represents an advancement that can enhance air filtration and improve health and safety. By using our expertise and research skills, we aim to deliver solutions that not only meet industry standards but also exceed our clients' needs. Our goal is to create a cleaner, healthier environment for everyone.

MANN+HUMMEL GLOBAL RESEARCH & DEVELOPMENT NETWORK:

R&D Employees

1,131

Worldwide

R&D Locations

31

Worldwide

Patent Applications

120+

Per year

University Partnerships

60+

Worldwide

Patent & Applications

4,700+

Overall

MANN+HUMMEL - Air Filtration Americas
112 S. Respess St.
Washington, NC 27889

T +1 877 752 5811

airfiltration.mann-hummel.com/us-en