ASHRAE TCs 2.3, 2.4, and 2.9 and TRG4

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TC Section 2.0 Environmental Quality

- TC 2.3 Gaseous Air Contaminants and Gas Contaminant Removal Equipment
- TC 2.4 Particulate Air Contaminants and Particulate Contaminant Removal Equipment
- TC 2.9 Ultraviolet Air and Surface Treatment

Why does Environmental Quality matter?

- Outdoor Air
  - Ozone, SO_2, NO_2
  - Exhaust fumes, photo-chemicals, stack emissions
  - Pollen

Empty highways in Wuhan

- Indoor Air
  - Volatile Organic Compounds (VOCs)
  - Aldehydes, bug spray, cooking fumes, etc.
  - Smoking, vacuuming, sneezing

From tgp.com.ph

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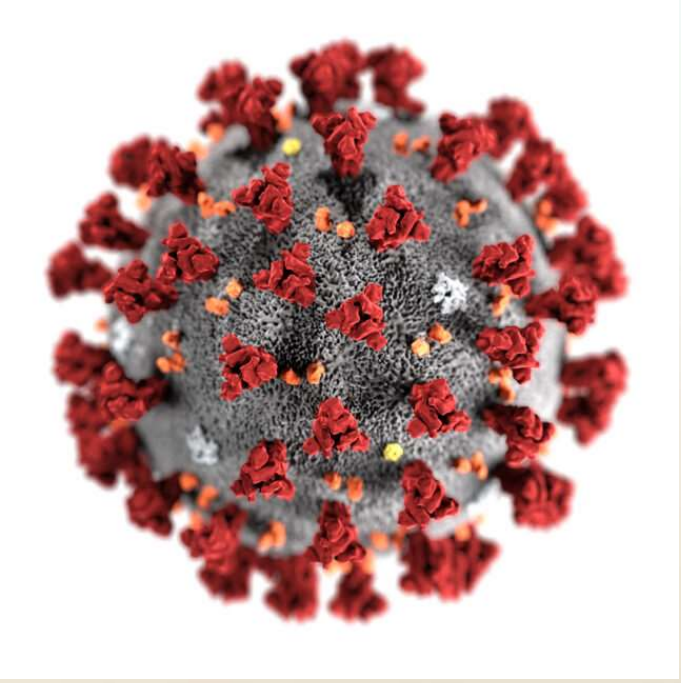


- Indoor Air
  - Volatile Organic Compounds (VOCs)
  - Aldehydes, bug spray, cooking fumes, etc.
  - Smoking, vacuuming, sneezing

COVID19 virus

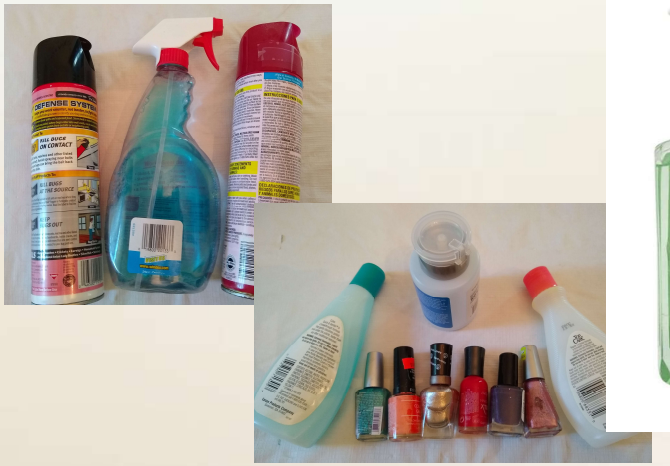
Overriding everything else right now

TC 2.3 Gaseous Air Contaminants and Gas Contaminant Removal Equipment

Committee Scope

TC 2.3 is concerned with the nature of trace gaseous contaminants; the measurement of their properties; their effects on living things and materials; the means of removing unwanted gaseous contaminants from gases; and the effectiveness, energy usage, and economy of such purification equipment.

- Research
- Handbook
- Program
- Standards
- https://tc0203.ashraetcs.org/



TC2.3 Research

- Upcoming Project
  - 1858-WS Evaluation of HVAC ventilation effectiveness in reducing semi-volatile organic compounds (SVOCs) in indoor spaces
- Active projects
  - 1838-RP Emerging gas-phase electronic filtration technologies and ASHRAE 145.2 test standard
  - 1720-RP Validation of gas-phase air-cleaner performance test method (Standard 145.2) by laboratory testing of commercially available filtration devices
  - 1579-RP Testing and Evaluation of Ozone Filters for Improving IAQ

TC2.3 Handbook

- Fundamentals: Chapter 11, Air Contaminants:
  - Air contamination is a concern for ventilation engineers when it causes problems for building occupants. Engineers need to understand the vocabulary used by the air sampling and building air cleaning industry. This chapter focuses on the types and levels of air contaminants that might enter ventilation systems or be found as indoor contaminants.
- HVAC Applications: Chapter 46, Control of Gaseous Indoor Air Contaminants:
  - This chapter covers design procedures for gaseous contaminant air-cleaning systems for occupied spaces. Procedures are appropriate to address odors and gaseous irritants. Removal of contaminants for the express purpose of protecting building occupants or to protect artifacts (such as in museums) requires application of the same design principles but applied more rigorously and with great emphasis on having specific design and performance data, providing redundancy, and added engineering safety factors.

TC2.3 Program - example

- Seminar for KC: The Role of Gas Filtration on Improving IAQ
- The technology of removing gaseous contaminants from the air and maintaining acceptable IAQ is becoming increasingly important for the health and well-being of mankind. The objective of the seminar is to provide the basic principles of air cleaning technologies, how to apply them, and to improve IAQ using the technologies.
- 1. Potential of Air Cleaning for Improving Indoor Air Quality
- 2. The Role of Gas-Phase Air Filtration Improving for Improving IAQ: Case Studies
- 3. IAQ: Keep the Oxygen, Lose the Pollutants

TC2.3 Standards

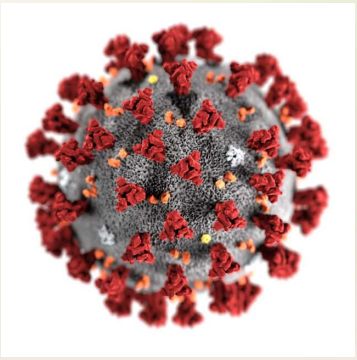
- Standard 145.1 Laboratory Test Method for Assessing the Performance of Gas-Phase Air Cleaning Systems: Loose Granular Media
- Standard 145.2 Laboratory Test Method for Assessing the Performance of Gas-Phase Air Cleaning Systems: Air Cleaning Devices
- *Guideline 27-2019 Measurement Procedures for Gaseous Contaminants in Indoor Environments*
- GPC 35 Method for Determining the Energy Consumption Caused By Air-Cleaning and Filtration Devices

TC 2.4 Particulate Air Contaminants and Particulate Contaminant Removal Equipment

Committee Scope

TC 2.4 is concerned with the nature of particulate contaminants, both solid and liquid; the measurement of their properties; their effects on living things and materials; both solid and liquid; the means of removing unwanted particulate contaminants from gases; and the evaluation of the effectiveness, energy usage, and economy of such purification equipment.

- Research
- Handbook
- Program
- Standards
- https://tc0204.ashraetcs.org/



TC2.4 Research

- 1734-RP, Reproducing the Typical Urban Atmospheric Aerosol in Laboratory for Air Filter Loading
- 1784-TRP, “Repeatability and Reproducibility Assessment of ASHRAE Standard 52.2 as Currently Amended

TC2.4 Handbook

HVAC Systems & Equipment Volume

Chapter 29: Air Cleaners for Particulates
This chapter discusses removal of contaminants from both ventilation and recirculated air used for conditioning building interiors. Complete air cleaning may require removing of airborne particles, microorganisms, and gaseous contaminants, but this chapter only covers removal of airborne particles and briefly discusses bioaerosols.

TC2.4 Program - examples

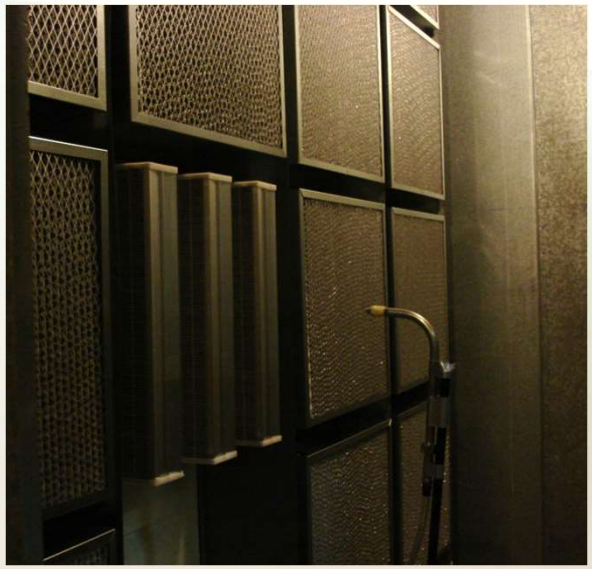
- Workshop 4: Filter Forecast: The Future of Filtration

  Nano-particle filtration and the energy cost of using air filters: two critical pieces of the future of filtration. Ultrafine particles (below 100 nm) are now known to influence health (and equipment), but our current filter testing does not tell us how well our filters work. On another front, filters are believed to impact energy usage in buildings. Is this true and how much do they use? Bring your topics for open discussion about how air filtration can help the future and HVAC systems can improve indoor air quality.

  - 1. How Much Will Clean Air Cost You?
  - 2. Measuring Air Filter Efficiency Down to Single-Digit Nanometer Size
- Debate: Filtration Doesn't Matter. . .or Does it?
- Seminar: Room Air Cleaners: Can they Improve IAQ?

TC2.4 Standards

- SSPC 52.2 Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size (the MERV test)
- GPC 35 Method for Determining the Energy Consumption Caused by Air-Cleaning and Filtration Devices
- GPC 26 “Guideline for Field Testing of General Ventilation Filtration Devices and Systems for Removal Efficiency In-Situ by Particle Sizes and Resistance to Airflow”
  - Now retired as ISO converted this method into the international standard



TC2.4 Standards: MTGs

- MTG.BIM: Building Information Modeling

  coordinates the activities of multiple TC/TG in the area of standards and approaches to support the implementation of BIM within ASHRAE products and the industry workplace. Also represents ASHRAE interests within the BIM marketplace and provides a conduit for funneling information about BIM to ASHRAE members.

- MTG.ACR: Air Change Rate

  coordinates TC/TG/TRG/SSPC technical activities to help evaluate the technical basis and adoption of airflow rate specifications (Air Change Rate (ACR) or Air Changes per Hour (ACH)) for spaces such as cleanrooms, laboratories, patient rooms, operating rooms, and other similar spaces.

- MTG.IAST: Impact of ASHRAE Standards and Technology on Energy Savings/ Performance

  generates research proposal(s) and works with selected consultants/contractors to conduct research, collect and organize the data in a useful and conveniently summarized format for Initiative 1B of the Society Strategic Plan "ASHRAE will research the true impact of its standards and technology."

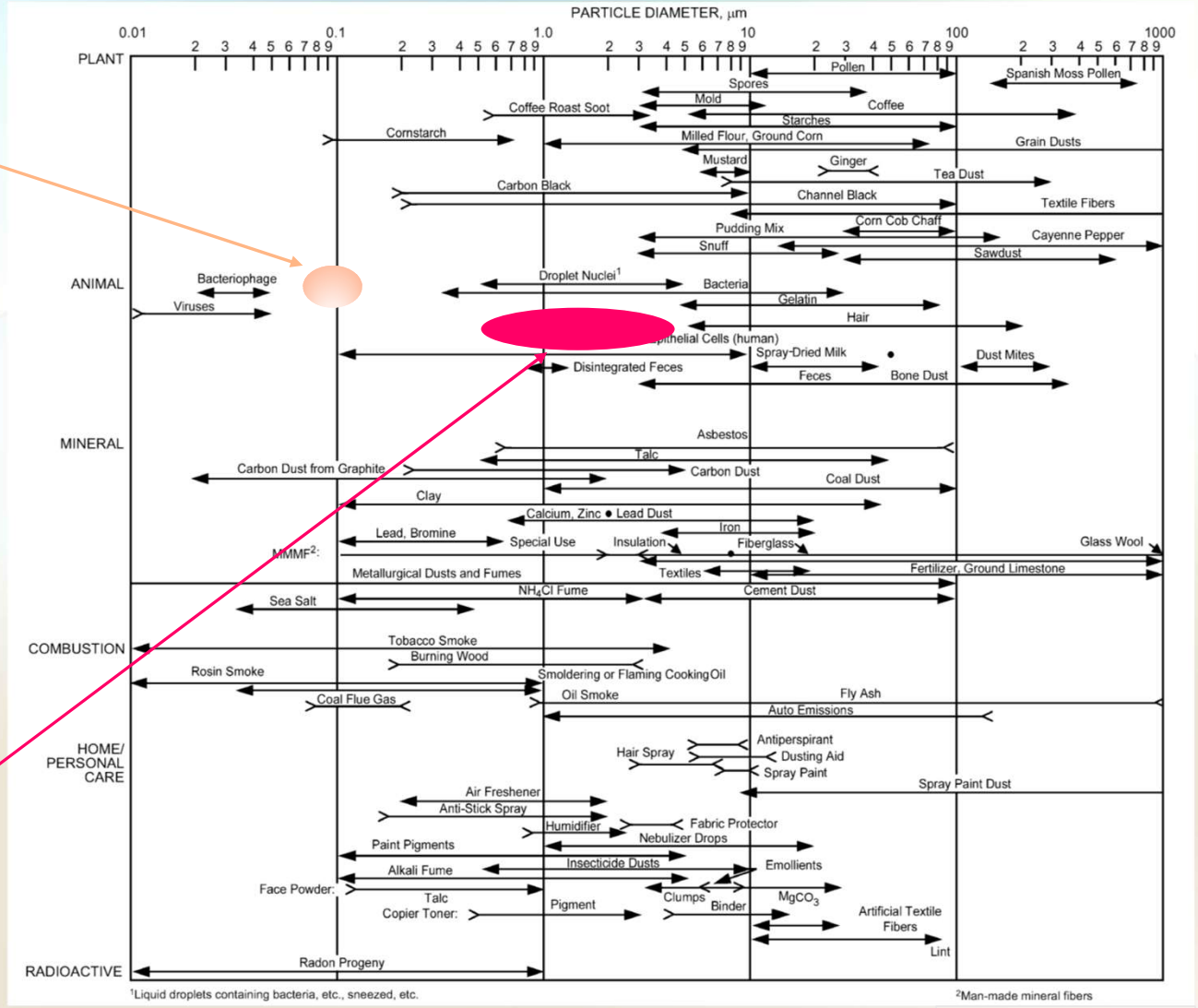
TC 2.4 FAQs

- What is ASHRAE's recommendation for residential filtration?
- What level of filtration is recommended for my application?
- What is ASHRAE's recommendation on the use of ultraviolet light in air systems for microbial control?
- What research is ASHRAE conducting regarding air filtration?
- What are ASHRAE's recommendations for filtration efficiency for commercial applications?
- What are ASHRAE's recommended filtration efficiencies for medical applications?

COVID19 virus

Particles are everywhere, but do you want to breathe them?

COVID19 - actually in the air



TC 2.9 Ultraviolet Air and Surface Treatment

Committee Scope

TC 2.9 is concerned with all aspects of equipment and systems that utilize ultraviolet radiation to destroy or deactivate chemical and/or biological air and surface contaminants in HVAC systems and indoor spaces, including, but not limited to, effectiveness, safety, maintenance and economics.

- Research
- Handbook
- Program
- Standards
- https://tc0209.ashraetcs.org/

TC2.9 Research - recent

- 1738-RP: Field Measurements and Modeling of UVC Cooling Coil Irradiation for HVAC Energy Use Reduction

  There is anecdotal evidence that UVGI is effective for bio-fouling mitigation with an associated increase in system efficiency, but no independent, third party research exists to back up these claims. Results from this project will enable the adoption of and energy saving technology and will assist in the design and maintenance of healthy, high-performing buildings.

TC2.9 Handbook

- HVAC Systems & Equipment Volume Chapter: Ultraviolet Lamps

  This chapter includes a review of the fundamentals of UV-C energy's impact on microorganisms; how UV-C lamps generate germicidal radiant energy; various components that comprise UV-C devices and systems; and a review of human safety and maintenance issues.

- HVAC Applications Volume Chapter: Ultraviolet Air and Surface Treatment

  This chapter discusses common approaches to the application of short-wave ultraviolet (UVC) products. It also surveys the most recent UVC design guidelines, standards, and practices and discusses energy use and economic considerations that arise when applying UVC systems.

TC2.9 Program - examples

- Effective Deployment of UVC in Healthcare Environment

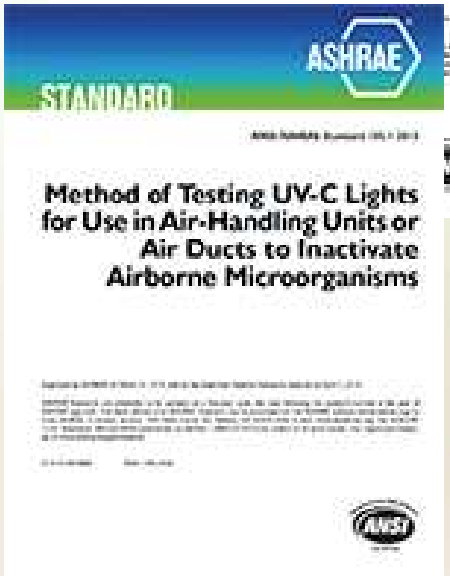
  Covers the application of UVC (short-wave ultraviolet radiation) energy for the next generation of healthcare facility design, construction and retrofit applications.

  - ASHRAE Position Paper on Airborne Infectious Diseases
  - Upper Air UVC in a Health-Care Setting
  - UVC for In-Room Surface Disinfection UVC for In-Duct Healthcare Applications

- Indoor Air Quality: Impact of Variables
  - Ultraviolet Germicidal Irradiation (UVGI) in Hospital HVAC Decreases Ventilator Associated Pneumonia (NY-14-C023)

TC2.9 Standards

- Standard 185.1: Method of Testing UV-C Lights for Use in Air-Handling Units or Air Ducts to Inactivate Airborne Microorganisms
- Standard 185.2: Method of Testing Ultraviolet Lamps for Use in HVAC&R Units or Air Ducts to Inactivate Microorganisms on Irradiated Surfaces
- Proposed Guideline: GPC 37P: Guidelines for the Application of Upper-Air (Upper Room) Ultraviolet Germicidal (UV-C) Devices to Control the Transmission of Airborne Pathogens



TC2.9 Standards: MTGs

- MTG.O&MEE: Operations and Maintenance Activities That Impact Energy Efficiency

  coordinates TC/TG/TRG activities to help support the application of ASHRAE guidelines, Standards and other technical resources to support regulatory bodies, utilities, building owners and others who are attempting to enhance efficiency of existing buildings. Responsibilities include suggestions for research, development and presentation of technical programs of all types on maintenance and its impact on energy consumption and efficiency. It is especially involved with interactions with those who are introducing and evaluating strategies for building efficiency enhancements.

TRG4.IAQ

- Technical Resource Group (TRG)
- Indoor Air Quality Procedure Development (IAQ Procedure, IAQP)
- Committee Scope: TRG 4 is concerned with developing specific guidance to allow users to apply the IAQP method as defined under ASHRAE Standard 62.1.
- Joint group pulling from many TCs formed to make IAQ procedure easier to use, possible more logical

ASHRAE Standard 62.1 Overview

- ASHRAE Std. 62.1: Ventilation Rate Procedure (VRP) - Prescriptive
- ASHRAE Std. 62.1: Indoor Air Quality Procedure (IAQP) – Performance-Based
  - Pollutant control ventilation (PCV)
  - Cleaning efficiency
  - Compliance report
  - Occupant survey

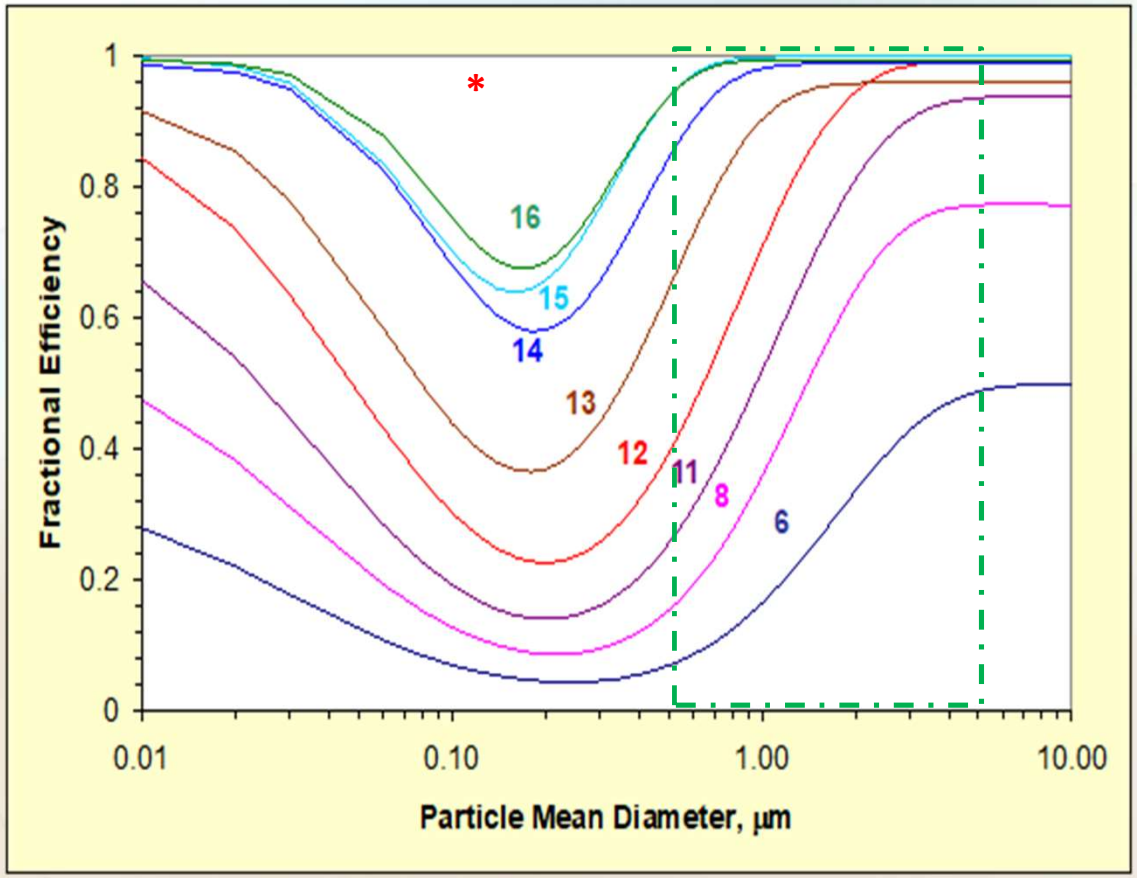
TRG4.IAQ Status

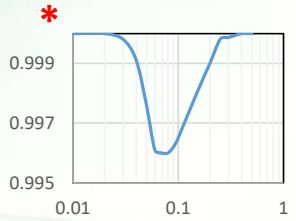
- To apply IAQ procedure, one must choose contaminants to model
  - TRG4 is working to define that list
  - Compounds need to be identified
  - Acceptable Concentrations need to be agreed upon
  - Air Cleaner Efficiencies need to be determined
- Work with 62.1 to implement

TCs 2.4 and 2.9 in the COVID World

- Viruses are viable particles.
- May be present and spread in aerosol form.
  - This is likely based on other organisms, but not proven for COVID19 yet
- Can be removed by filters – TC2.4 and SSPC 52.2
- Can be inactivated by UV – TC2.9 and SSPC 185.1

Filters by MERV vs HEPA





HEPA ≥99.97%
at 0.3 µm MMD

Ensor 1988

EPA United States Environmental Protection Agency

TECHNOLOGY EVALUATION REPORT

Biological Inactivation Efficiency by HVAC In-Duct Ultraviolet Light Systems

	Test organism		
	Spore form of bacteria *(B. atrophaeus)*	**Vegetative bacteria (S. *marcescens*)**	**Bacterial virus (MS2 bacteriophage)**
Inactivation efficiency, (UV light on) %	93	∃99.97[a]	99

a – the value 99.97% is based on the upper 95% confidence limit for the mean downstream count of S. *marcescens*. There were no downstream counts measured.

	Test organism		
	Spore form of bacteria *(B. atrophaeus)*	**Vegetative bacteria (S. *marcescens*)**	**Bacterial virus (MS2 bacteriophage)**
Inactivation efficiency, (UV light on) %	6.9	99.8	59

Input to ASHRAE ETF

BACKGROUND/CONTEXT
- Modes of Transmission
- ASHRAE Statements on Airborne Transmission
- Scientific Data & Literature

FACILITIES/MAINTENANCE
- Personal Protective Equipment (PPE) Basics
- HVAC System Maintenance and Filter Replacement
- Special Precautions

AIR FILTRATION
- Mechanical Air Filters
- High-Efficiency Particulate Air (HEPA) Filters
- Electronic Air Filters
- Gas-Phase Air Cleaners

AIR DISINFECTION
- Ultraviolet Energy (UV-C)
- Photocatalytic Oxidation (PCO)
- Bipolar Ionization/Corona Discharge
- Ozone

SURFACE DISINFECTION
- Spray/Wipe Chemical Disinfectants
- Ultraviolet Energy (UV-C)
- Vaporized Hydrogen Peroxide
- Ozone
- Pulsed Xenon Lamps
- 405 nm Visible Light
- Far Ultraviolet

From ASHRAE Covid19 site

Recommendations for Filters

- ASHRAE recommends ≥MERV 13, with MERV 14 preferred
- Do not upgrade unless the HVAC system can handle it (pressure drop, space, cost)
- Make sure filters are reasonable new and sealed in
- Be sure to run the HVAC as much as possible
- If you or your customer really want HEPA, see point 2 above.
- If you still want HEPA or you want filtration nearer to your source (if known) consider an in-room unit.

UV-C or UVGI Recommendations

- To inactivate the virus (rather than capture it)
- UV-C in HVAC Ducts
- Upper Air UV-C
- Low Pressure Drop – good where you can't increase MERV
- Upper Air – installed on upper walls or ceilings
  - Good for single rooms to limit spread to rest of building

ASHRAE ETF

- https://www.ashrae.org/technical-resources/resources
- Or search on-line for ASHRAE COVID19
- **Questions? Email COVID-19@ashrae.org**
- Or ask me and I will point you in the right direction